A theory about diffusion of innovations in developing countries : practical experiences in Tanzania

Buskens, V.W.

Award date:
1992

FACULTY OF PHILOSOPHY AND SOCIAL SCIENCES
EINDHOVEN UNIVERSITY OF TECHNOLOGY

A Theory about Diffusion of Innovations in Developing Countries

practical experiences in Tanzania

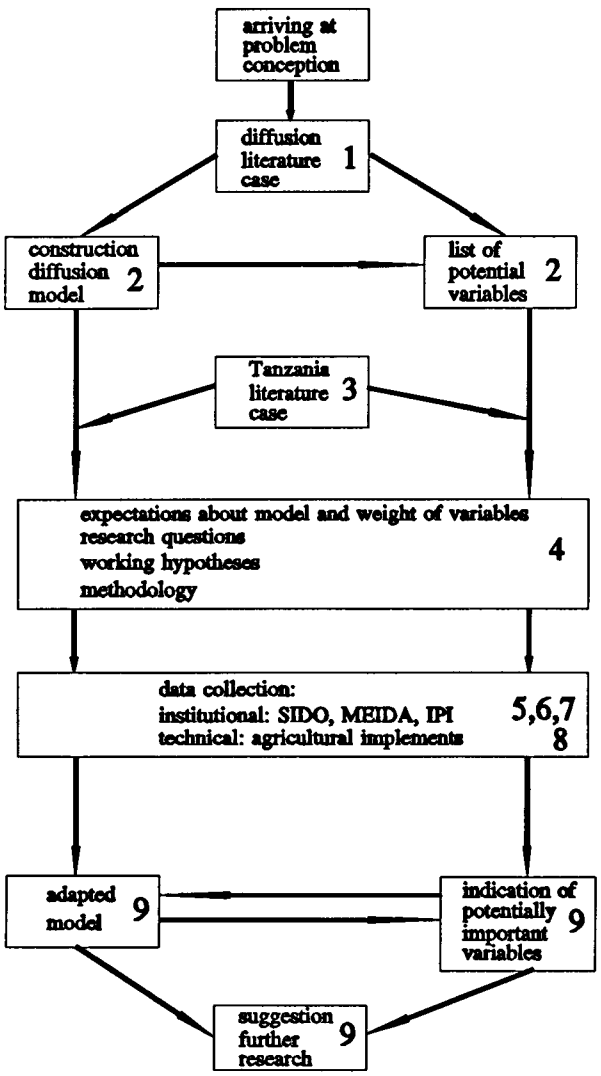
Vincent Buskens

status:	M.Sc.-research Technology and Development Sciences	
supervision:	P.E. Lapperre M.Sc.	Centre for International Co-operation Activities
	Dr. C.A.A.M. Withagen	Faculty of Mathematics and Computing Sciences
	Prof. dr. C.J.L. Bertholet	Centre for International Co-operation Activities
	Dr. A.M.C. Lemmens	Centre for International Co-operation Activities

August 1992

SUMMARY

The overall aim of this research is to build a theoretical framework to obtain more knowledge about the diffusion of innovations, especially in developing countries. A preliminary test of the framework is executed in the agricultural sector in Tanzania. A diagram of the different steps passed in the research is presented below. In each block of the diagram is indicated in which chapter of the report the subjects concerned are dealt with.



Outline of this report

The research started with an extensive review of the literature of the last decade about the diffusion of innovations. The result was that we could develop a theoretical model describing the diffusion process and a list of variables occurring in the literature that play a role in the diffusion process. Combining that list with our model, we were able to construct a new list of variables that appeared to be more complete than the one solely based on literature.

To get some idea about Tanzania a short study was made about the situation in Tanzania, including historical, environmental, cultural, structural and institutional aspects. The results of this study were combined with the diffusion model to extract the elements from the Tanzanian environment which we expected to be important for diffusion.

The last step before we could deal with the field work was an accurate formulation of the research questions and working hypotheses. We concentrated on the usefulness of the model, the importance of the variables and the diffusion problems in Tanzania. A methodology for the collection of the data in Tanzania was developed.

The data collection can be divided in two main parts: data collected from different institutions which are active in the diffusion process and data collected from some technical cases concerning diffusion of oil-processing equipment. At SIDO data were collected about the small scale industries in Tanzania and the activities of SIDO which are related to the diffusion process. Furthermore, some small industrial units were studied to get an idea about the problems of small scale producers in Tanzania. At MEIDA an inventory of metal industries was made with emphasis on the agricultural sector. IPI, and to a lesser degree, TEMDO and CAMARTEC were studied as innovation institutes to get an idea about their problems and the innovations they have introduced.

In the technical part of the data collection, different kinds of oil-processing equipment were studied. The IPI oil-processing equipment is a manual type of equipment developed to be used in rural areas. The increase in the price of steel made the equipment so expensive that it is hardly sold at the moment. The Bielenberg press is a much smaller type of manual equipment. It is cheap and there are already more than 500 items sold in Tanzania. The main problems are the supply of seeds that can be pressed and the human strength needed to operate the press. Furthermore, there are a number of powered expellers in Tanzania. They use electric engines and can be only used in urban areas. Their number is still increasing.

After the field research, there were no reasons to change the model and the list of variables. A couple of variables was indicated as really important in the studied cases, but from the cases it was impossible to say that other variables could not be important for other innovations or in other environments.

The main results of the research are the following:

- The developed diffusion model appears to be useful to follow and evaluate diffusion processes.
- The list of variables contains the most important variables that play a role in the diffusion process.
- The model enabled us to indicate important variables in the diffusion process which did not occur in earlier literature, like variables concerning producers, production and developers.
- In Tanzania the environment appeared to be important for the bottlenecks in the diffusion process. Clearly observed bottlenecks were the physical infrastructure, financial position of the target group and the industrial level.

Still, a lot of research has to be done to improve the knowledge about the possible instruments to weigh variables under different conditions in time and space. In addition research is urgently required to study the possible relations between variables. Some proposals for further research are done at the end of the report.

PREFACE

Already nearly two years ago, in September 1990, I started to think about my M.Sc.-research to finish my study in Technology and Development Sciences. After a not spotless preparation period of one year, I went to Tanzania for my practical training in September 1991. Six months I collected data for my research and tried to learn something about the life in this country, which is so different from everything we know in the Netherlands.

This report is the result of my M.Sc.-research which would have been impossible without the many people that have assisted me here and in Tanzania. It would never have been so pleasant without my friends here and in Tanzania. Therefore in this preface I want to thank these people.

- Firstly my supervisors in the Netherlands, especially Paul Lapperre M.Sc., who stood at my side with his advise, during the whole process. Even two weeks in Tanzania. But also dr. Cees Withagen and Prof. dr. C.J.L. Bertholet, who supported me during the preparations and the writing of this report.
- Secondly the people who supported my work in Tanzania; at SIDO, especially Mr. M. Laiser and Mr. C.M.N. Ntabajana B.A. M.Sc. who assisted me personally; Dr. F.M. Mboya at the University of Dar es Salaam, also for the three weeks I lived with him in Arusha; at IPI, especially Mr. Richard Mandara B.Sc., for our good discussions and the valuable and pleasant trip to Iringa; at TAMECO, especially Mr. R.L. Mbawala for arranging my housing and helping with all kinds of problems at the practical side.
- Halafu rafiki zangu za TAMELT na TAMECO kwa ujamaa, urafiki, kusaidia na siku za kupendeza. Asante sana. Nitawakumbuka.
- Vervolgens mijn vrienden en familie in Nederland en andere plaatsen in de wereld die mij overspoelden met hun brieven.
- Last but not least the people from CICA for the assistance with funds, coordination and infrastructure necessary for my research.

Vincent Buskens, August 1992

CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABBREVIATIONS

ASP	Afro-Shiriza Party
CAMARTEC	Centre for Agricultural Mechanization and Rural Technology
CAPU	Craftsmen and Artisans Promotion Unit
CCM	Chama Cha Mapinduzi (Revolutionary Party)
CFF	Common Facility Foundry
CFW	Common Facility Workshop
CICA	Centre for International Cooperation Activities
DSM	Dar es Salaam
EUT	Eindhoven University of Technology
FES	Friedrich Egbert Stiftung
FoE	Faculty of Engineering
GNP	Gross National Product
GTZ	Germany Agency of Technical Cooperation
IDRC	International Development Research Centre
IE	Industrial Estate
IMAC	Iringa Maintenance Company
IMCO	Iringa Manufacturing Company
IPI	Institute of Production Innovation
KIT	Koninklijk Instituut voor de Tropen (Royal Tropical Institute)
MEIDA	Metal Engineering Industries Development Association
NDC	National Development Corporation
NGO	Non-Governmental Organization
NRI	Natural Resources Institute
R&D	Research and Development
RHP	Rural Hire Purchase
SDP	Sister Daughter Programme
SICATA	Small Industries Consultancy and Training Centre
SIDO	Small Industries Development Organization
SIP	Sister Industry Programme
SSI	Small Scale Industries
SUDECO	Sugar Development Organization
TAA	Tanganyika African Association
TANU	Tanganyika African National Unit
TCP	Triangular Cooperation Programme
TEMDO	Tanzania Engineering and Manufacturing Design Organization
TIRDO	Tanzanian Industrial Research and Development Organization
TPC	Training cum Production Centre
TSH	Tanzanian Shillings (TSH 24,000 = US$ 100)
UDSM	University of Dar es Salaam
UFI	Ubungo Farm Implements
UHP	Urban Hire Purchase
UNICEF	United Nations Children Fund
VOPP	Village Oil Press Project
WP	Women Projects

INTRODUCTION

This report deals with the diffusion of innovations in developing countries. Continuous attempts are made to diffuse many innovations in developing countries. These cost a lot of money and the results are very often unsatisfactory. The general aim of this study is to throw light on the problem why certain innovations are so difficult to diffuse or disseminate in developing countries. (The terms diffusion and disseminations are mostly used together in literature, but we will try to use only diffusion to prevent confusion.)

From literature it became clear that the diffusion problem is very broad and complex. In nearly every new piece of literature you find new problems in the diffusion process. All the literature seems to touch a special side of the diffusion process.

This study builds a framework for studying diffusion processes and gives a first example how the framework can be used and better specified for certain innovations.

Part I of this report tries to structure the diffusion process with help of the literature of the last ten years. This results in a model and a list of variables that play a role in the process. Part I continues with the preparations for a first test of the model in the agricultural sector in Tanzania. A small country study of Tanzania is made, followed by a chapter treating the implications of the Tanzanian environment for our model, the aim of research in Tanzania, the research questions, working hypotheses and the methodology of the research are given.

Part II of the report deals with the data collection. The first chapters give an idea of some of the producers and researchers in Tanzania who could play a role in the diffusion process. It is also a search for innovations for which the whole process could be studied. These turn out to be some oil-processing technologies and these are treated in the last chapter of Part II. The aim of the data collection is to throw a first light on the value of the developed model.

Finally Part III evaluates the data collection in the light of the model. It includes conclusions, implications for the developed model and the list of variables and ideas for further research.

PART I THEORETICAL BACKGROUND

1. DIFFUSION

1.1. Introduction

The diffusion of innovations is already studied for a long time by a lot of researchers from different disciplines. The aim of the literature review in this chapter is to throw light on the different aspects of the diffusion process with help of some literature of the last decade. Special emphasis is placed on the diffusion of innovations in the agricultural sector in developing countries.

Before we start we need some definitions of important concepts. We take a look at Rogers (1983, p.5) who did a very extensive research. He presents an often used definition of diffusion:

Diffusion is the process by which an innovation is communicated through certain channels over time among members of a social system.

In this definition we find four important elements of the diffusion of innovations:

Innovation: idea, practice or object that is perceived as new by an individual or other unit of adoption. (This can be a tool, an instrument, a method, a structure of organization etc.)

Communication channels: means by which messages get from one individual or other unit of adoption to another. (Means can be here media facilities as well as interpersonal structures.)

Time

Social system: a set of interrelated units that are engaged in joint problem solving to accomplish a common goal.

These four elements with their properties (Rogers, 1983) already provide us with a lot of important variables playing a part in the diffusion process. It also gives us a method to measure diffusion, namely by the rate of adoption:

Rate of adoption is the length of time required for a certain percentage of the members of a social system to adopt an innovation. Adoption itself can be defined as the acceptation and use by an individual or group of the social system.

Although Rogers states that the given elements are the main elements of diffusion, not everybody agrees with that. Some important parts of the diffusion process are kept in the background. These are the researchers, developers and producers of the innovation. This part is worked out further by Brown (1981), who emphasizes the supply side of the diffusion process. This is the first time we see that one can look at the diffusion process from different points of view, namely emphasizing the users or the researchers/producers, in other words, the demand side and supply side.

Hardeman (1984) even paid attention to a third group of authors, which can be seen as a reaction upon the other two. This group is called people of the resource-base theory. They try to explain the diffusion not directly by means of the specific characteristics of the users and producers, but out of the system both groups are living in. More is said about these three points of view when we deal with Hardeman. He himself also tries to explain diffusion of innovations with Mexican farmers by means of the system they live in.

This research will give way to the idea that these three theories tell all parts of the whole diffusion story. All the theories have acceptable illustrations for their argumentations. But these examples dealt with different innovations in different systems and one often looked at different things by the examination of the innovation. In this paper it will be attempted to give a complete as possible set of variables that *could* play a part in the diffusion process. These variables can be divided into different groups and one possible division is:

1. properties of the innovation;
2. properties of the acting groups;
3. properties of the systems the acting groups belong to;
4. properties of the relations between the innovation, the acting groups and the involved systems.

We will see these variables in Section 1.2. of this report, which contains a literature review on diffusion especially for the 80s. In Section 2.2., a model will be developed to order all these variables and to get an idea about their relations.

1.2. Literature review

The variables playing a part in the diffusion process can be divided into parts in different ways. One of the ways is to look at different disciplines for which there is research to do on the process of diffusion. First we have the people examining the social system of the target group to get an idea about the needs: *sociologists, anthropologists*. Further there are people developing new technologies: *engineers, physicians, bio-technologists* etc. Then there are people busy with *communication* to examine the contacts between developers and target groups and later on between producers and the target group. For production, marketing, etc. *industrial developers* and *economists* are needed. For the training and instruction of the target group, research is there for people in *education* and *extension*. *Geographers* furthermore do research on spatial processes of diffusion and *psychologists* study attitudes: why adoption, why not. Finally, some researchers tried to make *mathematical models* of the diffusion process.

Examples of researchers in these disciplines:

Sociology:	Nowak (1987); Tarde (Rogers, 1983, p.40); Ryan and Gross (1943); Yambo (1982).	
Anthropology:	Niehoff (Rogers, 1983, p.49).	
Economy:	Biggs (1990); Howes (1980); James (1989); Ruthenberg (1985); Ruttan (1989).	
Technology:	Technicians:	Agarwal (1983); Barnett (1982, 1990); Bosschè (1983); Hyman (1987).
	Physicians:	Bonair, Rosenfield and Tengvald (1989).
	Bio-technologists:	Bunders (1990).
Communication:	Chattopadhyay and Singh (1989); Rogers (1983); Röling, Ascroft and Wa Chege (1976).	
Industrial development:	Basilli (1989); Onkvist and Shaw (1989).	
Education/Extension:	Bhola (1988-89); Melkote (1988).	

Geographers:	Agnew (1979); Blaut (1977) Brown (1981); Hägerstrand (Brown, 1981, p.17); Hardeman (1984); Meir (1979); Yapa (1977).
Psychology:	Triandis and Brislin (1984).
Mathematical models:	Mahajan and Sharma (1986); Mahajan and Peterson (1985); Skiadas (1985).

Overviews of the literature can be found in different works: (Brown, 1983; Hardeman, 1984; Rogers, 1983; Schmidt, 1976).

Another way to divide the variables playing a part in the diffusion process is by looking at the different elements:

- the innovation itself;
- the people of the target group and their social system;
- the national/international environment of the target group;
- the researcher/developers and their environment;
- the production and its environment;
- the change agents/extension workers/educators and their environment.

In Table 1.1. we present the variables of the diffusion process ordered according to the elements as found in literature.

Table 1.1. Variables of the diffusion process as found in literature

Important variables in the diffusion process	Author(s)
RELATED TO THE INNOVATION	
- relative advantage (economic variables and status aspects)	Agarwal (1983), Barnett (1990), Hardeman (1984), Nowak (1987), Rogers (1983), Rutherford (1985)
- compatibility in relation with values, believes, norms, needs, etc.	Agarwal (1983), Hardeman (1984), Rogers (1983), Rutherford (1985)
- complexity	Rogers (1983), Rutherford (1985)
- trialability	Rogers (1983)
- observability	Rogers (1983), Rutherford (1985)
- type of decision (optional, collective, authority)	Rogers (1983)
- physical attributes of the innovation	Agarwal (1983), Bhatia (1990), Yambo (1982)
- dependent or independent on other innovations	Brown (1981)
- size of investment	Rutherford (1985)
- desirability	Chen et al. (1989)
- perceived risk and uncertainty	Feder et al. (1982), Onkvist and Shaw (1989), Rutherford (1985)
- ecological characteristics	Nowak (1987), Yambo (1982)

Table 1.1. Variables of the diffusion process as found in literature (continued)

Important variables in the diffusion process	Author(s)
RELATED TO USERS	
- education	Chen et al. (1989), Hardeman (1984), Rogers (1983), Yambo (1982)
- social status	Hardeman (1984), Rogers (1983)
- exposure to mass media	Chen et al. (1989), Rogers (1983)
- exposure to interpersonal channels	Rogers (1983)
- change agent contacts	Rogers (1983)
- social participation	Rogers (1983)
- cosmopoliteness	Rogers (1983)
- attitudes and personality of individual adopter	Agarwal (1983), Bhatia (1990), Chen et al. (1989)
- economic position	Chen et al. (1989), Feder et al. (1982), Hardeman (1984), Nowak (1987)
RELATED TO SOCIAL SYSTEM OF THE USERS	
- norms	Rogers (1983)
- cultural interconnectedness	Rogers (1983)
- communication channels	Rogers (1983)
- socio-economic structure	Agarwal (1983), Bonair et al. (1989), Brown (1981), Yambo (1982)
- class basis of the society	Agarwal (1983), Hardeman (1984), Röling et al. (1983)
- infrastructure	Agarwal (1983), Bonair et al. (1989), Melkote (1988)
- accessibility to the market	Bhatia (1990), Brown (1981), Feder et al. (1982)
- possibilities of transportation	Brown (1981)
- maintaining possibilities	Brown (1981)
RELATED TO DEVELOPMENT	
- method of first generation and development	Agarwal (1983), Barnett (1990), Rutherford (1985)
- participation of the target group	Barnett (1990), Bonair et al. (1989), Melkote (1988), Röling et al. (1983), Rutherford (1985)
- use of indigenous technologies	Agarwal (1983), Hyman (1987), Yambo (1982)
- cultural differences innovators/users	Röling et al. (1983)
- performance of the technology	Barnett (1990)

Table 1.1. Variables of the diffusion process as found in literature (continued)

Important variables in the diffusion process	Author(s)
RELATED TO EXTENSION	
- extend of promotion efforts	Melkote (1988), Nowak (1987), Rogers (1983), Rutherford (1985)
- client orientation	Agarwal (1983), Rogers (1983), Röling et al. (1983), Rutherford (1985)
- homophily with clients	Rogers (1983)
- credibility in clients eyes	Rogers (1983)
- quality of the extension system	Agarwal (1983), Brown (1981)
- advertising expenditure	Brown (1981)
- knowledge and skills of extension	Melkote (1988)
RELATED TO PRODUCTION	
- use existing small scale/informal producers	Hyman (1987)
- production assistance	Hyman (1987), Röling et al. (1983)
RELATED TO NATIONAL OR INTERNATIONAL ENVIRONMENT	
- bureaucracy	Agarwal (1983), Röling et al. (1984)
- credit facilities	Feder et al. (1982), Hardeman (1984), Rutherford (1985)
- government institutions	Bhatia (1990), Burmeister (1987), Hardeman (1984), Hyman (1987), Röling et al. (1976), Rutherford (1985)
- exchange rate	Röling et al. (1983)
- banking system	Röling et al. (1983)
- macro-politic environment	Barnett (1990), Bhatia (1990)
- institutional changes	Ruttan (1989)

In the following part we illustrate Table 1.1. with help of some of the literature.

We start with the most important work: *Diffusion of Innovations* by E. M. Rogers (1983). As we have indicated in the scheme before, this work comes out of the communication discipline. The variables that get most attention are the properties of the innovation, the target group and their social system. The most important variables are:

- RELATED TO THE INNOVATION:

  + relative advantage (economic variables and status aspects);
  + compatibility (with values, believes, previous introduces ideas, needs);
  − complexity;
  + trialability (degree to which an innovation may be experimented with);
  + observability (degree to which the result of an innovation is visible to others);
  O type of decision (optional, collective, authority).

- RELATED TO POSSIBLE USERS:

  + education;
  + social status;
  + exposure to mass media;
  + exposure to interpersonal channels;
  + change agent contacts;
  + social participation;
  + cosmopoliteness.

- RELATED TO THE SOCIAL SYSTEM OF POSSIBLE USERS:

  O norms;
  + interconnectedness;
  O communication channels.

- RELATED TO THE CHANGE AGENTS:

  + extend to promotion efforts;
  + client orientation;
  + homophily with clients;
  + credibility in the client's eyes.

(+ means positive relation with the rate of diffusion, – negative, O can be positive or negative.)

Rogers states that diffusion is a matter of communication. The information a person gets is the important variable in the adoption decision. Also important is the individual attitude of the members of the social system. Rogers indicates five adopter categories: innovators (first 2.5% of individuals to adopt an innovation), early adopters (next 13.5%), early majority (next 34%), late majority (next 34%) and laggards (last 16%). One important consideration which will come up more often later on, we found also in Rogers, namely that people with more change agent contacts will adopt an innovation earlier than people with less change agent contacts. These people are almost always the richer people and they will have most of the profits of the innovation because they adopt it as one of the first. So the gap between poor and rich might grow in this way.

Important examples given by Rogers are:

- Water boiling in a Peruvian village. Illustrating the importance of norms, values, believes and past experiences of the social system (compatibility), the interpersonal networks and the acting of the change agents (Rogers, 1983, p.1-5).
- Hybrid corn study of Ryan and Gross (1943) in Iowa. Showing earlier adoption of people with more land, money and education. It can also be seen that different communication channels play an important role in various stages of the diffusion process.

Two schematic presentations of Rogers are important to understand the ideas of diffusion, especially those of Rogers. The innovation development process (Rogers, 1983, p.136) is presented in Figure 1.1.

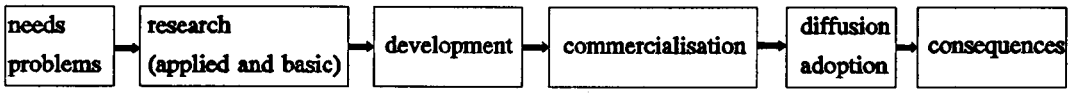


Figure 1.1. The innovation development process

Figure 1.2. is called the innovation decision process and this is for Rogers the process of diffusion (Rogers, 1983, p.165).

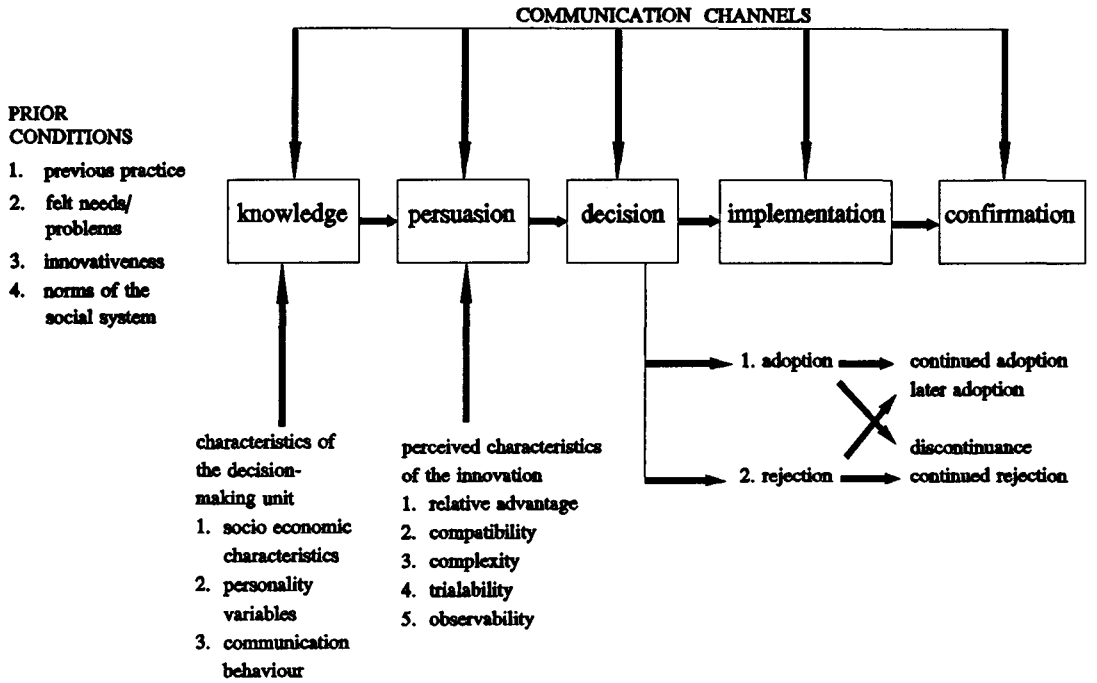


Figure 1.2. A model of stages in the innovation-decision process

We immediately see from this that Rogers places the emphasis on the demand sides. We continue with the work of Brown (1981), who emphasizes the supply side. Brown is a geographer. Brown does not say that the variables mentioned by Rogers are unimportant, but he thinks that other variables are also important and are not dealt with sufficiently until that moment. Brown focuses on market and infra-structural variables such as:

- accessibility of possible users to the market;
- costs and possibilities of transportation;
- maintaining possibilities;
- advertising expenditures;
- economic conditions;
- diffusion agency capability and effectiveness;
- other connected innovations which are supplied or will be supplied in a short time.

A third work to treat is that of Agarwal (1983). It concerns rural innovations in developing countries, especially wood stoves. In this study it is also indicated that in different studies different variables of diffusion are treated. To give them as Agarwal does:

- attitudes and personality of the individual adopter;
- physical attributes of the innovation;
- methods of first generation and subsequent development of the innovation;
- economic costs and benefits of the innovation;
- supporting rural infrastructure;
- socio-economic structure of the community.

Special attention is paid to the third point. It is said to be important to keep in close contact with the possible users during generation and development of the innovation and to use indigenous technologies if possible. The aim is to get real appropriate technology for developing countries in this way.

It is also stated that *'institutions providing information, credit, production inputs etc. are so dominated by the interest of the few, who are economically and socially powerful, as to preclude the majority of the people from access to the innovation.'* Transformations needed for diffusion of innovations by more people are:

- improving the extension system;
- diminishing the rigidity of bureaucratic rules and procedures;
- changes in the class basis of the society.

Agarwal argues that variables which are important in the diffusion process, depend on the technical, social and economic characteristics of the innovation involved. It is said that: *'for example, innovations which require cash expenditure (the economic characteristic) are likely to be much more difficult to diffuse, particularly where the potential adopters are poor and have little cash at their disposal. Again innovations which require communal cooperation for successful adoption (the social characteristic) are likely to be much more problematic to promote.'* These innovations can hardly be diffused by a market oriented approach.

In the work of Röling, Ascroft and Wa Chege (1976), it is also noted that if one wants to diffuse rural innovations to farmers, one should pay special attention to them. They conclude that *government intervention* can play an important part in the process. If it does not, there is a big chance that diffusion of innovations enlarges the difference between rich and poor.

Hardeman (1984) looked at the peasants in Mexico and found that diffusion was less if peasants had less capital, education, credit facilities, land etc. For him the situation of the land tenure is the most important variable. He found five essential conditions which can be reached partly by intervention of the government to help the poorer farmers:

- rather egalitarian agricultural sector with farmers having control of their own land;
- possibilities to use the resources of the country effectively;
- government conducted market mechanism;
- possibilities for participation and small scale solutions;
- innovations that strengthen the subsistence, diminish risks and are not expensive.

Many studies give the same variables. The following variables come all from studies in the agricultural sector, which are mainly concerned with the rural poor. Important innovations are wood stoves (Howes, 1980; Hymen, 1987), rural energy (Barnett et al., 1982; Barnett, 1990), farm implements (Helsloot, 1986) etc. Other studies are (Burmeister, 1987; Chen et al., 1989; Feder et al., 1982; Melkote, 1988). Important variables coming up in these studies are:

1. If an innovation is part of a whole set of innovations belonging together, such innovation has to be seen in relation with the others.
2. For diffusion it is important to develop an innovation after a good need assessment in the social system of the target group. Also participation of the target group and the use of indigenous technologies can help the diffusion process. So the target group orientation is important.
3. The availability of an innovation for the poor farmers can be enlarged by good credit facilities, overall supply, subsidies, etc.
4. For diffusion also the training and extension facilities are important to learn the users how to use, maintain and repair the innovation. Also the advantages of the innovation can be made clear.
5. The government can play an important part by improving the infrastructure, helping with workshops for repairs, giving subsidies, price policies, export and import rules. Also the international organizations can play an important part here. E.g. with the regulation of world market prices.
6. The difference that exists between developers and target groups can be a problem for diffusion. There are cultural differences, differences in standard of living etc. Participation of the target group in development can diminish this problem.

An important work about rural innovations is Rutherford (1985), who comes from an economic background. Besides very understandable economic analysis, also other aspects like compatibility are treated in this work. Special attention is also paid to what is important for extension services. More details about this work can be found in Section 3.2.

Surely not all diffusion research is restricted to the rural sector. Similar problems we find in the diffusion of conservation (Nowak, 1987) and medical (Bonair et al., 1989) technologies. These technologies are in principle not economically profitable. They can improve the situation of life in a longer or shorter term by better environment or better health. Therefore to diffuse these technologies it is very important to have:

1. Good information and education to make clear the advantages of the innovation.
2. Good financial incentives of the government to make the innovation profitable in that way.

If we now take a look at developing countries, it is still the case that most innovations coming to these countries are developed in industrialized countries. If these innovations have to be diffused in the developing countries, they first have to be transferred to the developing country. The University of Technology in Eindhoven (1988) has put the variables that play a part in this process together in Figure 1.3.

If we take an intensive look at this figure, we see most of the variables mentioned before:

1. the properties of the innovation and the way the innovation is diffused in the centre of the scheme;
2. the properties of the target group as part of the society of the receptor country;
3. the properties of the invention group as part of the donor country society;
4. the properties of the diffusion agents coming from the donor or receptor country;
5. the properties of the international environment, in which the different societies find their place, in relation with the innovation.

This figure does not say much about the relations between the various groups of actors and the institutions. Nevertheless, it visualizes one of the major diffusion problems. We have two different societies with a very different structure and culture. In principal this is true for all different institutions: economic, technical, political, religious, educational, etc. Then, there is a trans-cultural international environment between them, which is, in all likelihood, more an obstacle than a bridge.

Apart from that we see the invention group far away from the target group. One group consisting of highly educated specialists. The other group, for example, of lowly educated farmers. If they do not understand each other, how can one group develop something valuable for the other group. Perhaps the diffusion agents can act as a kind of bridge, but in a lot of cases this will be difficult to build. Finally we see that three groups have to judge about the innovation, firstly the innovators, secondly the change agents and thirdly the target group. If one of these judgments of these different groups is negative the innovation is rejected. From all this, it becomes clear that there must come a solution for the gap between the different societies. Participation of the target group in the developing process can be part of the solution.

In the next chapter we will develop our own model for the diffusion of innovation with help of the literature as dealt with before.

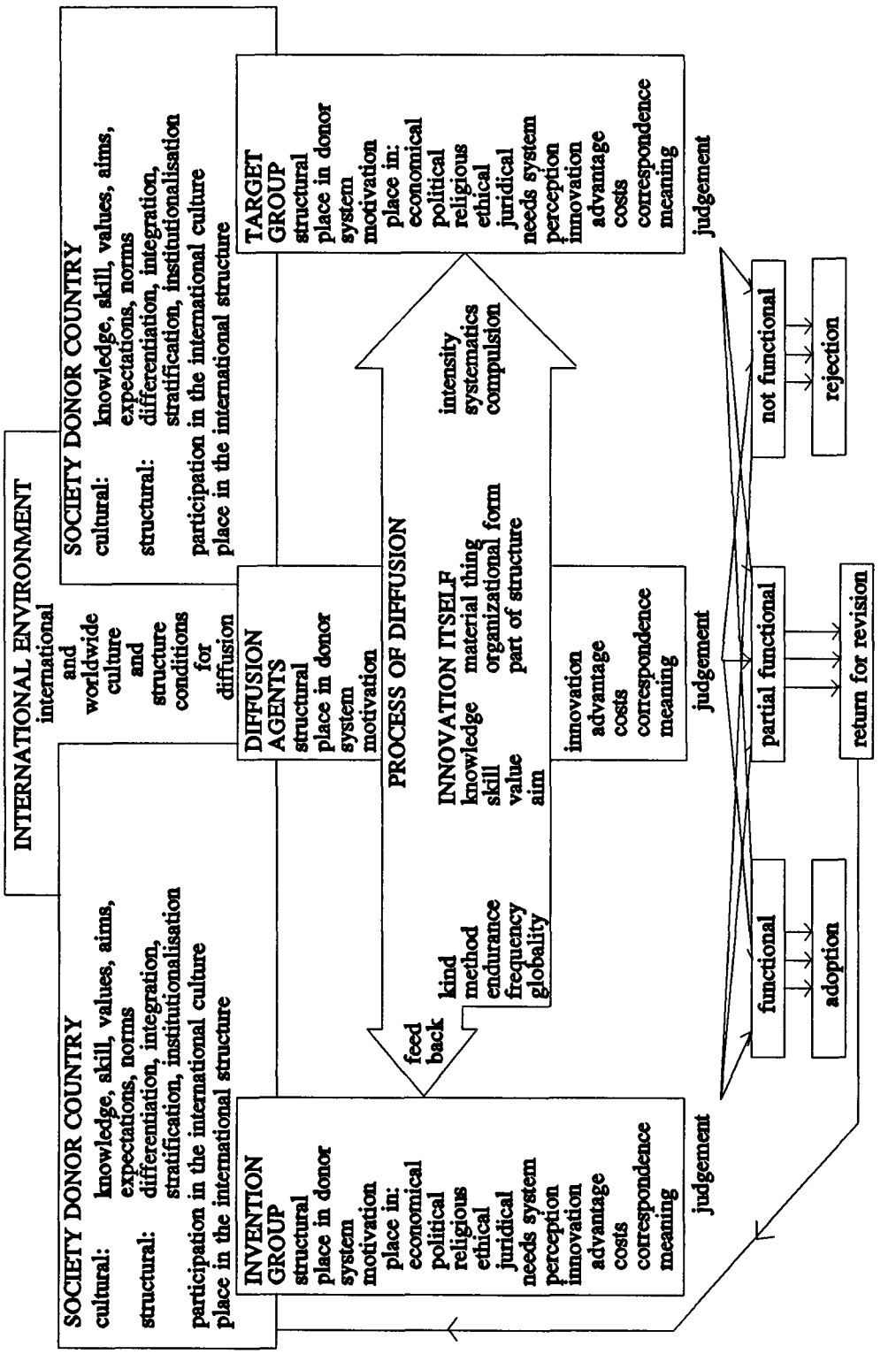


Figure 1.3. A model for the transfer of technology to developing countries

2. A MODEL FOR THE DIFFUSION PROCESS

2.1. Introduction

In this chapter we develop a model for the diffusion of innovations. Major parts of the model can already be found in (Zonneveld, 1985). After studying the literature, a number of adaptations were made. This model will be helpful in understanding the process of diffusion and to find the variables that play a part in the process.

Before starting with the model we need some more definitions. Important concepts for the model will be: society, social structure, social culture and institutions. We saw these concepts already in Figure 1.3. Useful definitions can be found in (Lapperre, 1992) and the important ones will be recalled here.

Society is the for a specific group of interacting people most comprehensive, multi-functional and multi-dimensional social system. Such social system consists of the related body of structural and cultural elements. The related body of these elements determines the "social behaviour" - preserved and standardized social relations - of people in a specific group.

Social structure is the relative system of permanent social positions connected in social space through a network of more or less standardized and collectively accepted interactions and communications. Or, in other words, a relatively permanent system of social relations connected through social positions. The distinguishing elements of social structure are function, differentiation, social distance, integration, stratification and scale.

Social culture is the relative body of autonomous norms, expectations, values, goals, knowledge and know how, including technology, which people collectively share and acknowledge as legitimate within a specific society and which can be transferred to others. The function of this body of elements is to direct, specify, coordinate, preserve and standardize human behaviour.

An **institution** is the more or less stable, standardized, collectively accepted and formalized way in which a specific function in society is performed. It embraces the interrelated complex of structural and cultural elements that guide and provide the organizational frame work within which behaviour takes place. Structurally, it provides the set of social positions and relations within actions that take place. Culturally, it delineates and legitimizes the specific goals to be achieved, provides the norms, expectations, know how, knowledge, science and technology, pertinent to the actions involved. Examples of institutions are the economic, political, religious, kinship and educational institution.

2.2. Description of the model

In our own model three different elements are used:

actions and attitudes of people, events happening;

result, output, innovation;

1. Between two : the people/events in the first block influence and can change the actions of the people/events in the second block. These relations are in principal twofold, because people which have contacts influence each other.

2. From a to an : an action leading to an output.

3. From an to a : an output leading to a new action.

The model as developed is given in Figure 2.1.

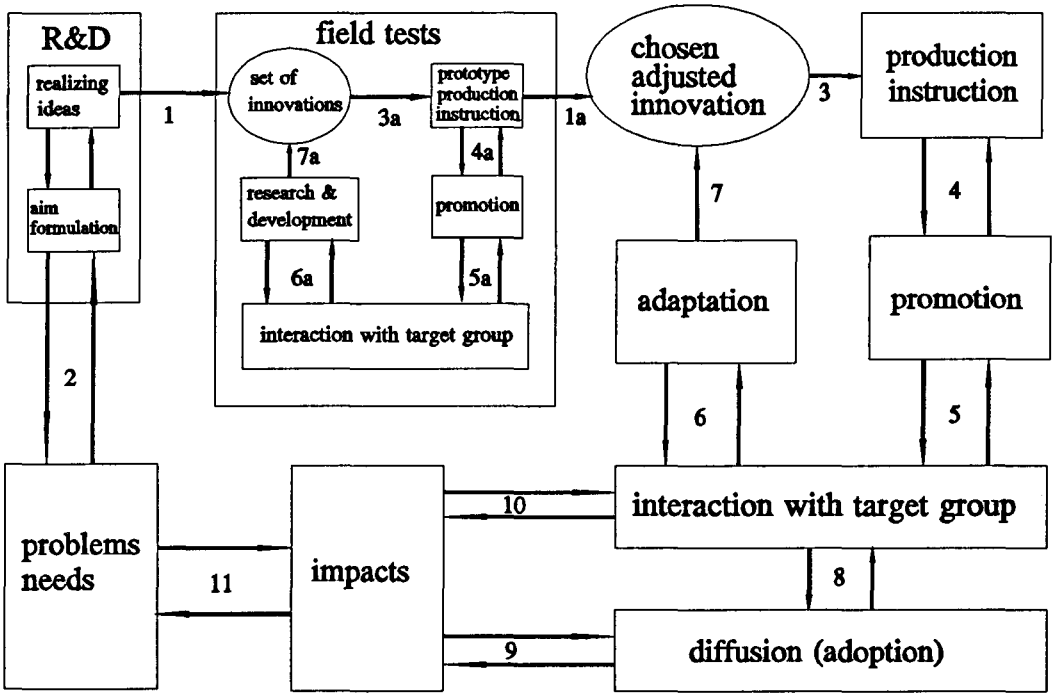


Figure 2.1. A model for the process of diffusion

The model is meant for the introduction of innovations to solve the problems and fulfil the needs of the target group in a specific area. It needs some modifications if we want to use it for innovations that solve national or global problems (like innovations improving the import/export balance of a country), which are not necessarily beneficial for the target group that has to adopt the innovation.

Now we will define the elements of the model as far as they are not defined in the introduction.

Needs/Problems: Material or immaterial things people want to possess/solve such as e.g. food, water, housing, health, work, vacation, watches, televisions, etc. Some connected problems are water supply, enough work, etc.

Research & Development: It may be clear what R&D is, but in this situation we take it very broad, containing all kinds of inventive thinking and acting to come to innovations. In this context we can split it in two important parts:

1. Realizing ideas: R&D that invents and realizes new ideas for the target group as mentioned.
2. Aim formulation: Research that looks for needs/problems in the target group and formulates aims for possible solutions and sends this, for realization, to the first group. Or it formulates aims for an already invented innovation. The two fold relation between the two elements of R&D is made clear now too.

Field tests: This may be seen as part of the R&D in which the diffusion is simulated on a very small scale. This can be done with more innovations to get an idea for each about the:

- chance of adoption;
- market size/possible adoption;
- satisfaction of the needs;
- impacts, etc.

Production/Instruction: Realization of the innovation so that the target group can use it. For software innovations this will be an instruction, for hardware innovations this will be a product, possibly accompanied by an instruction.

Promotion: Making the target group acquainted with the existence and possibilities of an innovation. We have some different methods:

- commercials in different kinds of media: television, radio, journals, etc.;
- diffusion agents: people going to the target group and promoting the innovation;
- interpersonal contacts: promotion from one person to the other inside the target group.

Interaction with the target group: all kind of things that happen in the target group as a result of the contacts with media, diffusion agents and the innovation. Also it contains the reactions of the target group, which are a result of this.

Adaptation: Changing little things of the innovation by the target group or by the producers as a result of the reactions of the target group.

Impacts: All kind of changes that have taken place by the introduction of the innovation. These impacts can be intended or unintended, foreseeable or unforeseeable. The impacts can be economic, social, technical, environmental, etc. (see also (Lemmens, 1987)).

We present now an analysis of the relations as given in the model. They consist of the most important relations in the model. In the field research maybe more relations come up. The relations are numbered as in Figure 2.1.

1. Possible innovations are always the result of a new idea of someone, which comes up after some inventive thinking. The idea has to be executed also. So there is always some R&D done to make an innovation, how small or how extensive this may be.
2. The relation between the needs and problems of the target group has evidently the twofold relation as indicated before. Researchers can let influence their research by the needs of the target group. They start with a need-assessment study and try to find innovations in relation with that. On the other hand, it is possible that a certain invented innovation creates its own need. People never had the idea to need such a thing, but its existence makes that they want to have it.

3. The properties of the innovation influence the production process. We have already seen the difference between a hardware and a software innovation. The innovation also can ask for: small or large scale production, production at a certain place, mass-production or just a few units. This process on a small scale is found in the field tests (3a).
4. The producers will contact media and promotion people to promote their innovation. They will have great influence on the way and the means of promotion. But also the promoters have ideas about the product. Especially on instructions, which they have to use for their promotion, they will have influence. (Again we find this on a small scale in the field tests. (4a))
5. Now the promoters can go to the target group and try to sell the innovation. On the other hand the reactions of the target group will lead to changes in the promotion strategy. Also the promotion by interpersonal channels can start now. (Again we find this on a small scale in the field tests. (5a))
6. Here we find different relations, although they are similar in the field tests and in the 'real' situation. During the field tests, there is still much room for R&D and innovations can be totally changed at that moment as a result of the reactions of the target group. The R&D results will again have their influence on the target group. In the 'real' situation only small changes can be made, which cause only small adaptations in the production, etc. Otherwise the process will cause no diffusion and the needs stay the same, so we will return to the R&D.
7. The adaptation can, but not necessarily has to, lead to a small change in the produced innovation. It also can be the case that a user made an adaptation for his own use only. In the field tests this relation (7a) is very important, because it takes care of the selection out of the set of innovations. Each circle in the field tests will lead to another set of innovations. If the set is reduced to one useful innovation, we can get out of the block and have one chosen adjusted innovation. If the set becomes empty we have to wait for new output from the R&D-block.
8. If the target group has seen the innovation, the diffusion can start. People will adopt the innovation and the interaction with the target group will affect more people.
9. The adoption of the innovation can have good or bad impacts for the user, which may change his way of life. The adoption by sizeable parts of the target group can change norms and values in their social system. On the other hand these impacts can speed up or slow down the diffusion process.
10. The reaction of the target group can change if they see the impacts, positively or negatively. The knowledge about an innovation (also without diffusion) can cause changes in the system of the target group.
11. The impacts can cause new needs. If you, e.g., get more money, you want to buy things you could not effort before. Also new needs can cause impacts, which influence the diffusion. We shall give an example here to throw a light on the final relations. Someone invents a very drought-resistant maize variety, that gives very high yields per hectare. It is accepted enthusiastically by the target group. The impact is a high amount of maize. Then one needs storage and transport possibilities. These needs cannot be fulfilled and the maize starts to rot. At the same time, the farmers see that this maize variety diminishes the quality of their soil more quickly than the old variety did. The diffusion stops.

Some other considerations have to be made. In the model there are a lot of steps backward. It may be clear that diffusion will not be reached just by following some steps of a receipt. The process can stop somewhere during the field tests, because no satisfactory innovation is left. But also if we come to real production, we see from the model that we can end again at the needs without ever reaching some amount of diffusion. That can also be seen in reality. Hunger still grows in the world, although lots of innovations are developed to diminish it. Not all the variables that play a part in that problem can be found in this model.

We have to realize that the diffusion process is not a closed system. That means that there are a lot of other systems influencing the process. It is important to remember that the model gives the steps of the process and the influences inside the model, but all the argumentation and reasoning for certain steps are not incorporated, because they come from outside the system: from international or national structures, etc.

2.3. Variables occurring in the model

To present a better idea about what is meant by the blocks in the model presented in Figure 4, a list will be given for the important variables playing a part in the diffusion process. We distinguish 14 elements in the model and for each we give the essential variables. These are given in the first column of Tables 3.1. until 3.14. In the second column we indicate the most important distinguishing elements of the variables, from which we rather easily can come to the operationalizations. Possibly there is a third column, where the distinguishing elements are more specified. Of course the distinguishing elements itself are also variables as we have seen them in Section 1.2. So here we can call them sub-variables. Finally, a last column with room for the specific measuring of the operationalization. It has to be filled in with the qualities and quantities of the variables.

The different elements are:

1. target group*;
2. needs of the target group;
3. R&D-group*;
4. R&D;
5. innovation;
6. field testers*;
7. field tests;
8. producers*;
9. production;
10. promoters*;
11. promotion;
12. impacts;
13. adaptation;
14. involved governmental institutions*.

The elements indicated with a * are groups of people playing a part in the diffusion process from their specific place in society. Variables concerning these people can be divided in structural, cultural and institutional variables. These are in this order given in the tables and divided by a double line. In these cases structural and cultural variables occur always, institutional variables sometimes. We have shaded the variables that cannot be found in literature.

Table 2.1. Variables of the target group

variables	distinguishing elements	operationalization
scale	size	
stratification	religious, kinship, job-based, money-based	
communicational structures	social interconnectedness, economic interconnectedness, geographical distribution, access to mass media	
infrastructural properties	accessibility, maintenance/repair facilities	
cultural background	norms, knowledge, skills	
economical background	poor, rich, labour costs	
kinship background	men, women	
educational background	illiterate, literate	

Table 2.2. Variables of the needs of the target group

variables	distinguishing elements	operationalization
exclusiveness	basic, luxury	
tangibility	material, immaterial	
origin	felt, pushed, individual, group	
newness	new, substitutional	
visibility	clear, hidden	

Table 2.3. Variables of the R&D-group

variables	distinguishing elements	operationalization
geographical situation	local, foreign	
organizational background	government, non-government, commercial	
infrastructural properties	relation with field testers, relation with producers, relation with promoters, local, regional, national, international	
technological means	design facilities, construction facilities, test facilities	
cultural origin of the staff	exogenous, endogenous	
disciplinary background	α, β, γ	
source of finance	government, non-government, commercial	

Table 2.4. Variables of the R&D

variables	distinguishing elements	operationalization
kind of problems	short term solutions, long term solutions	
specifity problems	specific, general	
problem solving techniques	need-assessment study, innovation specification, literature review, technology review	
relation with target group	direct, indirect, none	

Table 2.5. Variables of the innovation

variables	distinguishing elements	operationalization
economic properties	relative advantage, price, uncertainty, work saving, work creating, government support	
decision making	individual, collective, authority	
cultural properties	compatibility, complexity, observability, status giving	
adaptability	by users, by specialist	
appearance	hardware, hardware & software, software	
structural influences	newness, individual use, group use, system independent, system dependent, system disturbing	

Table 2.6. Variables of the field tests

variables	distinguishing elements	operationalization
scale	quantities, places, demonstrations	
orientation	opinion leaders, average group members	
feedback	interaction with R&D	

Table 2.7. Variables of the field testers

variables	distinguishing elements	operationalization
organizational background	government, non-government, commercial	
infrastructural properties	relation R&D-group, local, regional, national, international	
disciplinary background	α, β, γ	
cultural origin	exogenous, endogenous, homophily/hetrophily with target group	
source of finance	government, non-government, commercial	

Table 2.8. Variables of the producers

variables	distinguishing elements	operationalization
organizational background	government, cooperation, private	
infrastructural properties	relation with R&D relation with promoters, local, regional, national, international	
competitive situation	one producer, few producers, many producers	
activity concentration	marketing, production	
cultural origin	exogenous, endogenous	
educational background	technical level, economical level	

Table 2.9. Variables of the production

variables	distinguishing elements	operationalization
scale	small, medium, large	
sector	informal, formal	
profitability	low, high	
origin of means	machinery, raw materials	
technology level	traditional, modern, capital intensive, labour intensive	
capacity	small part of market, big part of market	

Table 2.10. Variables of the adaptation

variables	distinguishing elements	operationalization
source	users, specialists	
profiting group	individual, general	
importance	detail, essential	
influence	none, copied by users, taken over by producers	

Table 2.11. Variables of the promotion

variables	distinguishing elements	operationalization
directness	mass media, target group contacts	
scale	extend of efforts	
financial background	government, non-government, private, credit facilities	

Table 2.12. Variables of the promotion group

variables	distinguishing elements	operationalization
organizational background	government, non-government, commercial	
specificity	concentration on few items, many items	
orientation	individual, group, opinion leaders, average target group members	
infrastructural properties	relation with R&D, relation with producers, local, regional, national, international	
cultural origin	exogenous, endogenous, homophily/hetrophily with target group	
disciplinary background	α, β, γ	
credibility	high, low	

Table 2.13. Variables of the involved governmental institutions

variables	distinguishing elements	operationalization
organizational background	exogenous, endogenous, international	
role	financial, promotional, idealistic	
continuity	continual, discontinual	
attitude	positive, neutral, negative	

Table 2.14. Variables of the impacts

variables	distinguishing elements		operationalization
desirability	desirable, undesirable	technical, institutional, social, economical, environmental, psychological, legal	
predictability	foreseeable, unforeseeable	technical, institutional, social, economical, environmental, psychological, legal	
directness	direct, indirect	technical, institutional, social, economical, environmental, psychological, legal	

Of course, this list of variables is not complete, but we have tried to find the most important ones for the diffusion process. The last column with operationalizations is not yet filled in. This in the first place because it goes beyond the function of this theoretical background. In the second place operationalizations of the distinguishing elements depend very much on the specific case studies and the possibilities of data collection.

If we look at the target group, we see first the variable scale, with the only element size. Here the measuring is a 'simple' count or estimate of the number of people.

If we look at the infrastuctural properties, we get a much more complex system of measurements. Accessibility can be divided in roads, railways, airways and access to transport facilities. The number and quality of roads is important, also the number of months per year they can be used. Concerning maintenance and repair facilities, it is important to know which workshops and technologies are available for help and how accessible they are. Furthermore, the possibilities to get maintenance products and spare parts are important. For this variable we can still make a list of things which have to be measured.

We finally look at the cultural background. Here we are confronted with the enormous complex of norms, knowledge, skills, etc. In this case it is impossible to describe the whole cultural system, so it is important to describe that part that is important for the innovation, like: which skills and knowledge are necessary and can be helpful, what will change in the cultural system, where can norms block the introduction of an innovation, etc.

In this way the last column can be filled in with simple figures, short and longer stories. Further research and reviewing literature must make it possible to weigh the different variables against each other for a specific case. In the next section we will discuss which variables are seen as important for innovations in the agricultural sector in recent literature.

To compare our own list of variables with the variables found in literature, we have shaded the variables that cannot be found in literature in Table 2.1. until Table 2.14. From this comparison we see that a lot of variables do not feature in literature.

1. Although many authors emphasized the importance of need-assessment before starting the development of an innovation, not much attention is paid to the role of the characteristics of the needs.
2. A second striking point is that hardly any attention is paid to the background of important actors in the diffusion process: researchers, field testers and producers.
3. Production aspects can hardly be found in literature.
4. The adaptability is presented as important in literature, but more specifications are not found.
5. Rogers (1983) wrote already that studies about impacts are important, but still hardly anything is found in literature.
6. Items which are already dealt with very well in literature are the innovation and the promotion/extension work.

Further research will be necessary to get an idea about the importance of the missing elements in literature until now. Maybe some of them are irrelevant, but others can turn out to be really important.

3. TANZANIAN ENVIRONMENT

3.1. Introduction

As we have seen in Chapter 1 and 2, the diffusion of an innovation is a difficult process where the target group and its environment play an important part. So it will be impossible to understand diffusion processes in Tanzania without elaborating to some extend on its physical and social properties and how it became as it is nowadays.

Therefore, this chapter deals with the history of Tanzania, the natural environment, geopolitical and social structures and institutional characteristics. Section 4.1. will show the importance of this chapter by reviewing some of the facts that can be important for the diffusion process in Tanzania and so justify the extensiveness of this chapter.

Important parts of this chapter are based on Heynen (1978), Kliest (1984) and Kussendrager (1991). Sentences or parts of sentences that are thought to be important for the diffusion of innovations in Tanzania are printed in italics.

3.2. History

3.2.1. Pre-colonial history

The borders of Tanzania as they are now, are not much older than one century. They got their shape when Africa was divided between the western powers at the Conference of Berlin (1890). The United Republic of Tanzania exists only since 1964 when the mainland (Tanganyika) and the islands Pemba and Zanzibar became one country. But how Tanzania became as it is now, is already a process of thousands of years in which many groups of people played a part.

Archaeological discoveries in the Olduvia rift in the North West of the country indicate that the Australopiticus, a primitive precursor of the Homo sapiens lived here. Also remains of a later and more advanced predecessor, Homo erectus, are found. About 200,000 years ago there were small groups of hunters and gatherers wandering around on the planes of what is now Tanzania.

The first food producers, Kushiets and Hamiets, came from the Ethiopian Highlands. They lived around Kilimanjaro and Ngorongoro Crater, but they did not use iron implements. These groups were in turn incorporated in two new groups: Bantus and Nilots. The Bantus came from the South and the West. They used iron weapons and agricultural implements, which gave them an advantage over the present population. They settled in the highlands Rungwe and Buhaya and on the South side of the Kilimanjaro. The Nilots were more nomadic livestock owners. They came from the North to the drier parts of Tanzania. Maasai and Luo belong to the language group of the Nilots.

All this mixing up of different groups caused a complicated social-cultural and economic system, which has strongly been influenced by external trade contacts. Already nearly 2000 years ago Indonesians and Chinese came to the coasts of Tanzania. Since the 13th and 14th century, Arabs started small settlements on the coast. Kilwa was one of the important ones. It was more a control point and staple place for gold and ivory from Zimbabwe and Mozambique. In 1498, Vasco da Gama reached Tanzania and that was the start of some bloody and religious conflicts between Portuguese and Arabs. In these times also Zanzibar became an interesting trade place. At the end of the 17th century, the Portuguese were finally defeated by the Arabs.

During the 19th century the influence of the Arabs on the mainland grew. They made some trade routes mainly for slave trade. These trade routes caused changes in the mainland. First, there was the introduction of crops like sugar cane, beans, sweat potatoes, pineapple, mango, papaya and maize. Also Kiswahili (a mixture of Arabic and local Bantu languages), the official language of Tanzania now, is a result of these contacts. Another results is that the Islam became an important religion in Tanzania. *So Tanzania remained with a mixture of cultures and religions, but with a common language.*

3.2.2. German protectorate

In 1884, Karl Peeters travelled through the mainland by order of the German East African Company and concluded treaties with local leaders. One year later at the Conference of Berlin, Germany got a say on the mainland. After some negotiations with England, Tanganyika became a German Protectorate in 1890. The sultan of Zanzibar did not like this because he lost his say on the mainland, but he had to agree that his area became Pemba and Zanzibar under protection of England.

To get control in Tanganyika, the Germans had to fight several years. The most important revolt against the German regime was the Maji-Maji war in 1905. The Germans suppressed the revolt which cost more than 75,000 Tanganyikans their lives. The Germans introduced sisal, arabica coffee and cotton and they started big farms. Also they built two main railway lines: from Tanga to Moshi and from Dar es Salaam to Kigoma. The last one is a 1200 km long stretch right through Tanganyika to Lake Tanganyika.

The First World War did not pass East Africa. The British troops followed the German troops for years, without beating them. Plundering, hunger and illness cost about 100,000 Tanganyikans their lives. After the First World War, in 1919, all claims of Germany with respect to its colonies were withdrawn and Tanganyika became a British mandate area. Only the areas which are now Rwanda and Burundi were occupied by the Belgiums and detached from the original Tanganyika.

3.2.3. British mandate area

For the British government Tanganyika was not an important area overseas. They copied the German ruling system, but did not take much care about the development of Tanganyika. This situation continued until the Second World War. During the Second World War they started to stimulate production of export crops like rubber and sisal. Also the food production was stimulated.

After the Second World War, the agricultural development continued, but more than once farmers were send out of highly populated areas to other areas. Resistance started to grow, but the Tanganyikans saw no use in a straight fight and started to improve political consciousness. The Tanganyika African Association (TAA) was established. It was a non-tribal organization which gave opposition to the colonial government. On July 7, 1954, the organization, under leadership of Julius Kambarage Nyerere got a new name which showed that the people wanted independence.

Under the new name, Tanganyika African National Union (TANU), the organization grew into a political party with a wide social basis.

At the same time, many farmers had organized themselves in large cooperations. An important person in this was Paul Bomani, who would play an important part when independence was gained. For TANU the important points were national self-determination, freedom (*uhuru*), trade unions and the disappearance of tribalism.

In 1959, Tanganyika got its first own cabinet with 5 ministers. In 1960 TANU won the general elections with 70 of the 71 seats and Nyerere became Prime Minister. On December 9, 1961, Tanganyika became independent.

3.2.4. Zanzibar

Under protection of England, Zanzibar became not much more than a colony. The British were the leaders, the Arabs formed the middle class, Indians controlled trade and the Africans did the work. Because of the division the British stayed longer in power at Zanzibar. There were four organizations, two for the Africans (one for the Shirazis which were born at Zanzibar (80%) and one for immigrants from the mainland), one for Arabs and one for Indians.

In 1963, independence came but the Africans were still oppressed by the Arabs and Indians. This regime could stand only for one month until the Africans started a revolt and sent the regime away. The power was taken over by the Afro-Shirazi Party (ASP), consisting of Shirazis, Africans from the mainland and Arabs. This regime, under leadership of sheik Abeid Karume turned to a socialistic policy. On April 22, 1964, Tanganyika and Zanzibar formed the United Republic of Tanzania.

3.2.5. The first years of independence

Already in 1962, Nyerere was chosen as President of Tanganyika and in 1964 he became president of Tanzania. One of the first things he was concerned about was unity (*umoja*). The national language Kiswahili was helpful with this. TANU was decided to be the only party allowed.

But after independence, the economic development could not match the expectations. Exports stagnated, employment did not grow. Industrialization was very slow. As a reaction on the crisis, Nyerere came with his Arusha Declaration on February 5, 1967. He wanted to start a socialistic policy based on self-reliance and *ujamaa*. *Ujamaa* in Kiswahili means brotherhood or family relationship which, according to Nyerere, formed the basis of the pre-colonial traditional African society. It is based on the fact that with common efforts of individual members of a society a certain prosperity for this society is reached. In the years after the Declaration Nyerere worked out his policy. People had to live together in *ujamaa*-villages. They should work together and have land in common property. Social provisions like education, health care, water, etc. could be realized more easily in these central *ujamaa*-villages. When this policy was starting Nyerere emphasized that it had to happen voluntarily. In Tanzania as well as in the whole world people were enthusiastic about the new policy.

3.2.6. After the first enthusiasm

It was a pity that Nyerere's politics could not bring what he had expected from it. Reasons for that can be found externally as well as internally. Tanzania had to contend with the rise in oil prices in the 70s and 80s. At the same time Tanzania got less for its own products like coffee, tea, sisal, cotton and tobacco.

Also bad for the Tanzanian economy was the end of the East African Community, which was a cooperation between Kenya, Uganda and Tanzania. Tanzania even got a war with Uganda at the end of 1978, causing a sharp increase in the defence costs in 1979. In the same year, Tanzania had to contend with heavy floods and in 1980 with severe drought.

The most important internal reason for the stagnation can be found in the formation of the villages. Although the first reaction was positive, it appeared later that many people did not want to leave their living places. At that moment millions of Tanzanians were forced to leave their houses and to move to *ujamaa*-villages. But the production did not grow very fast. The location of the villages was often chosen not very well. The soil was not always very useful for agriculture. Promised services did not come up very quickly. Also the idea of *ujamaa* did not work so well in the villages where people from different places were put together. Furthermore, the cooperations were abolished and replaced by parastatals, which were easier to control by the government. But these government enterprises often turned out to be rather corrupt, inefficient and bureaucratic.

The economic crisis caused more corruption in governmental institutions, not in the first place because the salaries were too low to keep ones head above the water. In 1982 the protests started against the party and in 1985 Nyerere left his place voluntarily and was succeeded by Ali Hassan Mwinyi. Nyerere kept influence as chairman of the Chama Cha Mapinduzi (CCM) or Revolutionary Party, which is the party that is a combination of TANU and ASP, started in 1977.

3.3. Natural environment

3.3.1. Situation

The United Republic of Tanzania has a surface of 945,087 km^2 and is the biggest country of East Africa. It lies between 1°S.lat. and 12°S.lat. and between 29°E.long. and 41°E.long. Tanzania, situated at the Indian Ocean, is surrounded by Kenya and Uganda in the North; Rwanda, Burundi and Zaire in the West; Zambia and Malawi in the South-West; Mozambique in the South. Its situation in Africa is shown in Figure 3.1. and 3.2.

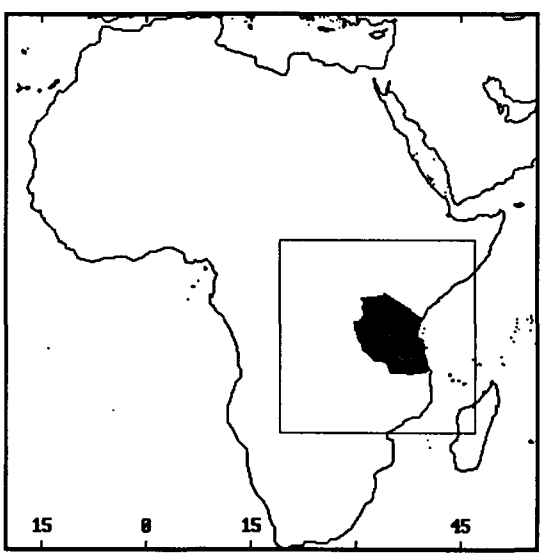


Figure 3.1. Tanzania in Africa

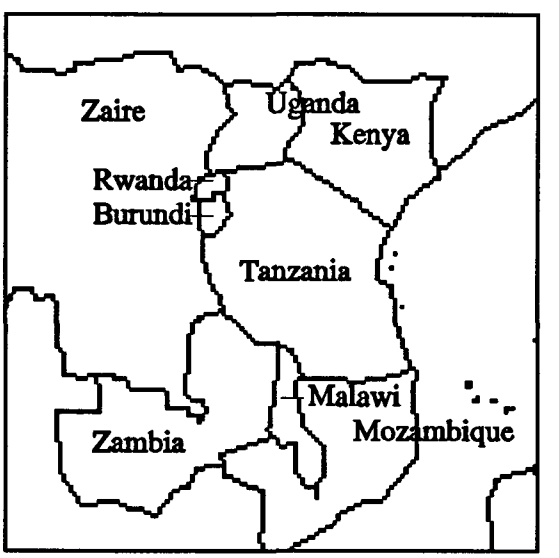


Figure 3.2. East-Africa

3.3.2. Landscape

The Tanzanian landscape is very multiform. The most conspicuous element is the East African rift valley, which gives the landscape important contrasts like the highest mountain in Africa, the Kilimanjaro (5895 m) with eternal snow and very deep lakes, e.g. the bottom of Lake Tanganyika is 400 metres below sea level.

Only a small part of Tanzania is situated at sea level. Large parts are high, especially high plains cover big surfaces, like the Central Plain and the South-Eastern Plain. Lake Nyassa and Lake Tanganyika are parts of the Western branch of the East African rift valley, but the very big Lake Victoria (67000 km^2) is not. It is not very deep, but full of fish. The most important features in the landscape of Tanzania can be found in Figure 3.3.

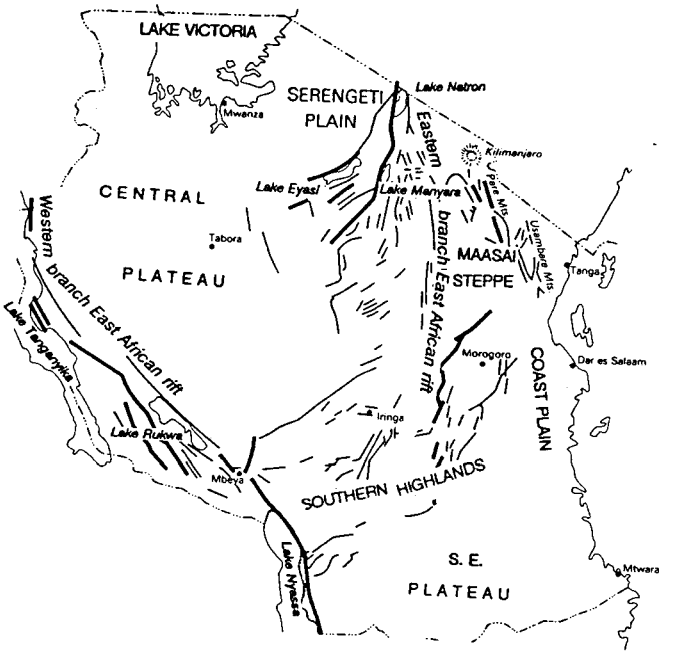


Figure 3.3. Features in the landscape of Tanzania

Different kinds of vegetation can be found in Tanzania. Real forest with a closed cover of high trees is almost absent. Only at some places where trees are planted, on the slopes of the Kilimanjaro and a at few other small places. What occurs in the largest parts of Tanzania is the Miombo woodland. This is a vegetation with low and sparse trees. There is an important role for lower vegetation. It is a typical vegetation for places with a real wet and dry season.

Two other types of vegetation are the tree savanna and bush savanna, containing again less trees. They can be found in the dryer parts of the country. Finally, small parts of the country are covered with grass, swamp and semi-dessert.

Important features in the landscape are the national parks. The most famous ones are situated in the North of the country: Ngorongoro, Serengeti and Lake Manyara. Here all kinds of wild animals like troops of gnus, zebras, gazelles and giraffes occur. But also considerable numbers of elephants, lions and buffalos. Furthermore beautiful birds and some rhinos.

3.3.3. Climate

The most important variables of climate are temperature and rainfall. The temperature in Tanzania at sea level is really tropical with an average yearly temperature of 26°C. If we come in higher regions this temperature goes down. In fact, the temperature differences during the year are very small, certainly compared to the Netherlands. Table 3.1. presents the exact figures.

Table 3.1. Temperatures in Tanzania (degrees Celsius)

place	hight in m	average max. year temp.[a]	average min. year temp.[b]	average year temp.[c]
Arusha	1390	25.2	13.9	19.6
Dar es Salaam	15	29.7	21.9	25.8
Dodoma	1120	28.9	16.4	22.7
Iringa	1640	24.7	13.5	19.1
Kigoma	880	27.9	19.2	23.5
Mwanza	1140	27.5	17.7	22.6
Zanzibar	20	30.3	23.5	26.9

a) average daily maximum
b) average daily minimum
c) sum of a) and b) divided by 2

Source: Kliest (1984)

Although the temperatures seem not to be very high, the climate at sea level is rather sultry because of a very high humidity. In higher regions, the climate is more comfortable.

With respect to rainfall, Tanzania has a distinct wet and dry season. Normally the wet season starts in November and ends in April/May. But also some areas, North from Dar es Salaam and in the Northern mountain areas, have two rainy periods. The first one in November and December. January and February are rather dry and the second period follows in March, April and May. The quantities of rain also differ rather much over the country. Figure 3.4. presents the rainfall in Tanzania.

3.3.4. Ecological zones

According to the agricultural development, we can distinguish 5 ecological zones in Tanzania.

Zone 1: Highlands with a lot of rain. These parts are very useful for agriculture. The higher, cooler, slopes can be used for export products like tea and coffee. The lower, warmer, slopes are useful for fruits, vegetables, cereals, etc.

Zone 2: Areas with rainfall around 750 mm per year. Rainfall in these areas is enough for agriculture. Important export products are coffee, cashew nuts and sisal. Food products are maize, beans and cassava. These areas are also suitable for keeping livestock.

Zone 3: Miombo woodland. The Miombo woodland is not very fertile. Agriculture has to change to drought-resistant crops like millet, sorghum and cassava. Also one can find tobacco and sisal. Livestock keeping is difficult because of the presence of the tse-tse fly.

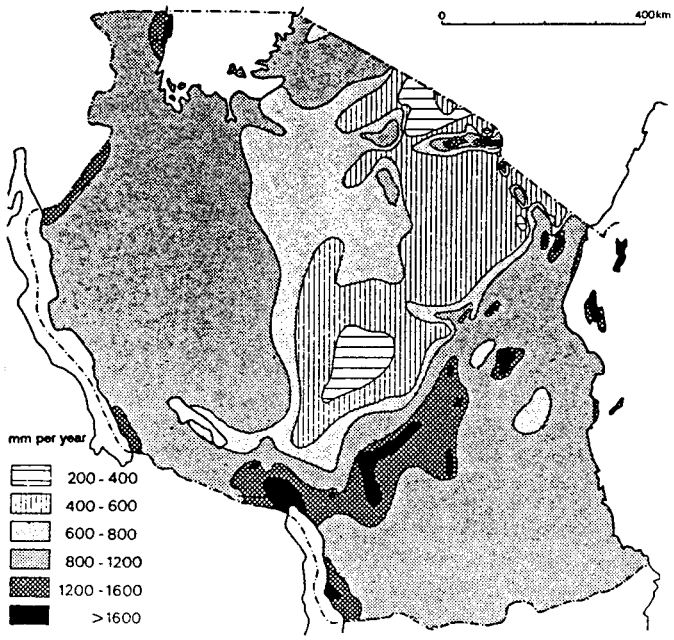


Figure 3.4. Average rainfall in the Tanzania

Zone 4: Semi arid areas. Agriculture is very difficult here. You need fast ripening crops or very drought-resistant crops like sorghum and cotton. There are possibilities for livestock, but you need a lot of land because of the poor vegetation.

Zone 5: Arid areas. These areas are very poor. Only nomadic tribes like Maasai manage to make a poor living in these areas with their cattle.

From all the data in this section it can be seen that there are important regional differences if we look at climatological and environmental conditions.

3.4. Geopolitical and social structures

3.4.1. Geopolitical structure

Tanzania is divided into 20 regions on the mainland and 5 regions on the islands Pemba and Zanzibar. The regions are divided into districts. They are again divided in wards, divisions and subdivisions. In Figure 3.5. a map of Tanzania is presented with the division in regions and districts.

The total population of Tanzania is now over 26 million people. The capital is officially Dodoma, which was chosen as capital for decentralization reasons. In spite of this, Dar es Salaam is economically and politically still the most important town in the country, with nearly 2 million inhabitants according to unofficial estimates. Other important towns are Zanzibar, Tanga, Mwanza (±150,000 inhabitants (1990)); Mbeya, Tabora (100,000); Morogoro, Arusha and Moshi (70,000).

The *population density* of the different regions is given in Figure 3.6. As can be seen, most people are living along the borders of the country. On average the population density is 26 people per km^2 but three quarters of the people is living in one quarter of the country.

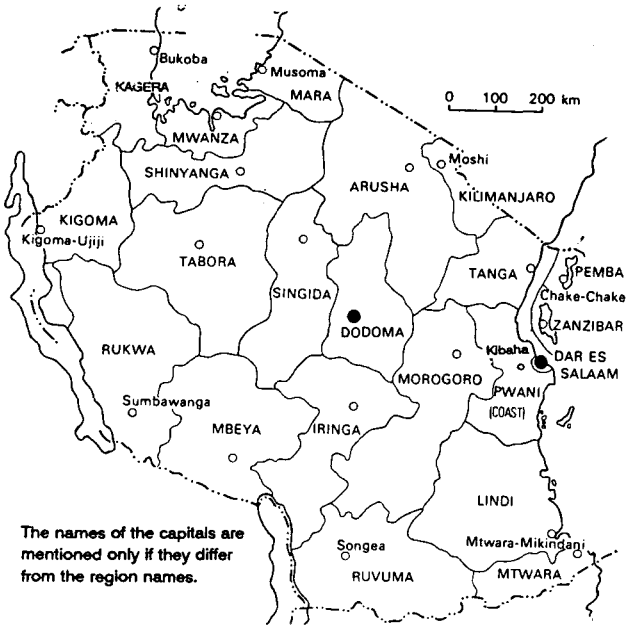


Figure 3.5. Geopolitical structure of Tanzania

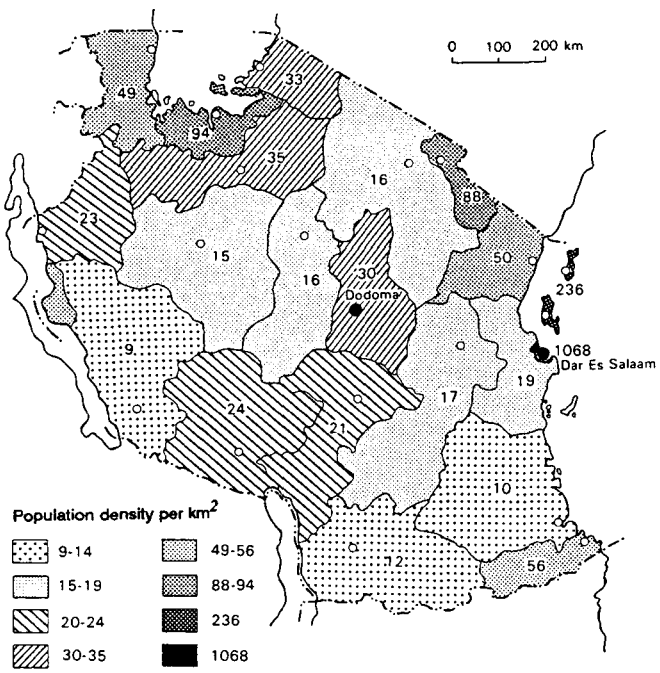


Figure 3.6. Population densities in the regions of Tanzania

The population of all the districts, based on in the Population Sensus of 1988 (Bureau of Statistics, 1989) is given in Appendix E. At that moment the total population was 22,533,458 on the mainland and 640,578 on Zanzibar, which made together 23,174,036 inhabitants. The average population growth is estimated at 3.5% for 1980-1990 and 3.4% for 1990-2000. The growth in the urban areas is faster. Already about 20% of all people are living in urban centres. Dar es Salaam grew from 273,000 in 1967 to 769,000 in 1977 until nearly 2 million in 1992.

3.4.2. Social structures

If we look at their origin, the population of Tanzania is not a unity. As explained in Section 3.2, many different tribes came to Tanzania through the centuries. The most important tribes, if we look at the number of people, are now: Sukuma, Makonde, Chagga, Haya, Nyamwezi, Ha, Hehe, Gogo, Nyakyusa, Sambaa, Lugaru, Bena, Iraqw, Luo and Maasai. Also considerable numbers of Arabs and Indians are still living in Tanzania.

There is no tribe in Tanzania which consists of more than ten percent of the total population and so no group is able to dominate the others. The division in tribes does not play an important role and is invented partly by the Europeans. So are the Sukuma (people of the North) a collection of all very different people, but for the colonists useful for planting cotton. On the other hand, the Makonde, living in Mtwara in the Southern part of Tanzania, were of little use for the colonists. Now they are known for the wood-carvings they make from ebony, which are very popular by tourists. The Chagga are living on the slopes of Mount Kilimanjaro. They are known as good traders and rich coffee farmers in Tanzania. Nomadic tribes like Maasai and Barabaig kept most of their old cultures and are less incorporated in the Tanzanian society.

More difference can be found between the Africans and the non-Africans. Before the Declaration of Arusha, the Indians and the Arabs controlled important parts of the economy, like building, trade and industry. After nationalizations, many of them left the country, but since the liberalization in 1985 their influence is growing again.

But although there are so many groups, the people in Tanzania seem to feel themselves Tanzanians. You do not feel much from tension between the different groups.

3.5. Institutional characteristics

3.5.1. Political institution

Tanzania is still a country with one party. The Chama Cha Mapinduzi (CCM) is the only party allowed in the country. This party is very much integrated in the social system of Tanzania. In the most far away villages you find CCM-offices, with a CCM-chairman and a CCM-secretary. The executive committees of the party and the government with the ministries are very interrelated and can hardly be distinguished. *Law is still based on the old English system.*

After more than 20 years socialistic policy in 1985, President Nyerere did a step backward and brought forward the new President Mwinyi, who could start with a more liberal policy. This change was partly forced by the World Bank and the International Monetary Fund (IMF), who refused to give loans if Tanzania did not change to a more liberal course.

In 1990, Mwinyi was chosen as President for a second and last period of 5 years, but other important Ministers, like Prime Minister Joseph Warioba were replaced. The new Prime Minister is a more pragmatic one called John Malecela. Also a new Minister of Home Affairs was chosen, Minister Mrema, who often reaches the newspapers because of his remarkable opinions.

Until the start of the 90s, the CCM was fully in charge in Tanzania. In government enterprises, they have their office, in each village an office and even each ten houses cell has a leader, which is a CCM-member. CCM has its own sub-organizations, like a workers union, a women organization and a youths organization. Talking with the Tanzanians they did not seem to be unsatisfied with the situation. But at the start of the 90s, some opposition grew. Also from outside the country came a strong call for a multi-party system.

So inside and outside the CCM, the discussion about the multi-party system started. New newspapers were started as alternatives for the government newspapers. But also from Nyerere, who has still a lot of influence on the party, multi-party system ideas come up. In July 1992, it was promised that new parties can be registered, but they may not be based on religious, tribal, or racial basis and have to be real Tanzanian parties. As the proposals are now, elections will follow one of the next years.

In Tanzania it is very well possible to talk about politics with the people. Doing so you find out that they are very unsure what the multi-party system will bring them. They were not so unsatisfied with the CCM, although economic progress has been marginal or zero, but they like the peace and quietness of their country.

Concerning foreign policies, Tanzania has also been rather active and maintained the socialistic attitude. They supported the Mozambican Liberation Movement and the African National Congress. Tanzania tried to cooperate with other countries, e.g. in the East African Community. This was meant to create an economic cooperation with Uganda and Kenya but, as we have seen, it turned out not to be successful.

3.5.2. Economic institution

With *an income of $160 per head of the population* (World Bank, 1990), Tanzania belongs to the group of least-developed countries in the world. The country has had no possibility to get out of poverty. The monetary unit in Tanzania is the Tanzanian Shilling (TSH). In January 1992 $1 was equal to TSH 230 at the official market, but equal to TSH 400 at the black market. *Since May 1992 the trade in foreign exchange is legalized.* It may be clear that this brings the rate under high pressure.

Tanzanian economy is based on Five Year Plans. The first one (1964-69) emphasized industrialization and mechanization of agriculture. The growth was higher than any year later, 5.3%, but the dependence on other countries and the fact that important parts of the growth reached not the African but the Asian population, brought that the policy changed. After the Arusha Declaration, the new policy changed to economic independence and better division of prosperity. There was a wave of nationalizations of big farms, banks, trade companies and industries. Emphasis changed to small farmers and food crops, but investments did not come. The only really growing sector in these times was the government, whose part in the Gross National Product (GNP) doubled in the 70s. During the Second Five Year Plan (1969-74) the economy grew with 4.8%. Export crops were doing well, but food production decreased because of a drought period in 1973 and 1974.

Although progress in education and health care was reached, the situation was not satisfactory. Dependency of other countries continued, government enterprises did not do well, agriculture stagnated. In the period 1982-85, economic growth decreased to 2%, less than the population growth.

The debt from Tanzania grew because of low exports and bad prices for their products, while the prices for products they had to import increased continuously. In 1988, the total debt was 4 billion dollars.

In June 1982, a Structural Adjustment Programme was started in cooperation with the World Bank. Price controls became less, productive sectors were stimulated and costs of government decreased. After long negotiations with the IMF, Tanzania started the Economic Recovery Programme, but had to agree with some rules of the IMF, like a less important positions for the government, devaluation of the Tanzanian Shilling and a better trade balance.

Now a big part of the government investment (23.8%) was used for transport and communication, a sector that was neglected for a long time. Further important investments were planned in agriculture and industry. The results of the liberalization can be seen clearly. The shops are not empty any more. They are full but for most people prices are much too high. Again, the Asian population is profiting more than the Africans, because they are still controlling the trade in the country. Inflation is going up.

Agriculture

Agriculture is the most important sector in Tanzania. *Agriculture takes care of 80% of the export income and 90% of the population gets the daily income from agriculture.* But productivity is not high. The agricultural sector takes care of only 50% of the GNP. Agricultural production is for about one half food crops. Maize is most important but cassava gets more important. For cassava, quality of soil and climate do not have to be so good The nutritional value is however much less. Important cash crops are coffee, tea, cotton, tobacco, cloves (Zanzibar and Pemba) and sisal.

Most important in Tanzanian agriculture are the small farmers or peasants. These farmers plant mostly food crops and cash crops. They normally make use of intercropping, so they plant different crops on the same field at the same time. *New techniques are tried mostly first at cash crops. For their daily food these farmers are very hesitating to try something new, but prefer the sure way.*

In the 80s more attention was paid again to the farmers. The cooperations came back and the government took more care of implements, fertilizer, seeds, etc. There is still an emphasis on cash crops, but in the 80s the growth of all crops was luckily much more than before, namely 3.8%.

Livestock and fishery

Livestock is not an important sector in Tanzania. In the dry areas some nomadic tribes go around with their cattle. Livestock is sometimes an extra source of income besides agriculture. The very thin cows are kept mostly not for milk, skins and meat, but more for a small investment. They can be sold in bad times. The price for a bride can be paid and this capital gives also rent in the form of calves.

It is estimated that there are about 14 million cows in Tanzania. The number is restricted because of the tse-tse fly, which is found mainly in the Miombo woodland and causes the terrifying sleepy sickness.

Also fishery plays only a marginal role. Most fish is caught in the big lakes in the West of the country, Lake Victoria, Lake Tanganyika and Lake Nyassa.

Industry

Most industries in Tanzania are directed to agriculture. Firstly, there are important processing industries for fermenting and drying of coffee and tea, ginning cotton, brewing beer, milling grains, etc. Secondly, there are some industries producing fertilizer, tractors, implements, etc. Other important branches are wood, paper and cement industry.

But the industry is really a problem child in Tanzania. *Most machinery and raw materials have to be imported. Productivity is low. Spare parts and raw materials are difficult to get, because for enterprises it is difficult to get foreign exchange. At the moment the government tries to make it easier to get foreign exchange. Also for industries is electricity a big problem. Electricity is cut at unexpected moments for an unknown time.*

Still it is important for Tanzania to use its own resources to diminish the difference in imports and exports. Besides the agricultural resources, there are some other resources, like hydroelectric power, tin, phosphates, iron ore, coal, diamonds, gold, etc., but all of these do not play an important role in the industries of the country.

Tourism
Tanzania is in principle a very interesting country for tourists, with a beautiful landscape, white beaches, national parks with wild animals and a special flora and some beautiful mountains like Mount Meru and Mount Kilimanjaro. But the Tanzanians have not done much for the tourists, because they were afraid that it would create a new colonialism.

Tourists bring foreign currency and Tanzania needs that very much. So since the 80s tourism is stimulated more, but still you do not see many tourists. Most tourists are coming to the North of Tanzania, making a few day trip from Kenya and going back again.

Transport and communication
Transport is one of the most important problems in Tanzania. Roads are very bad, full of potholes and very destructive for cars and trucks. Especially during the rainy periods some roads cannot be used any more. Also the railways do not work accurately and effectively, the harbour of Dar es Salaam is too small and aircrafts are rather old and flights are often cancelled.

Since the 90s, there are at last all kinds of plans for improvements. Some roads are improved indeed, but others are still terrible. Transport of people is not so bad. Since the liberalization there are many people who started bus companies. In Dar es Salaam hundreds and hundreds of buses bring people from every corner of the country to another. They are mostly old, very full and uncomfortable, but rather fast. Also there are all kinds of bus services between the bigger cities in Tanzania. Even some are rather luxury (especially Dar es Salaam-Arusha v.v.) and they bring people, mostly daily, everywhere in the country. Finally from Dar es Salaam, there is a new very fast and comfortable boat service, which brings you in Zanzibar in one and a half hour.

Mass media are not very well developed in Tanzania. There are some newspapers, but they often do not reach the villages. For a short time the radio broadcasting from Dar es Salaam can be received in the whole country. Television broadcasting does not exists at the Tanzanian mainland at the moment, but only at Zanzibar.

3.5.3. Religious institution

The religious institution does not play a dominating role in Tanzania. The people have freedom of religion. *About 1/3 of the people is Christian, 1/3 is Islamic and 1/3 kept to the traditional believes.*

The people in Tanzania seem to be rather religious, but really fanatic groups play no important role. *The different religions live peacefully together.* The Christians as well as the Islamic celebrations are celebrated by the specific groups.

An interesting phenomenon is that although most Tanzanians left their traditional believes, not everything of this is disappeared. Ancestors still play important parts and are asked for advice in difficult decisions.

3.5.4. Kinship institution

Kinship plays still a very important role in Tanzania and it is one of the more difficult things to understand for a stranger. *For a Tanzanian his family is very important.* If a member of your family has trouble and you can help him, you have to. Perhaps in the towns this attitude becomes a little bit less, but in the country it is surely still the case. And then is the family a very broad concept. Tanzanian children often grow up with different people. So they have different people acting as their father and mother. In principal they call all brothers of their father also father and all sisters of their mother also mother. The other uncles and aunts are indeed called uncles and aunts.

But in this way all the men which occur in the same level of a family tree are brothers and all men one level higher are their fathers. To see these relations is a very strange experience for somebody coming from Europe.

There seems to be a rather strict stratification in the kinship structure. Parents and old people are respected very much. The women are taking care of the children, cooking, washing, cleaning, etc. Men are going to the job. Children help around the house when they are still rather small.

When you are coming as a guest, there is taken care of you mostly very well. You have to eat something, sometimes yourself or together with the man of the house. Women and children will not join you, but eat outside. Children when they are grown up take mostly care of their parents.

As we have seen before the people from Tanzania come from many tribes, but principles as described above are rather universal. The tribes have mostly their own languages, but all can understand each other because they talk Kiswahili all. This together with the policy aiming at unity made that the people at the moment are more Tanzanians than Chagga or Sukuma.

3.5.5. Education and health care

Education is one of the points of success for the policy of Nyerere. *Estimated is that 75% of the adults can read and write* and this is very high compared with the countries around. *Nearly all children between 6 and 12 are going to primary schools. Secondary education is less developed.* Only 5% of the children attend secondary education. There is a strong selection and since the liberalization school-fees have to be paid.

Also concerning health care Nyerere had some success. Everywhere in the country rose dispensaries, health centres and hospitals after the Arusha Declaration. At the moment 90% of the Tanzanians live at a distance less than 10 kilometres from some health facilities. From 1965 to 1988, infant mortality decreased from 138 to 104 per thousand birth, mortality decreased from 22 to 13 per thousand and live expectancy increased from 35 to 53. But also in health care there is not enough money. Salaries are very low and medicines are scarce especially in the government hospitals. In private hospitals and pharmacies, there are more medicines.

4. PREPARATIONS FOR THE FIELD WORK

4.1. The model in the Tanzanian situation

4.1.1. Introduction

In Chapter 2. a model for diffusion is given. This model is not very specific. It can be used for many innovations in many different places in the world. This study concentrates on the diffusion of innovations in the agricultural sector in Tanzania. This chapter explains what that specific area of research means for the model.

There is a lot of literature about diffusion in the agricultural sector. In Section 4.1.2. we treat some important facts from the literature. In Section 4.1.3. we confront the model with the general Tanzanian environment as given in Chapter 3. In the last section of this chapter we apply of the model in such a way that we will show about which variables of the diffusion model we can already say something in the light of the background of this study.

4.1.2. Diffusion of innovations in rural areas in developing countries

As most of the examined literature, this report pays special attention to the diffusion of innovations in rural areas in developing countries. Reasons for this are:

1. Small farmers in developing countries have often poor living conditions. To improve this situation the introduction of useful innovations is necessary.
2. The diffusion of innovations in rural areas has its own specific problems and asks for special attention to special points in the process.
3. Improving the situation of the rural poor and increasing the output of the agricultural sector are two major points to improve the situation of developing countries.
4. We wanted to do some field work ourselves in Tanzania concerning the diffusion of rural and household implements.

The fact that the diffusion of innovations in rural areas has its own problems does not mean that we cannot use the models in Section 1.2. and 2.2. The point is that we have to pay special attention to specific points and the models can even be useful to structure the problems. Looking at the model of Section 2.2. we can start with the properties of the innovation. Especially in rural areas it is important that an innovation is *compatible* with the norms and culture of the target group. A second point is the *price*. The poor farmers produce hardly any surplus and have not much money available. Also important is that innovations like farm or house implements are often so called *system innovations*. That means that introduction implies changes in the system and often the necessity of adopting more innovations.

For example, a new wood burning stove can cause a whole new way of cooking or, at least, the necessity of a new set of pans and kettles. The fourth point that makes diffusion difficult is that in a lot of cases a collective decision is needed (e.g. windmills). An innovation is meant for a group of people in such case. Of course also relative advantage, complexity, trialability and observability, as mentioned in Section 1.2., are important variables.

If we look at the properties of the users and their social system, we find some more problems. Poor farmers, as we have seen, have little money to spend. They do not like to take *risks*. They live just above the subsistence level with their own system and want to keep it. If they change something in their subtle balance, there is a good chance that if a little thing goes wrong, they fall under the subsistence level.

Often not the whole target group consists of poor farmers but also of some richer farmers. These richer farmers can afford more and adopt an innovation more easily. By this the richer farmers adopt the innovations first and get the so called *windfall profits* such as: subsidies, higher prices for produced products etc. The poorer farmers get less profit if they adopt the innovation, if they want to adopt at all at that moment. In this way the rich become richer and the poor stay where they are.

A following point, we have seen before, is the culture of the target group. This and the foregoing two points ask for special characteristics of the change agents, promoters and developers. To reach the poor, you have to develop an innovation that is compatible with their norms, values, knowledge and skills. Therefore, the developers have to be very well informed about these. The problem often is that there is a big difference between the culture of the developers and that of the target group. This bring us to an important concept. Make use of participation of the target group in the developing process. Make sure that you know the needs of your target group and try to develop innovations according to these needs. If possible, let members of the target group cooperate in the developing process. They know the norms and values of their people and if the innovation is ready, they know how it works and are probably able to repair it.

Also for change agents it is important to know about the culture of the target group. But a second thing has to be said. Change agents often concentrate on the more innovative members of the target group. They think that the others will follow automatically. In this way they reach the richer people, whilst it is important to focus on the poorer. The richer people will follow surely. Because we want to reach the least educated part of the people, training and education is often needed for successful adoption. For this reason extension services can play an important role in the diffusion process.

So far, we have treated the different actors and what seems to be important is the emphasis on the poor farmers and participation of the target group. To extend the background of this study, we will deal with a recent publication that only shortly came up until now. It is an economic evaluation of small farmers in the tropics by Rutherford (1985) edited by Jahnke. It treats the economic rationality of the small farmers and states that diffusion of an innovations has to be appropriate and attractive to farmers. It this book the following characteristics are give as likely to be important [p.28]:

1. the gain in income, or rate of return on the investment;
2. the size of the investment in relation to the current income level;
3. the complexity of the innovation, its compatibility with existing farming systems and farmers' attitudes to work, to change their diet and their way of living;
4. the risks involved;
5. the conspicuousness of the innovation, both because the adopter may attain prestige from displaying its technical progress and because other farmers will become aware of its introduction into the area more quickly.

The book does not only deal with the innovation. Also generation and diffusion is treated. Important points about extension services are presented as summarized by Benor and Harrison (1977) [p.199]:

1. There must be a single line of command from the governmental agency responsible for agriculture (mostly the Ministry of Agriculture) to the field-level extension worker.
2. Extension personnel should devote all their time exclusively to professional extension work. They should not be assigned regulatory or administrative work.
3. The work of the extension officer needs to be organized in a systematic time-bound programme of visits and training. Under this system, schedules of work, duties and responsibilities are clearly specified and closely supervised at all levels.
4. Extension efforts should be concentrated to achieve a clearly visible impact. The work should be concentrated on (a) the most important crops and livestock activities, (b) those few practices which promise the best economic results, (c) selected contact farmers, who offer the best prospects for a rapid spread of innovations and (d) the most promising areas within the district.
5. It is very important to achieve an immediate impact.
6. It is impossible to maintain regular contacts with most of the farmers directly. The focus should be on contact farmers. These should not be the community's most progressive farmers, because their situation tends to be regarded by the majority of the farmers as exceptional and not-applicable.
7. Extension must be linked to a vigorous research programme, well-tuned to the needs of the farmers. A network of field trials is required.
8. Extension has to be linked to the input supplies and credit.
9. The agricultural extension service requires a built-in process for continuous adaptation to changing circumstances, so that a sequence of innovations can be introduced.

From the nine points we see that there is more than we have mentioned before. The government of the country where the target group lives plays an important part. A good organization of the extension services is one thing it can do. Some other things are:

- subsidies;
- credit facilities;
- price regulations (e.g. minimum prices);
- export/import regulations;
- promoting collectivity (for innovations needing it).

And some general things like:

- infrastructure;
- primary education;
- general policy to strengthen the poor farmers.

The innovations in developing countries are often developed (partly) by people of developed countries with money of development aid. It is important that the government of these countries has a continuous policy. This because adoption, including complete understanding of the, technology takes time. It is important that transferring technology not only includes the introduction or giving away of technology, but also training to understand the technologies, possibilities for repairs and contacts for feed back. That this is an important point is shown by the immense quantity of rusting equipment in developing countries.

To finish the list of variables which are important and to complete the parts that exist in Figure 1.3. of Section 1.2., we take a cursory look at the international environment. This is important because of, for example, world market prices and export/import regulations.

These are often one of the reasons why small farmers in developing countries get little money for their products. Because of this the motivation to produce cash crops is not as high as it could be and the money available for new innovations is less than it could be.

Concluding, it can be said that indeed it must be possible to find the important variables mentioned in this section from the model in Section 2.2. But the problem will be: what are the important variables for a specific innovation in a specific target group?

4.1.3. The diffusion model and the Tanzanian environment

In this section we follow the sections of Chapter 3., but now for each section the importance for the diffusion model will be given.

History
The points that need attention related to the Tanzanian history are:

1. The population is a collection of a lot of different cultures.
2. As a result of the colonial period, there can be a certain level of suspicion if non-African people are concerned.
3. As a result of the *ujamaa*-policy the people have some experiences in working together.

Natural environment
Concerning the natural environment it should not be forgotten that:

1. There are very important regional differences.
2. There are, in relation with 1., different regional specializations of economic agricultural activities.

Geopolitical and social structures
For the diffusion of innovations some aspects of the geopolitical and social structures are important like:

1. The bureaucratic structures of regions, districts, etc.
2. The important power structures.
3. Communication structures which play an important role.

Institutional characteristics
Finally we get the institutional characteristics, which are certainly important and can be divided for the different institutions again.

1. **Politics** can make or break an innovation. With subsidies and other credit facilities they can help. Export and import regulation can be stimulating or counteracting. Important specifically for Tanzania are:
   - one-party system;
   - law based on English system;
   - a more liberal system after some years of socialism.

2. Concerning **economics** there are a lot of important variables:
   - low income;
   - bad transport facilities;
   - poor mass media facilities;
   - lack of foreign exchange, but an emerging free market;
   - very important agricultural sector;
   - rather small and poor equipped industrial sector.

3. The role of **religion** is perhaps not so extensive, but it is good to know that:
   - there are different strong religions;
   - they live peacefully together.

4. Concerning **kinship** it is important to remember that:
   - the family is very important for a Tanzanian;
   - there is a rather strict stratification.

5. Finally **education** of the target group is one of the variables of importance, looking at Tanzania we can say:
   - primary education is rather good;
   - the higher eduction possibilities are relatively poor.

This list, hopefully, makes it clear that diffusion problems in a certain country cannot be understood without knowing what is going on in that country. It is even questionable if reading about it is enough and makes you understand enough. Here we reach again the variable of cultural difference between the target group and researchers, field testers, etc., which can influence the diffusion process negatively.

4.1.4. Application of the model

The diffusion model as presented in Figure 2.1. is very broad and universal. Although not all innovations will follow that process and some innovations will take short-cuts, we want it to be possible that an important part of the innovations can be viewed with help of this model. Of course, it is impossible to test it immediately for the whole world, for all kind of target groups, all kinds of innovations, etc. Therefore, a certain restriction of the problem is necessary.

As mentioned before, the model will be tested for the Tanzanian situation. In Tanzania there will be a concentration on the agricultural sector. This means that our cases in the study can include agricultural implements (hoes, ploughs) and methods, household implements (knives, wood stoves), or processing equipment for agricultural products (maize mills, oil-expellers).

What does this mean for our model and the list of variables? From the literature it became clear that we have chosen a set of innovations that has a lot of diffusion problems in general. We are not treating coca cola, watches, transistors, etc., which have proved to be easier to diffuse. From our starting point we can already form a notion of some of the elements of our model. The target group will be a part of the Tanzanian farmers which live in a rather kinship based society, have little access to mass media, are widely distributed and badly accessible. They are mostly poor and the level of education is relatively low. The needs involved are mostly basic. For our research the R&D-groups are placed in Tanzania, but more than once expatriates and foreign financing are involved. This is the same for field testers and promoters. The innovations mentioned are nearly always system dependent and in the case of more expensive pieces of equipment like tractors meant for group-use.

4.2. Problem definition

4.2.1. Introduction

As we have seen this research started because of the idea that a lot of money and effort is put in the diffusion of innovation in developing countries, but that the results are often unsatisfactory. This idea must stay in mind when we are formulating the problem definition.

After all the literature research, modelling of the diffusion process and concentration on Tanzania, we have reached the moment to accurately formulate what has to be done in the field work and what we want to achieve during this field work. So in this chapter we will formulate a general problem definition, give and motivate the research questions and aim of the field work.

4.2.2. Problem definition

To find a good problem definition, that fits in a research period of six months, is not easy for our subject. There are two important reasons for this.

1. The whole diffusion process with all its elements and actors is so extensive that it is impossible to study it in all detail during a period of six months.
2. The agricultural sector in Tanzania is wide and we do not know much about innovations playing a role there.

In spite of these problems we will keep the problem rather wide, because this study will be an *inventory study* and a *preparatory study for a number of research projects* which will be executed by students at the EUT in the next five years. So it will be important that this study lays a strong basis for further research on which other students can build. This brings us to the following problem definition:

Problem definition: to build a strong theoretical and practical framework to obtain more knowledge about the diffusion of innovations and to execute a preliminary test for this model in the agricultural sector in Tanzania; both to provide a good basis for other researchers in this field.

From this problem definition immediately a number of research questions follow which will be formulated in the next section.

4.2.3. Research questions

The research questions will not ask for very detailed information on specific innovations or parts of the diffusion process. Also in the research questions the function of a basic study will be important. The research questions are as follows.

1. Is the diffusion model presented in Figure 2.1. and the list of variables good and useful for further research about the diffusion problem?
2. What are the bottlenecks in the diffusion process and which variables seem to be important during the process?
3. What happens in Tanzania in the agricultural sector in relation to the diffusion of innovations?
4. What are the subjects of research that could contribute to widen the bottlenecks of the process of diffusion and contribute to the knowledge about the process of diffusion in the agricultural sector in Tanzania?

4.2.4. Aim of research

The aim of the research consists of four parts analogous with the research questions.

1. Developing a workable model with a good set of variables to do research on the diffusion of innovations in developing countries, especially in Tanzania.
2. Finding the bottlenecks and the main problem variables in the diffusion process as given in Figure 2.1.
3. Finding innovations valuable for studying diffusion processes in the agricultural sector in Tanzania.
4. Formulating some specific subjects of research in the field of diffusion of innovations in the agricultural sector in Tanzania, with the purpose to come to a continuous research programme for the next five years.

4.3. Working hypotheses

4.3.1. Introduction

To answer the research questions and to find a good methodology to reach these answers, it will be important to have an idea what you expect to get. Therefore we will formulate in this chapter the working hypotheses. These hypotheses can be divided in two different groups:

1. hypotheses with respect to the diffusion model;
2. hypotheses with respect to the agricultural sector in Tanzania.

4.3.2. Hypotheses with respect to the diffusion model

At this moment in the research it is difficult to present hypotheses on details of the model and on the importance of specific variables. As a result of this, the hypotheses will not be very revealing, but they give a good insight in what we want with this study. First we will review the model in Figure 4.1. The shaded blocks already recieved a lot of attention in research in developing countries (see the literature review in Section 1.2.).

The following hypotheses are based on the literature research and the developed model. The first three are more general, the last one is related to what we see in Figure 4.1.

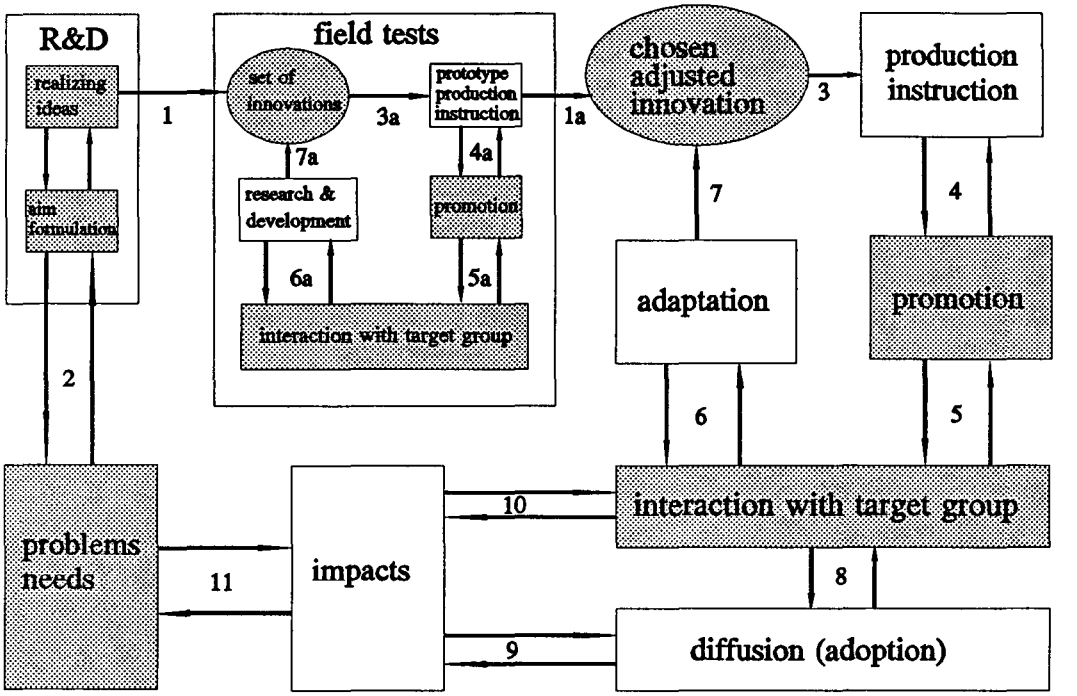


Figure 4.1. Research emphasis on the model of diffusion

Hypothesis 1. It is possible to prepare, follow and evaluate the diffusion process of a lot of innovations with the model presented in Figure 2.1. Especially innovations in developing countries eventually introduced by technology transfer from developed countries.

Hypothesis 2. The list of variables presented in Table 2.1. to 2.14. contains the most important variables playing a role in the diffusion process for most innovations, especially in developing countries. Not all variables have the same importance.

Hypothesis 3. With help of the diffusion model in Figure 2.1., in combination with the description and Tables 2.1. to 2.14. containing the variables, it is possible to indicate important variables that did not occur in literature (Table 1.1.) until now.

Hypothesis 4. Production aspects, impacts and the cyclic character of the diffusion process are aspects that are underexposed in literature until now.

4.3.3. Hypotheses with respect to the agricultural sector in Tanzania

Probably many of the variables that will turn out to be important in the diffusion process in the agricultural sector in Tanzania are specific for the situation in Tanzania. Therefore, it is good to realize that before starting the research, because it will decrease the possibility of generalizations that are not allowed. Now we list hypotheses about the diffusion process in Tanzania as far as we expect them from the country review.

Hypothesis 5. The physical infrastructure, especially roads, telecommunication, electrification, mass media channels and technical support systems, in Tanzania is rather bad. This will cause important problems during diffusion processes, especially in the rural areas.

Hypothesis 6. The financial position of the small farmers is rather bad, so innovations have to be cheap or possibilities for financing must be given for a good diffusion.

Hypothesis 7. The industrial level in Tanzania is very low, especially in the rural areas, this will present restrictions to the level of technology that can be diffused easily and it will give problems with repair and maintenance.

Hypothesis 8. The education level is relatively low in rural areas in Tanzania, which makes good and adapted demonstrations and manuals very important when an innovation is introduced.

Hypothesis 9. Innovations that need a lot of foreign exchange for their production are more difficult to diffuse than similar innovations that do not.

Hypothesis 10. Innovations that disturb the kinship structure are more difficult to diffuse than innovations that do not.

So far, the hypotheses that will be tested in this research. In the next chapter the methodology will be given for the collection of the relevant data.

4.4. Methodology

4.4.1. Introduction

Doing research in developing countries is not easy and to get reliable data is perhaps even more difficult. Also making a good plan and keeping to it is very difficult. But this is more a reason for setting up a good and detailed methodology than an excuse to forget it. This gives you a guideline and it gives other people a possibility to check your activities and to get an idea about the reliability. Furthermore, it gives them insight in where you have got problems in executing your research.

The methodology of this research can be divided in three parts which will be treated in the next sections. The first concerns the preparatory work, containing the desk work in the Netherlands with the literature review, the study on Tanzania and the finding of partners for cooperation in Tanzania. But also a first inventory in Tanzania. The second part concerns the collection of the data in Tanzania. The final part concerns the analysis of the data collected in the preparatory phase and in Tanzania.

4.4.2. Preparatory phase

Part of the results of the preparatory phase can be found in Chapters 1 to 4. Although a finishing touch had to be done after returning from Tanzania, the development of the model and getting acquainted with the Tanzanian situation was done before leaving.

After writing about 10 letters to Tanzania, it became clear that several institutes wanted to cooperate in the research, like SIDO, MEIDA and TEMDO. At the University of Dar es Salaam, we also got some cooperation and IPI turned out to be a valuable partner in Tanzania. Details about these institutes can be found in Part II.

One of the first problems was that, before departure from the Netherlands, it was impossible to make a selection of innovations. As a result of this, it took a lot of time in Tanzania to find useful innovations. On the other hand it made it necessary to study the institutes like SIDO and IPI more accurately. In the literature review, one of the remarks is that in other research not much attention is paid to this.

4.4.3. Field data collection

The data collection started with drawing up an inventory of enterprises and activities in the small scale industries and metal industries. Also information about R&D institutes was collected. Some data about Dutch NGO's in Tanzania was collected before leaving, but it did not give any projects that seemed to be useful. In Tanzania no special attention was paid to these possibilities, although we met several foreign NGO's occasionally.

After this inventory study it turned out that only 2½ months were left for the special cases. Therefore practical reasons formed an important argumentation in the selection of the cases like:

1. accessibility of information;
2. willingness of people to cooperate;
3. transport possibilities.

But fortunately in the end two cases could be selected which were in the agricultural sector and were already somewhere on their way to diffusion. Even a third related case could be added, although it could not be investigated very much in detail. All cases concern oil-pressing equipment. The details are treated in Chapter 9.

Data collection about the selected innovations was done from two sources:

1. reports and publications;
2. people.

The first source was investigated as far as possible and we were lucky that the literature sources were not so bad for my cases. For the second source three questionnaires were made, which can be found in Appendix D:

1. for users;
2. for developers;
3. for producers.

The questionnaires were discussed with a Tanzanian before using them in the field. But no test of the usefulness of the questionnaires could be made. This is perhaps a reason why the questionnaires as they are, were not directly useful. On the other hand, they formed a good guideline for a rather unstructured interview with the different groups. With the users the questionnaires were rather useful, but then you get a language problem and although you have a good interpreter and some knowledge of the language yourself, this gives again restrictions. In the contact with the users, we knew the questions by heart and asked the questions instead of using paper and writing down all the details all the time. This practice gave us the idea that the interviews were more relaxed and that it made the answers more reliable. Of course, the problem is that it costs something of your memory.

4.4.4. Analysis of the results

The treatment of the data will be descriptive. For a research like this, this is no problem. The aim of the research is to develop a theory which is mainly based on literature research. After that we want to execute a preliminary test of the model and its usefulness. This means to try if it is possible to find problems in diffusion processes with help of the model and to give explanations for these problems using the list of variables.

If we should want to use any statistical methods, we would perhaps do this with the data collected in contacts with the users. Therefore, we need a precise description of the target group and careful samples which ask for a lot of research. This can be done probably by the further research. Our cases are, as said in the foregoing section, purely selected on practical grounds and are not pretended to be representative for anything. Where we will search for, as far as possible, are common denominators of problems in the diffusion in the agricultural sector in Tanzania, which follow from the different projects. With the help of this, the model of Figure 2.1. will be examined further. It will lead to more precise hypotheses about the process of diffusion and the bottlenecks that occur in Tanzania. From this, further subjects of research can be identified. If we also want generalizations to more developing countries, the same research has to be done in other parts of the world.

PART II PRACTICAL EXPERIENCES

5. SMALL SCALE INDUSTRIES

5.1. Introduction

The research in Tanzania started with a period to get acquainted with the industrial situation in Tanzania and to find innovations for the diffusion subject. The Small Industries Development Organization (SIDO) was for this aim a good institute to start, because for nearly 20 years, it has been coordinating small scale industries in Tanzania. Also they have their own facilities for developing innovations and they are busy to try to diffuse some of these.

In this section we will treat the general activities of SIDO. After that we will treat some small scale industrial units at two Industrial Estates of SIDO, namely in Dar es Salaam and in Songea.

Facts that can be important in relation with the diffusion process in Tanzania are printed in italics and reviewed in the last section of this chapter.

5.2. Background and establishment of SIDO

At the time of independence, Tanzania had hardly any industrial base. Initial effort was directed at import substitution. After the Arusha Declaration of 1967 there was a change of emphasis to a strategy for the transformation of the economy and for self-reliance. So also the industry had to be reorganized. For this, the government established large scale parastatals. Besides this, the government issued guidelines on the establishment and development of Small Scale Industries (SSI). The important objectives were: utilisation of domestic raw materials and available technology, labour intensive production, provision of extension services, meet domestic demand and running on social principles. For the assistance of the SSI an organization was necessary.

The Small Industries Development Organization (SIDO) was established in 1973 by act of parliament No. 28 following the Party Policy Guidelines on SSI issued in April 1973. The act stipulated the following functions:

a) To promote the development of SSI in Tanzania.
b) To plan and coordinate the activities of small industry enterprises in Tanzania.
c) To carry out market research in goods manufactured by SSI in Tanzania.
d) To provide services necessary for or incidental to proper development of small industries to parastatals and other people engaged in small industry enterprises.
e) To advise the government on all matters related to the development of SSI in Tanzania.
f) To carry out research on the development of SSI and marketing of products thereof, including the standard and quality of such products.
g) To facilitate orderly and balanced development of SSI in the regions.
h) To provide technical assistance to persons engaged in SSI.
i) To provide and promote training facilities for those employed in SSI and to assist and coordinate the activities of other industries engaged in such training.
j) To provide management and consultancy services to small industry enterprises in Tanzania.
k) To undertake or assist any institution or person in the undertaking of technological research and to encourage and promote technological advancement in Tanzania.

In the first three years SIDO established a network of 20 regional extension offices. In the next two years, the extension personnel was trained and six Training cum Production Centres (TPC) were established to provide training in the skills relevant to rural industrialization.

In 1978 a small scale industries development plan was drawn up for the next five years. Because of some problems the plans could not be realized completely but in 1983 a total of 732 factory type of industrial units and 354 non-factory type of rural industrial units were set up.

At the moment SIDO has a network of 20 Regional Extension Offices. The organization owns 14 Industrial Estates (IE), each having a Common Facility Workshop (CFW), 8 TPC's and a Small Industries Consultancy and Training Centre (SICATA). In three regions SIDO is implementing estates. *Four of the existing estates have a Common Facility Foundry (CFF).* The total number of people working at SIDO is more than 800 at the moment.

The services executed by SIDO for the SSI now are:

1. consultancy, training and marketing support;
2. supply of machinery;
3. handicraft development and marketing;
4. technical support to industrial units;
5. appropriate technology development;
6. technology transfer.

These services will be treated in the next sections in some detail. In Appendix A a list of activities and facilities per region is given.

Looking at the organizational structure, we can say that every Regional Office has a Regional Manager, an Economist, a Technical Officer and other supporting staff. At the Headquarters in Dar es Salaam 100 people are working. The organizational structure of the Headquarters is shown in the Figure 5.1.

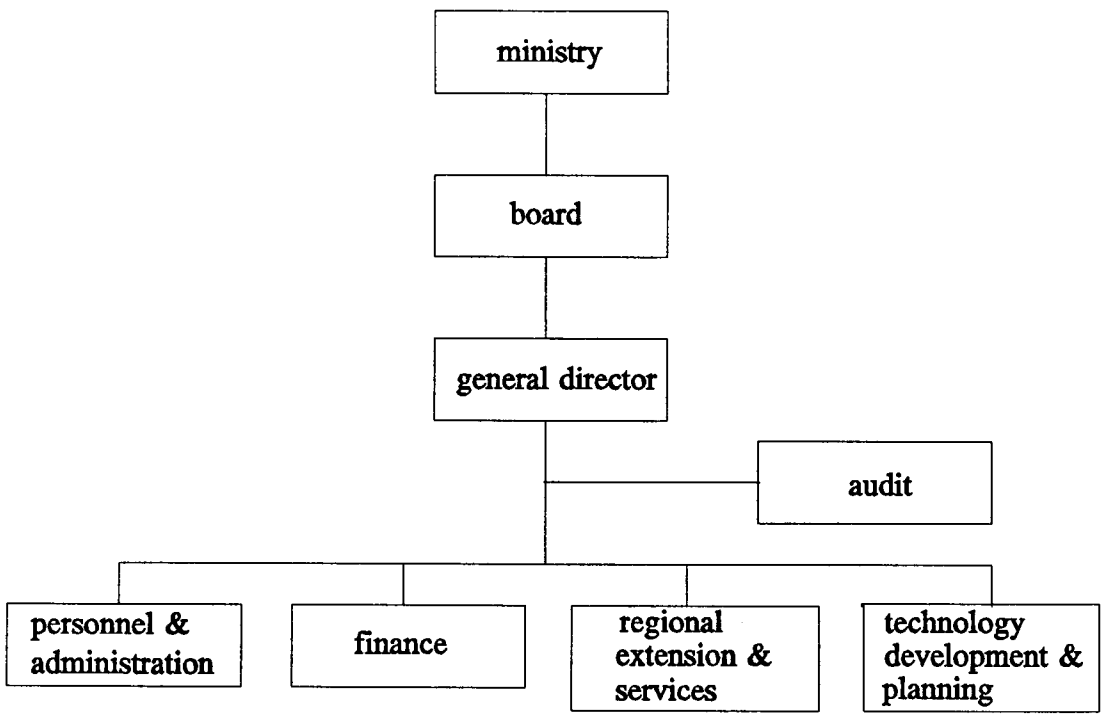


Figure 5.1. Organizational structure of SIDO Headquarters

5.3. Consultancy, training and marketing support

SIDO extends consultancy services in the field of technical, economic and, management, marketing, production and quality control, know-how and technology transfer, and conducts regular basic and upgrading multi skill training programmes, in-plant studies and techno-economic surveys.

To the economic services from SIDO belong general studies, like compiling censuses of SSI in different regions, preparing region plans and industry prospective studies. But SIDO conducts also specific ad-hoc industry studies and feasibility studies. Technical services are e.g. preparing technical profiles, building lay-outs and production/equipment designs, installing industrial units, selecting machinery and developing prototypes. But also for other problems, like managerial problems, small industrialists can seek advice from the Regional Offices.

To provide training SIDO has 8 TPCs throughout the country:

1. Tabora	weaving, metal fabrication, carpentry;
2. Dar es Salaam	tailoring;
3. Dodoma	cobblery, woodwork/joinery, metal fabrication;
4. Kilosa	oil extraction, soap making, sorghum dehulling, milling;
5. Tanga	fruit & vegetable preservation/canning;
6. Mbeya	pottery, ceramics, brick making;
7. Njombe	bamboo crafts, sisal mats and carpets, tailoring and embroidery;
8. Usangi	carpentry, metal fabrication, tailoring.

More than 3000 people are trained in these centres. Although this seems rather something, the TPCs were not very successful because they could not train the number of people that was expected and could not cover the operation costs. Last years two centres were closed, namely one for handmade paper technology in Kibaha and one for gourd crafts of artistic designs in Usseri. Also other reorganizations were necessary.

To cope with the increasing demand of training and services, SIDO started in 1983 the SICATA programme. The officers in this programme visit the different projects for studies and advices. The programme also facilitates courses to SIDO staff, entrepreneurs and people dealing with SSI policy formulation and implementation.

Marketing is also important for the success of SSI. Therefore SIDO provides marketing services like marketing research for intended products and improvement of the quality of products. Other activities are assisting in participation in national and international Trade Fairs and developing market channels for foreign markets.

5.4. Supply of machinery

Supply services involve selection and procurement of plant and machinery and raw materials (where necessary) imported and local for SSI. The most important activity is the supply of machinery on Hire Purchase basis. This means that SIDO buys machinery, locally or abroad. The enterprise, who wants to have them, has to do a down-payment and gets a loan for the rest of the amount. During the 1990s focus will be put on the promotion of smaller projects as part of SIDO promotional activities.

Under the Hire Purchase supply programme three schemes can be distinguished:

1. Urban Hire Purchase (UHP);
2. Rural Hire Purchase (RHP);
3. Micro-projects Hire Purchase (MHP).

The conditions for the different schemes can be summarized as in the Table 5.1.

Table 5.1. Hire Purchase Programme of SIDO

Scheme	UHP	RHP	MHP
loan ceiling (TSH)	18,000,000	3,500,000	100,000
down payment	10% or 25%	10% or 25%	5%-25%
rate of interest	22%	21%	21%-23%
grace period (months)	12	6-12	less than 2
maturity (years)	less than 8	3-5	

Source: (SIDO, 1991c)

For Women Projects (WP), projects under cooperative ownership, village governments and districts development corporations a 10% down payment is accepted. Other groups have to pay 25%. For the Micro-projects, the regions set their own rates within a range of 5% to 25%.

Up to June 1991 (SIDO, 1991c) about 1200 units were promoted under RHP, 160 under UHP and 283 special under WP. Since 1989 there are already 357 Micro-projects promoted. For specific numbers about regions see Appendix A.

For WP there are special regulations as mentioned before, because the position for women is more difficult than for men. In general they have less capital and more difficulties to get credits from banks. Their education is low and they need more training in e.g. basic management, bookkeeping, production and marketing skills. Women usually stick to traditional skills, because they feel more comfortable with these. The most important activities are grain milling (48%), tailoring (34%), pottery and weaving. Because everybody is doing the same, marketing becomes a problem.

The informal sector has been given high priority by SIDO. Therefore the MHP programme was started. People who want to engage in the informal sector are assisted by supply of tools, equipment and guidance on how to organize and manage an enterprise. Most tools and equipment needed can be obtained locally, sometimes import is needed. The Tools for Self Reliance arrangement has helped a number of rural artisanal groups with making available working tools at normal costs. Priority in the distribution of tools in this arrangement goes to the disabled rather than the abled, women rather than men and groups rather than individuals.

It may be clear that a number of promoted projects have to contend with breakdowns, lack of spare parts, etc. Therefore SIDO provides the Rural Projects Rehabilitation programme. A team from SIDO visits the projects and tries to rehabilitate it, if it is necessary. Since 1987 a number of 502 projects have been visited.

5.5. Handicraft development and marketing

Tanzania is very rich in skill based traditional arts and crafts. Handicrafts make a contribution to the foreign exchange earnings of Tanzania and it is a primary source of income for many households.

In 1976 a Five Year Plan for handicraft development and marketing was prepared by HANDICO, a subsidiary of SIDO. The plan included some surveys and market studies. Also financial help and help with the formation of cooperatives of artisans was included.

Still promotion of handicrafts is done by e.g. supply of raw materials, introducing new crafts, training and especially improving quality and upgrading craft skills.

Handicraft skills are:

- wood carvings, wood mosaics, wood ware;
- textiles-tie and dye, hand-screen printing on cloth, embroidery, handloom weaving;
- fibre based items, bamboo products, straw mats, bags decorative materials, horn products;
- leather products and utility varieties;
- artificial jewellers;
- pottery and ceramics;
- painting and drawings;
- soft stone ware.

5.6. Technical support to industrial units

SIDO has now in 15 regions an industrial estate. These are tracts of land subdivided into plots. The estate has provisions for roads, sewage, power, telecommunication, which are basic infrastructures for factories. The IEs are in the regions Arusha, Dar es Salaam, Iringa, Kigoma, Kilimanjaro, Lindi, Mara, Mbeya, Morogoro, Rukwa, Ruvuma, Shinyanga, Songea, Tabora and Tanga.

All the estates, except Iringa and Tabora, have a Common Facility Workshop (CFW). In Tabora the CFW is under construction and in Iringa the Iringa Maintenance Company (IMAC) and the Iringa Manufacturing Company (IMCO) substitute activities of such workshops. *These workshops provide technical and non-technical services to SSI entrepreneurs from the estate, but also from outside the estate. Activities are maintenance and repair of machinery, production of spare parts, manufacturing machines and tools for adaptable technologies.*

Besides the CFWs SIDO has four Common Facility Foundries (CFF) in Dar es Salaam, Songea, Shinyanga and Moshi (Kilimanjaro) and is shareholder of Nyanza Engineering and Foundry Company (NEFCO) in Mwanza. *These CFFs have a similar function as the CFWs, but they are specialized in casting metal spares.* A number of the estates is established with some foreign assistance, e.g. from Sweden, Hungary and the Netherlands. It seems that last years this aid has rather diminished. After 1983 some existing plans were executed, but furthermore there was not much progress in the extension of the IE programme to more regions.

In the 1990s the IEs, CFWs and CFFs have to be based on a commercial oriented entrepreneurial approach. They should be self-sustaining and even produce a surplus for other SIDO activities.

5.7. Appropriate technology development

At the IE in Dar es Salaam exists *the Product Design Cell, which is responsible for designing, development and adaptation for local use of various technologies. In the workshop and foundry machining and fabrication of the designed prototypes can be done.* Ideas normally come from studies and suggestions of the regional offices.

The following *technologies developed* by SIDO have been field tested and adapted for use: *hand grain mill, maize sheller, seed decorticator, tractor mounted maize/rice huller, hand oil press, powered sunflower oil expeller, palm kernel oil expeller, tricycles, wheel-barrows, planters, ox charts, bench vices, oil/water pumps, swivel wheels, baggage trolley, bending device, etc.* For more details about the most important designs of the production design cell, see Section 5.9.4. about the DSM Industrial Estate.

Also in other regions new technologies were developed. Concerning two of these, SIDO has been involved in two special programmes aiming at adapting and disseminating appropriate technology for manual oil pressing and sorghum dehulling.

The manual sunflower oil pressing

From 1985 to 1989 a Village Sunflower Project was conducted in the Arusha region. The project was able to establish 60 oil production units in 40 villages, producing 100,000 litres of edible oil during the 89-90 season. After 1989 the project was extended to other regions. Up to June 1991, 461 ram presses were manufactured in Tanzania. From these 368 have been sold, 355 in Tanzania and 13 abroad. The presses are sold in 18 regions, but most in Arusha (136), Singida (52) and Morogoro (40).

Last year the project faced the problem of a poor harvest. This leads to repayment problems, lower oil production and less purchase of presses.

People are working at design improvements of the Bielenberg press. There are some ideas, but it is not sure if they can give real improvements. There are some efforts to produce a smaller press. In the time coming they want to produce one with the same productivity as the big one, but easier to handle for women and children and better adapted to farmers, who just have smaller amounts of seeds to process. More about this oil-press project can be found in Chapter 11.

The sorghum dehulling programme

The Sorghum Dehulling Programme has started its first phase in 1976 as a result of the fact that the *government wanted to increase the production of drought resistance crops* in face of a lack of sorghum processing technology in Tanzania. With the help of the International Development Research Centre (IDRC) a dissemination programme was started. A first *pilot plan was started with technology from Botswana* at Chanzuru in Kilosa (Morogoro). The first market tests seem to be positive and it was decided to start phase 2.

Now *four dehullers were manufactured at the Arusha CFW* and the following four places were selected for installation of the units (place/name, (region, date of installation)):

2. Mlowa Barbarani (Dodoma, January '85);
3. Kintandaa (Singida, June '85);
4. Sumbigu (Shinyanga, November '85);
5. Isakamaliwa (Tabora, June '86).

Training for the operators was given in Kilosa and for the technical officers at the SIDO Headquarters. But there was more demand for units and with imported machines from Botswana units were started in:

6. Inganga (Tabora, March '86);
7. Wella plant (Dodoma, May '86);
8. Chibuku plant (Dar es Salaam, December '86);
9. Manengelo plant (Mwanza, December '86);
10. Msanga (Dodoma, April '87);
11. Mhenda (Morogoro, April '87);
12. Ruangwa (Lindi, July '87).

The results were not satisfactory. Several *breakdowns occurred already very quickly and the supply of sorghum could not reach the expectations.*

Phase 3 was started with a trial of *popularization of sorghum dehulling and milling technology. In May '88 a pamphlet on this was produced (3000 copies).* It was taken for distribution to the regions Dodoma, Singida, Shinyanga, Tabora, Mtwara and Lindi. In the same time units were started in:

13. Songambel (Dodoma, '87);
14. Makutupora JKT (Dodoma, '87);
15. Patri Ikora (Dodoma, '88);
16. Sanza (Singida, '88);
17. Gimagi (Shinyanga, '88);
18. Makanga (Shinyanga, '89);
19. Halid Issa plant (Tabora, '90).

In 1990 an evaluation of the popularization programme was carried out and the results were not positive. The information has hardly reached the regions and the villagers. Most units were out of use for different reasons: bad management, break downs, lack of spare parts and stolen parts. Some units did not run economically because of the lack of enough supply. This because sorghum was getting unpopular and a soft variety of sorghum that dehulls very poorly was used in some places.

The future plans for the project are:

1. *more promotion*: film, posters, radio programmes;
2. continue *monitoring and rendering services* to installed units;
3. *re-design dehuller to use it for smaller amounts;*
4. *executing an anthropological study to identify eating habits of the people, to get a better idea of the demand.*

5.8. Transfer of technology

There are tailor made programmes in SIDO which have been created to meet specific needs for effective transfer of technology and development of the SSI in Tanzania. *The technology transfer process envisages to make suitable arrangements for testing, evaluating, selecting, observing and controlling the capability for technology adoption.*

The three programmes concerning technology transfer from SIDO are:

1. Sister Industry Programme (SIP);
2. Sister Daughter Programme (SDP);
3. Triangular Cooperation Programme (TCP).

The SIP was started in 1976 in cooperation with Sweden. The purpose was to transfer technology from a Swedish Senior Sister Company to a small scale Junior Sister in Tanzania. *The transfer concerns not only buying of technology. Key persons of the Junior Sister will be trained in Sweden, by the Senior Sister. The Senior Sister will assist in the installation of the machinery in Tanzania and provides locally implementation training. It is the aim that the Tanzanians really master the technology.* Possibly one Swede stays in the company for maximal one year. Also after the first year, contacts remain between the sisters, sometimes even resulting in a Joint Venture.

At the moment under SIP, 31 projects are started and all operative. They are concentrated in Arusha, Moshi and Mbeya. Some are in Iringa and Tanga and the last one is started in Morogoro. For a complete list, see Appendix B.

One of the aims of SIP was an import substitution strategy. However, raw materials have to be imported. Sweden, therefore, gives import supply. At the moment some possibilities arise in Tanzania to get foreign currency from the government.

The first years SIDO made market and feasibility studies to identify projects. Then, with help of advertisement, they selected an entrepreneur to set up and run the enterprise. At the moment they first select the entrepreneur and he has to do, with assistance of SIDO, the studies. The machinery is bought according to the scheme.

The SDP can be seen as an extension of the SIP. Tanzanian SIP Sisters or other Tanzanian industries, which mastered foreign technology, transfer this to other Tanzanian enterprises, the Daughters. The machinery is still bought abroad, mainly in Sweden, but the personnel from the Daughters is trained in the Tanzanian Sister companies. The selecting of the entrepreneurs and the buying of the machinery follow the same process as in the SIP.

The SDP was started in 1986 and up to now eight projects are started. They are listed in Appendix B. Most of the projects face some problems in achieving the complete set of machines and raw materials. This is arranged by SIDO in most cases in cooperation with FIDE in Sweden. SIDO hands over the machinery to the entrepreneur if everything is tested and gives good results. Depending on the problems, the time between start and handing over of the machinery varies from one year to more than four years.

The *TCP* is the newest technology transfer programme. It *is aiming at a South-South transfer of technology, with help of a European country. SIDO searches with help of some European specialists in other developing countries, mainly in Asia, for appropriate technologies for Tanzania.* If in any case an entrepreneur comes with an idea, SIDO looks for an appropriate technology in Asia and appraises this to the entrepreneur. The entrepreneur will carry out some studies and if it seems feasible, the European country, until now Sweden, is asked for funds. This country delivers also consultancy services in the previous steps. *Again training accompanies the hardware in such a way that the Tanzanians can master the technology with help of the people from the delivering country.*

Conditions for a TCP project are:

1. it has to concern agro-processing;
2. raw materials have to be available locally;
3. the target market can be locally and abroad.

In October 1991 three units were working. Two in cooperation with Zimbabwe, producing sports equipment (in Iringa and Moshi) and one in cooperation with Malaysia, producing palm oil (in Kigoma). In cooperation with Taiwan and India, three new programmes are started and five others are initiated.

In the next two sections we will treat six units at the Industrial Estates of Dar es Salaam and Songea.

5.9. Dar es Salaam Industrial Estate

5.9.1. Introduction

The Dar es Salaam Industrial Estate is one of the four IEs having a CFW and a CFF. Twenty other enterprises rent buildings from SIDO at the IE. These enterprises with their most important products are:

1. Office Requisite Suppliers	file covers
2. Tanzania Spares	bolts and nuts
3. Imara Express	carpentry
4. Tanzansaws	handsaws, bendsaws
5. DDC Spectacle Frames	spectacle frames
6. Quality Shoe Laces	shoe laces
7. Sunraj Industries	(not yet started)
8. Endelea Sheetmetal	dustbins, buckets, water cans
9. Maintec, RHP programme	maintenance
10. Harona Engineering	pumps, clips, rubber pedals
11. Haraka Engineering	water tanks, water heaters
12. YMCA Bicycle Fasteners	bolts, nuts, bucket handles
13. Tanzanian Cycle Bells	cycle bells
14. Quality Engineering Metal Work	shovels, spades, brooms
15. MEIDA Maintenance Service	maintenance
16. Tanzania Electro Plating	electro plating
17. Dagets	cycle bolts
18. Pal Electrical	?
19. DDC Handmade Paper	handmade paper
20. Tricycles (run by disabled)	tricycles

The bicycle part producers suffered from the fact that the planned bicycle industry did not come up in Tanzania.

Also at the IE there are the SIDO regional offices and a Product Design Cell. In the next sections four units will be treated in detail, namely: CFW, CFF, Product Design Cell and Quality Engineering Metal Work.

5.9.2. Common Facility Workshop

Background

The Common Facility Workshop (CFW) was started in 1974/75. The CFW is owned by SIDO. The CFW is a service centre for the industries within the IE, but also for customers coming from outside. It provides technical and non-technical services. In the first years these services were free, but now the CFW has to operate as an independent enterprise, commercial charges have to be paid.

Organizational structure

The organizational structure can be described as in Figure 5.2. The CFW-manager is answerable to the Regional Manager. He has to coordinate and supervise all the workshop activities. The storekeeper is responsible for keeping in save custody raw materials, semi finished products, finished products and maintain up to date store records. The accountant is responsible for maintaining accurate and up to date accounting and financial records of the workshop. He is assisted by the cashier. The CFW-foreman is responsible for all the production matters. Nineteen production people are available for the production. After all there is a security guard which brings the total staff at 25 people.

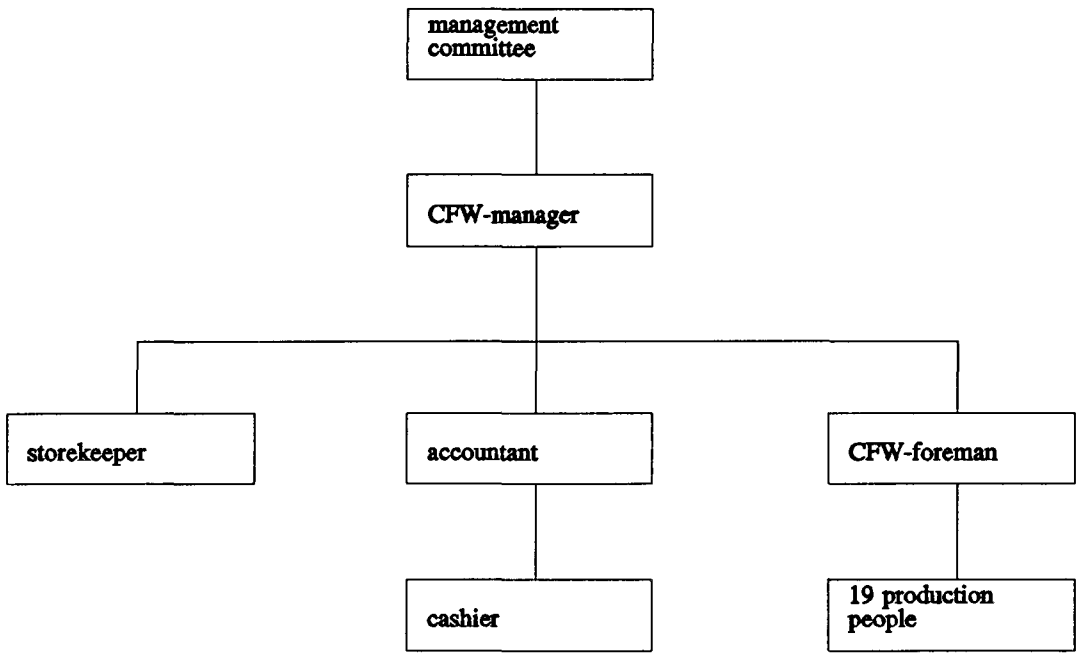


Figure 5.2. Organizational structure of the CFW at the DSM Industrial Estate

Production matters
The CFW consist of two parts:

1. sheet metal section;
2. general engineering section.

The sheet metal section is a rather busy section. They get enough jobs and the people and machinery have work enough. Machines that are available are: bending machine for bending sheets of metal, power press for punching different shapes out of a sheet, sharing machine for cutting sheets of metal, welding machine and some smaller equipment.

The general engineering section is, in contrast the sheet metal section, not a busy section. Most of the time there are no jobs and the people and the machines are not working. General engineering machines are present including 5 lathe machines.

The machinery of the CFW is never replaced and already about 17 years old. So the machines are not up to date any more and while the CFW has to act commercially, it is difficult to compete with modern machines.

The way of working is as follows. If an order is placed a job card is filled in on which all the specifications of the job are given. Including needed materials and involved costs. The foreman coordinates the jobs and requests for the materials from the storekeeper. The last one fills in the issue notes (if he gets products the received notes) and brings up to date the balance sheets. Each month the accountant compares the production with the budget targets and tries to find reasons for important divergences. Quarterly the management committee meets to discuss the situation and the problems.

Concerning the market not much activities are executed. The most important thing is to visit an International Trade Fair ones a year.

Results and outcome
The main results of the workshop are:

1. the employment of 25 people;
2. given services to small scale industries;
3. ensuring the survival of industries at the IE, with their services, although they have to be charged at the moment;
4. until the financial year 89/90 the expenses exceeded the incomes, but the last year the incomes exceeded slightly the expenses as long as depreciation was not taken into account.

The figures for costs and expenses are given for the last three years in the Table 5.2.

Table 5.2. Costs and income of CFW Dar es Salaam

(million TSH)	87/88	88/89	89/90
income	5.0	6.4	8.5
cost of sales	4.3	4.2	8.2
other costs	4.6	4.4	5.6
surplus (deficit)	-3.9	-2.2	-5.3

Findings
The workshop is a rather well equipped unit at the IE in comparison with the other units. In spite of this, the machines, especially at the general engineering section, are very under-utilized. The spare parts the CFW makes are very expensive and it faces a tough competition from private enterprises, having newer machines and working more efficiently.

Last year the results became only slightly positive, although four important measures were taken:

- prevention of unnecessary expenditures;
- employing a more qualified manager;
- seminars on the quality of products and looking for customers;
- review of prices.

After all, most earnings still come from the sheet metal section. The engineering section costs more money than it earns. Although there is a real problem to get enough jobs, there are no actions to find new markets and to attract more customers to the workshop.

Conclusions and recommendations
A workshop which wants to act as a commercial enterprise cannot afford to under-utilize machinery and labour available. So for this a solution is needed. One solution is to find activities to use the possibilities by more effective advertisement campaigns, which attract more customers. Or by finding your own sellable product in cooperation with e.g. the Product Design Cell (see also Section 5.9.4.), to produce at moments when there are no services to be executed.

A second solution is to finish the loss-making parts and restructure the workshop in such a way that healthy parts get a better change. Perhaps one could put up some new parts if after thorough market research a need for special services is found. If the workshop is afraid that some sporadic services, which are important, will be lost if it sells some machines, it can try to sell the machines inside the IE. Then the machines can be used for production of products of the specific unit and still provide the services in times when it is necessary.

5.9.3. Common Facility Foundry

Background
The Common Facility Foundry (CFF) was founded in 1977. In fact it has been some years together with the CFW, but since 1977 it became independent. Foundry machinery was supplied by GEMCO Holland. The CFF has the objective to execute foundry services to small industries, so the castings they make are mostly spare parts for small industries

Organizational structure
The CFF employs 18 people. They are related as in Figure 5.3. The manager takes care of the total coordination, getting orders, ordering spare parts, making work orders, etc. The accountant takes care of the accountancy work and makes the final accountancy overview at the end of each financial year. The foreman is responsible for all the production matters.

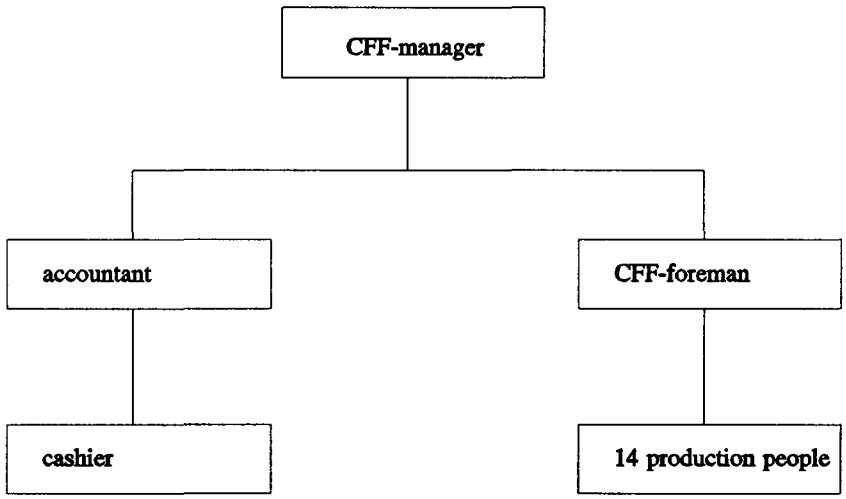


Figure 5.3. Organizational structure of the CFF at the DSM Industrial Estate

Production process
The production process starts with the pattern making. A wooden pattern is made in the shape of the needed spare part in the pattern shop. Wood, nails, thinner, etc. are locally available. Besides small tools, 5 machines are available and supplied by GEMCO in 1977: bendsaw blade machine, wood lathe machine, sand paper machine, bobbin sand machine and plaining machine.

With the pattern sand is put into the mould holders in the good shape. For a good composition and mixing of the sand, a sand mixer is available. To make great quantities of the same mould, a hydraulic moulding machine is present.

If there are enough moulds ready, which is checked by the foreman with help of the job cards, the casting material can be melted in one of the furnaces. There is one big furnace for 600 kg of material and a small one for 100 kg of material. Different materials are used, like bronze, aluminium, but the most important one is grey iron. For 600 kg is used: 300 kg of scrap (which is first broken into small pieces by a scrap crusher), 200 kg return grey iron, 100 kg of pig-iron, 10 kg glass, 10 kg of lime stone, 10 kg carbon 99% and some small additions to get grey iron. The wall of the furnace has to be covered with a reline material that has to be imported. The locally available material is of poor quality.

After melting the material pours out of the furnace in a barrel, which is pre-heated by a pre-heater. This barrel can be handled by a travelling crane to poor the casting material into the moulds.

After cooling down the sand is shaken out of the moulds with help of a shake-out machine. The waste is cut of the spare part and reused. The last sand is removed in a shot blaster machine with steel shot grains. Finally the spare part is ground on one of the two grinding machines.

Results
The first result of the CFF is that 18 people find their job in the factory. Secondly, they provide spare parts to mostly sugar industries, but also to other industries. So these get less dependent from foreign suppliers. Foreign currency is saved in this way.

Furthermore, the factory is able to make some surplus after paying salaries, rent of buildings, all other costs and after taking into account depreciation of the machinery. The figures of the last three years are summarized in Table 5.3.

Table 5.3. Costs and income of CFF Dar es Salaam

(million TSH)	87/88	88/89	89/90
income	7.3	8.9	10.8
costs of sales	3.9	3.2	1.8
other costs	1.5	6.0	5.1
surplus (deficit)	1.8	-0.3	3.9

Findings
When we visited the CFF 1200 kg of spare parts were just cooling down. It was also said that the factory gets enough jobs to keep the people busy. According to my own observations and the positive figures that could be shown, the CFF seems to be an enterprise that has the possibility to provide services to industries in a profitable way. Apparently the machines are working and small problems could be solved with help of the CFW.

Some materials have to be imported and at the moment there were some problems with the reline material for the furnace. The last time the imported material, provided by GEMCO, was another as the usual one and the people do not know how to use it. So they use local material which is of poor quality and is not as good for the furnace as the imported material. A few years ago the Dutch Aid has been withdrawn. So the CFF has to take care of its own imports. They can change local currency in foreign currency at the Bank of Tanzania.

Not many marketing activities are executed because the CFF is satisfied with its production and does not see big reasons to spend much money on this.

Conclusions and recommendations
The CFF is doing a rather good job and we think there are two important reasons for that:

1. it is one of the few foundries in the area;
2. they have some good customers.

To some points they have to pay attention, because doing well does not mean doing well for ever. They are depending on few big customers, so if one of them falls away, they can face serious trouble. Their machinery is not very complex, but if there are some serious breakdowns, it will perhaps be difficult to find good spare parts, because they do not have immediate foreign aid now.

So it is very important to use the earned money to take care of the future of the factory. First by taking good care of the market. To be aware of possible competitors and to look for customers so they are not depending on a few customers. Secondly they have to take care that their machines do not get completely out of date. Good investments in new machinery are very important, because old machines often cost money and give competitors a better change to enter the market.

5.9.4. Product Design Cell

Background
The Product Design Cell was started in 1984 with the objective to design and adapt technologies for specific Tanzanian situations. And to design products to replace those which should be imported otherwise.

The cell started with a Tanzanian technical officer and a foreign design officer. Later a Tanzanian design engineer was added, but he left after a short time. A foreign prototype engineer was added to coordinate the workshop activities for producing the prototypes. He also got a Tanzanian counterpart. After some time the foreigners left and there were only two Tanzanians. They have been assisted by another Tanzanian engineer for some time, but he has also left.

Some finished designs are: multi purpose wheelbarrow, hand grain mill, grain cleaner, bending device, bench vice, baggage trolley.

Present situation
At the moment the Design Cell has two members:

- technical officer who is able to make drawings;
- prototype engineer who is able to make a prototype after a drawing.

Furthermore, they have facilities to draw designs, like a drawing table. There are some prototypes available, but scarcely any products are sold. Some more than 100 hand grain mills are sold and some baggage trolleys are sold to the Dar es Salaam airport. But, e.g., one prototype wheelbarrow was made and then the whole process finished. To find reasons for this, two designs are examined in detail.

Hand grain mill
The first foreign design engineer had made some orientation trips in Tanzania. He found that many of the powered mills in the country were out of use by lack of spare parts and maintenance. So he got the idea to make a hand grain mill. He made some need studies and consulted the target group.

In 1985 he started the design of the hand grain mill. The result was a portable mill of about 15 kg, which can mill 3.5 kg in 20-30 minutes, depending on the human power used. The mill can be used with different pressure for more rough or fine milling and it can mill different crops like maize, millet, dry cassava and rice. The mill was intended for family use and it will be operated by women mostly. The price is TSH 20,000.

Seven prototypes were tested by women groups and other groups. Some technical improvements were made and a Kiswahili manual was provided. This because an often heard complain was that too much power was needed to operate the machine. According to the developers this could be improved by using good pressure. Also they explained that the mill was not intended to be operated whole days commercially, but just for milling your own family meal.

The technology used can be seen as simple to use. Also maintenance is not difficult. Sometimes a drop of oil and in 3-5 years changing the grinding plates, which are said to be available throughout the country.

Two main alternatives can be given. The first is just pounding. This takes much more time and costs lots of energy and is seen as a very time and energy consuming activity for the women. But it is cheaper and takes even less maintenance. The second alternative is the powered grain mill. This is much faster and can serve many people. But it is expensive and cannot be bought by one farming family. It has to be used by a whole community.

And if the mill is not situated in their village, women who want to use it often have to walk considerable distances. Furthermore these powered mills need a lot of maintenance. Up to now they have to be imported, at least the engines, and availability of spare parts is a big problem.

Although it seems to be a design that really could improve milling capacity in Tanzania and some market exists for this, only about 100 mills are manufactured and sold. *There is not much energy put in product promotion. Just exhibitions at trade fairs and a little advertisement. It is questionable if this reaches the rural areas. Also it is tried to find an entrepreneur to produce the mill commercially, but without success up to now.* A probably useful design is lying in a drawer unused.

Multi purpose wheelbarrow

In 1984 the foreign design engineer came, after some small study and observations, with the idea to make a wheelbarrow with a removable upper part. You could use it with a carrier to carry, for example, sand or a lot of small things. Secondly you could use it with just a piece of wood to carry heavy sacks etc. And finally you could use it with a self levelling upper part to carry water.

The design was made in 1984 and *one prototype was produced. It could indeed be used, where it was meant for, but the price was very high.* The advantage was that you could carry water, sacks and small things all comfortably. Otherwise you would need three wheelbarrows or carry some things less comfortably. The price of the new wheelbarrow is TSH 20,000 in comparison with the ordinary wheelbarrow which costs only TSH 8,000. A very big difference and the price of the new type could not be diminished. *Again not much promotion was done.*

The result is that no more wheelbarrows are constructed, because there were no orders. Perhaps because the price is to high, perhaps because it lacked promotion. It is impossible to say what the main reason is, because no detailed market study is done and no suitable promotion is carried out.

Findings

The Product Design Cell can be an important part of SIDO to contribute to their aim:

1. it assists the SSI by developing adapted technologies and makes them available;
2. it can contribute to the industrialization of the rural areas;
3. it can diminish the need for foreign exchange by making available, locally, products which should be imported otherwise;
4. it can contribute to the income of the CFW if they can produce and sell the products;
5. if the products turn out to be really useful for larger production, it could give reason for putting up a new industry.

Until now contributions of the Design Cell have been very limited. Only a few designs and even less sold products could be established. *The skills available are very limited. There is nobody who can develop his own designs any more. There is no input of well founded ideas, which come from accurate need-assessment studies, deciding what people need, give detailed specifications of a possible design and give a price indication what people can and want to pay for a new product.* After such specifications the study has to give an estimation of the market.

Finally, the Design Cell lacks promotion possibilities and so possibilities to reach the market. After all, this is also very difficult if they do not know what their market is.

Conclusions and recommendations

The Product Design Cell can contribute positively to SIDO and the SSI. For this, however, it needs the possibilities to operate accurately. Therefore in the first place a design engineer is needed, to develop new designs. Otherwise the Design Cell has no more possibilities than copying existing products.

Secondly, the Design Cell has to be provided with reliable need-assessment studies, so that they have exact specifications of the products they have to develop and they know that they are not making a design that appears out of the blue, but for which a real ground exists. After such study the market for the developed product will be known more or less. So the Design Cell knows where it has to test the prototypes. If after all a satisfactory product is developed, resembling the specifications from the need-assessment study, the Design Cell has to be provided with promotion possibilities. This can also be done more accurately now, because the market and so the target group for the promotion is known.

If everything works out well, it gives new products for SSI and income for the CFW and the Design Cell and also work for the CFW. These last things are especially important if SIDO wants to become financially self-sustaining.

5.9.5. Quality Engineering and Metal Works

Background

The factory was started as a cooperation with 8 founders in 1983. It was meant for producing little shovels and plastering equipment. But these turned out to be very difficult products. The price was low, about TSH 15 per piece, and the factory could only produce approximately 200 pieces per week. This was not enough to run the factory.

In 1987, six members took their share and left. Only two members stayed and they decided to change to other products like rakes, clamps and flush pipes.

Organizational structure

The factory employs 16 people, which are organized as in Figure 5.4. The manager is an engineer with experience in sheet metal work and administration. He coordinates all the activities of the factory. The secretary has Form 4 and followed a secretarial course. She does the usual secretarial work like typing, taking care of the office, etc. The cashier has also form 4 and has graduated in accountancy studies. She is responsible for payments, preparing salaries and other accountancy work. The workshop manager followed technical training and studies. He is responsible for planning of production, buying of materials and maintenance of machines. The foreman and his assistant are trained on the job for long time. They work in close cooperation with the workshop manager to realize the production.

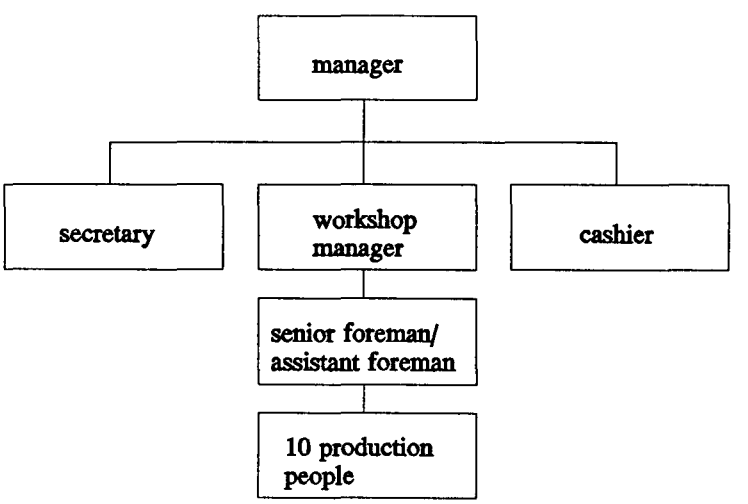


Figure 5.4. Organizational structure of Quality Engineering and Metal Works

Production

The factory has no real production line. There are only some machines available: lathe machine (for wood and metal work), sheet rolling machine, welding machine, grinding machine and a hand press. There is no shearing machine and no powered press. So for cutting sheets and heavy punching work, they have to hire facilities from the CFW or other units at the IE, which is very expensive.

All the available machines are bought second hand and already rather old. What has to be produced is decided from day to day, depending on the demand. The main products are rakes, clamps, flush pipes and trowels, but also a lot of other metal works like wheelbarrows is done, if somebody asks for it.

Some production aims and budgets are made, but according to the manager they are often out dated before the concerned period is started, because many things are uncertain, for example, costs of materials, electricity and services from other units. Also the market is very uncertain, because with their simple machines they can only make things everybody with a small workshop can make. So if the market is already flooded by rakes, they have to change to something else. If other units produce cheaper flush pipes or cheaper ones are imported, they have to make something else. There is no product they can make for which there is a stable market and they can be sure that they will sell if they just produce. So what happens, is waiting for orders and perhaps producing a little bit more than the order and store the other items until some small customers come.

Raw materials like metal sheets of different sizes, round bars, flat bars are locally available at the National Steel Cooperation.

The working situation is not very comfortable. The workshop is very untidy and warm, because of bad ventilation.

Not much effort is put in marketing. Just a little bit looking around in shops, but no search for a stable market, because according to the manager they do not have the facilities to produce something new that cannot be produced by somebody else. *On the other side not much money is put in promotion because the factory is already some years old and the customers are well acquainted with it.*

Results

The main results are that 16 people are employed at the factory and that for between 5 and 10 million TSH of metal products is supplied to the Tanzanian market. No real surplus is made. We saw the expenses and income of the last three months of 1990. There was a deficit of TSH 200,000. According to the manager the income exceeds the expenses with about TSH 500,000 in a year.

Findings

The factory is built on a very small basis of poor machines, day to day planning and diversification. They have some own products, but if customers come and demand something else, they make it. In fact they can make nothing because of a lack of some essential machines like power press and shearing machine. But with some services from other units they can make everything in a manner of speaking.

Every year the people of the factory hope that their small profit margin will be positive again and that there will be enough jobs. They have managed some years, so why not this year? The fact that the CFW has raised her prices for services, makes it not easier for a factory like this. In fact there is no money for doing investments, there is even no basis for getting loans.

According to the manager it would be difficult to improve the situation because:

1. they have no special skills, so they cannot make anything that is really a special product;
2. buying new machines is very difficult, because loans from banks are very costly and with assistance of SIDO it takes a terrible long time.

Conclusions and recommendations
As far as we can see, an industry like this will die a very slow death. The machines become worse, the competition becomes tougher and so the margins become smaller and smaller. Perhaps they can manage five more years or even ten with some help of SIDO, but without any new initiative, it cannot survive. No industry can.

If this industry collapses it costs SIDO money, because they cannot pay the rent for the building any more. So why not investing some money to find a new market, by doing an accurate market study. And to assist them in getting some new machinery which lifts them a little bit out of the mass of little workshops.

5.10. Songea Industrial Estate

5.10.1. Introduction

The Industrial Estate (IE) in Songea (Ruvuma Region) has the same function as the one in Dar es Salaam. There is also a CFW and a CFF. These two are studied in detail.

The following operating units are situated at the IE in Songea besides the CFW and CFF:

1.	Ruvuma Engineering Co. Ltd.	auto garage and general engineering;
2.	Globe Welders	general engineering;
3.	Consulting Electrical Engineer	motor rewinding and electrical installation;
4.	Hakika Furniture Mart	carpentry;
5.	Ruvuma Metric Scales	scales repairs;
6.	Ufundi Studi Workshop	maize mills, general engineering, furniture, metal and wood work;
7.	Bera General Engineering and Investments Enterprise	general engineering[1];
8.	Luxuva Motorbikes	motor bikes repair;
9.	Polykarp Augustin Gona	shoe making.

The following non-operating units are situated at the IE

10.	Ruvuma Enterprises Co. Ltd	oil mill; lack of spare parts, but is expected to work after short time;
11.	Ruvuma Animal Feed Co. Ltd.	chicken feeds; lack of management and high expenditures;
12.	Songea Aluminium Wares Co. Ltd.	aluminium utensils; lack of raw materials;
13.	Berny's Buttons, Textiles and Allied Products	acrylic buttons; manager is gone and there is no communication;
14.	Southern Tailoring	tailoring; owner is gone with everything;
15.	Luoga Bakery Unit	bread; could not pay electricity bill, but will be operating again soon.

[1] First this was a printing press, but this is not working any more. There was no market because of low quality and lack of management.

5.10.2. Common Facility Workshop

Background
The CFW in Songea is a service centre for industries at the IE and individuals and industries in the region, although there are not many industries around. The CFW consists of two parts:

1. carpentry workshop;
2. metal workshop.

Both were started in 1977 when they got the basic machinery. In 1979 and 1983 they got some additional machinery. All machinery was supplied by Dutch Aid.

Organizational structure
There are 20 people working at the CFW which are organized as in Figure 5.5. The manager is a mechanical engineer from Dar es Salaam Technical College. He takes care of the organization, personnel relations, motivation of workers, etc. The general foreman is a full technician and the two section foremen passed trade tests. Also some workers did. Furthermore, the workers get at the job training and are send to evening classes at the National Vocational Training Centre. The accountant, which is shared with the CFF, has just resigned and the Headquarters have been asked for a new one. The cashier, who has only long work experience, is doing the job now. The store keeper follows an evening course.

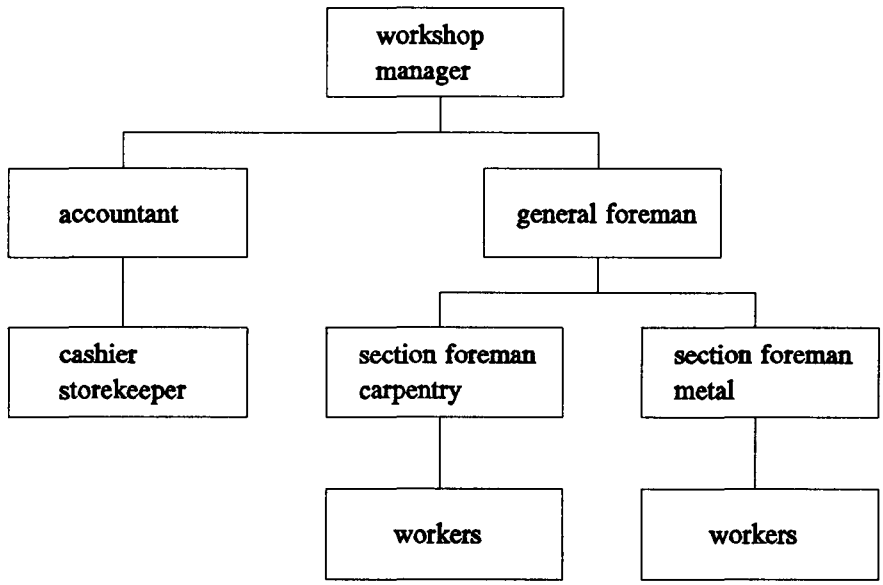


Figure 5.5. Organizational structure of the CFW at the Songea Industrial Estate

Production matters
1. Carpentry shop
The carpentry shop mainly produces on order. It makes mainly domestic and office furniture. Sometimes it makes some furniture in advance. The most important customers are parastatals and government institutions. The workshop is rather well equipped. They have the following machinery: surface and thickness machine, circular saw machine, bendsaw machine, moulding machine, wood lathe machine, crosscut saw machine, planer knife grinder, saw grinding machine, chain mortiser machine and a portable planner. The carpentry shop is in a rather difficult position because the productivity is rather low and they do not have special services. In a way of speaking everybody in Tanzania can do some woodwork, with few machinery, also for low prices. So they face serious competition.

2. Metal workshop

The metal workshop works mainly according to orders. It makes spare parts for grain mills and motor vehicles. At the moment it is producing maize mills, oil mills and maize hullers. Sometimes not on order. There is a diesel-engine repair service for Ruvuma Region in which one expatriate from Holland is working and one local engineer. This workshop is well equipped. They have the following machinery: two lathe machines, milling machine, shaping machine, some drilling machines, threading machine, welding machine, power hack-saw machine, two grinders, different bending machines, rolling machine, forging machine, grinding machine, shearing machine and a portable generator. A new power press is requested from the Headquarters, because the old one is out of order.

Results

The workshop employs 20 people. For these people they supply: lunch, milk and at some fixed times they can do their own jobs. In 1990/91 the total income of the CFW was TSH 17 million and the expenses TSH 13 million, which resulted in a surplus of TSH 4 million, which is not very much in relation with the available machinery and the people working. The CFW is in the first place important because of the services, although they are not much used because of the lack of industries in Ruvuma Region.

Findings

The workshop is very well equipped and likely to be the best equipped in the region. In spite of this, they cannot collect enough jobs to keep the people working all the time, especially in winter time. There are said to be plans for more active marketing of their services, but until now only very few is done about this. Another idea to get more work is to make some own products like maize mills and oil-presses, but the demand for these products is only few per year and maize mills are also produced by another unit at the IE. There are some other problems too. *The building is much too small for all the machinery. Raw materials have to come from very far, which makes them rather expensive. Frequently there is no electricity and the use of the generator is very expensive.* Apart from a new power press, there is no thinking about new investments in machinery. As long as there are not enough jobs this seems not to be necessary.

Conclusion and recommendations

The important thing to do, in relation with the findings, is first to search for services, which can be done especially by this workshop, because of their good machinery. Then they have to go to possible clients to promote these services. If they can combine this with a higher productivity and good quality, so they can work in strong competition with other workshops, there must be possibilities to increase turn over and surplus. It is questionable whether these extensive management and marketing activities can be done by one person, because there are in fact two workshops to be managed and two kinds of products to be marketed. Productivity and quality could probably be improved by leaving more space between machines on the work floor. This could improve working conditions and safety of the workers.

5.10.3. Common Facility Foundry

Background

The CFF in Songea was in the beginning together with the CFW. It was also meant as service centre for industries in the southern part of Tanzania. In 1984 it started to work on itself and machinery was supplied by GEMCO Holland. In 1989 the Dutch aid stopped and the manager left. After this time, a Dutch advisor worked with the new Tanzanian manager. In July 1991, the Dutch advisor left because his contract was finished and he felt he was not necessary any more.

Organizational structure

At the moment there are 10 people working at the foundry and they are organized as presented in Figure 5.6. The foundry manager has followed Yugoslavian and Canadian training and has been working with Chinese in a foundry in Tanzania for five years. There he has also got theoretical training. After working at the foundry in Mwanza, he came to Songea in 1989. He has worked in different positions in foundries. In Songea he takes care of the machinery, marketing, budget and assists everywhere in the foundry when there are any problems with machines, quality of products or anything else. The foundry foreman has only experience for some years and the workers passed national exams after obtaining some experience with foundries. The accountant, storekeeper and secretarial services are shared with the CFW and the Regional Office.

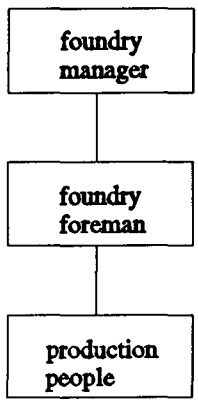


Figure 5.6. Organizational structure of the CFF at the Songea Industrial Estate

Production matters

The foundry depends on orders from the regions Rukwa, Iringa, Mbeya, Ruvuma and Mtwara. Most of the customers come from Mbeya and Iringa because there are the important industries. The most important customers are: tea factories, Southern Papermills, engineering workshops and a lot of other industries. They make a wide range of products: pulleys, cyclones for Southern Papermills, firebars for tea factories, charcoal irons, round bars, boiler parts, wood stoves, pump housings, etc. The foundry is said to be the worst equipped from the SIDO foundries. They have one crucible furnace, which can melt 100 kg per charge. Two charges are possible per day. Moulding is done by hand. Furthermore, there is a check-out machine, sand mixer, core-sand mixer, backing oven (for backing core), air compressor, pedestrian grinder, stand-by generator, bench drilling machine, a new grinder (1991), hand drill, overhead crane and two scales. Their sand-disc machine is situated in the CFW. They do not have their own pattern shop but use the carpentry workshop and for this the CFW uses the sand-disc machine. Scrap crushing is done by slash hammer. In 1989, when the manager came, the workshop was in a bad condition, but with help of the Dutch advisor they improved the situation. *They increased orders by executing some marketing activities like visiting enterprises, writing letters, making a calender and a booklet about the factory.* The use of pig iron was reduced from 10 kg per melt to 2-3 kg, which diminished their dependence on foreign exchange. The quality could be maintained or even improved. A company from Morogoro asked samples of a product in Dar es Salaam and Songea and chose for production in Songea, although the distance to Songea is much greater.

Results

The foundry provides work to 10 people. Lunch is provided and over time work for the workers is paid. The factory delivers spare parts to a lot of important industries in the southern part of Tanzania. Since 1989 its position has improved very much and in 1991 the foundry can pay all its costs and seems to make a profit comparable to that of the big foundry in Dar es Salaam. In the first three month of 1991 the surplus was nearly TSH 1 million. From July up to October 1991 the surplus was TSH 1.4 million and the turn over TSH 4.8 million.

Findings
Although the foundry is poorly equipped, it seems to be possible to produce good products and a reasonable surplus. Why can it produce as much as the big foundry in Dar es Salaam? An active marketing policy was followed which brought a lot of orders to Songea. Of course some help of the Dutch advisor was used, but also the Tanzanian manager seems to be very capable and involved in what was happening in the foundry. The people do a lot of over time work to cope with the orders and still there are some big orders waiting. Most orders are coming from far away, like Mbeya and Iringa. So it is questionable if the foundry is situated at the right place. From Ruvuma Region there are only very few orders. Because there is no automatic ram for moulding, it is difficult to get uniformity in the products because everybody uses different strength to make the moulds.

Conclusions and recommendations
It may be clear from this example that some advertisement and promotion can be very helpful to find new customers and to get more orders. But the success is just very short and there will be a lot of work to continue the results of the last months. Promotion has to be maintained and the surplus has to be used well for the creation of possibilities of increasing the quality and production. If SIDO wants this foundry to get on the way it has just started, some assistance would be welcome. There exists a danger that if somebody with some money sees the results of the foundry and tries to start his own in e.g. Iringa Region, he will have an important transport advantage. Also for the motivation of the people from the foundry, it will be good if they see that their energy put in their work results in a growth of the foundry.

5.11. Conclusions

5.11.1. Conclusions concerning SIDO

It is clear that SIDO has played a very important role in the development of SSI in Tanzania and the functions as given in Section 5.2. With the Hire Purchase programme a lot of industries were supported and the CFWs, everywhere in the country, are important. Some critical comments, however, have to be made.

If we look at the units studied, we often see that:

1. productivity is low and machines are under-utilized;
2. profit margins are very small;
3. marketing activities are not seen as very important; (The case of the CFF in Songea, however, shows that they really can help.)
4. problems with machinery, spare parts, raw materials and electrification.

5.11.2. Conclusions concerning diffusion

We now have to reflect on the diffusion model in Figure 2.1. SIDO plays a double role in the model. The Product Design Cell plays the role of a R&D-institute, developing innovations. Also in some CFWs innovations are developed. The CFWs and CFFs can be producers of innovations. On the other side SIDO occurs in the environment of the model as promoter of new industries that could produce innovations and as supplier of maintenance and repair facilities in the CFWs and CFFs. From the foregoing we can formulate the stronger and weaker points of SIDO.

Stronger points:

1. the expertise and experience to start new SSI, find entrepreneurs, import and install machinery;
2. the network of CFWs around the country for assisting SSI in the region, providing maintenance and repair services;
3. the provision of training facilities.

Weaker points:

1. difficulties in selling developed products;
2. inability to provide services at the CFWs and CFFs in a profitable way;
3. assisted entrepreneurs are not able to produce and sell their products profitably.

Looking at the Product Design Cell and the sorghum dehulling programme we can make some remarks concerning the diffusion process:

1. the need-assessment seems to be rather poor;
2. research and development facilities are poor;
3. there is few information about field tests;
4. there are problems to find producers;
5. there are problems with break-downs, spare parts and stolen parts;
6. promotion is poor or has not the intended effect;
7. the supply of sorghum is a problem;
8. management of the sorghum dehulling equipment can be a problem.

We see already that production aspects turn out to be important, although they are rather underexposed in literature.

For further diffusion research SIDO also has some innovations in the agricultural sector, which could be useful for further research. Examples are the hand grain mill, Bielenberg press and the sorghum dehuller. It is good to keep in mind the positive points of SIDO, which can be important if an innovation is brought into production and for the repair and maintenance facilities.

6. METAL INDUSTRIES

6.1. Introduction

To get an idea about the metal industries in Tanzania the Metal Engineering Industries Development Association (MEIDA) was consulted. This also to find the important industries producing agricultural implements, agro-processing technologies, etc.

In this section the activities of MEIDA in general will be dealt with first. After that there is an overview of the members of MEIDA involved in agricultural activities, as far as they occur in papers written by MEIDA (MEIDA, 1986, 1988, 1991).

6.2. MEIDA

MEIDA was formally registered under the Society Ordinance cap. 337 in August 1979. Membership is open to all persons dealing or engaged in the art of metal engineering or a related field, upon meeting entry requirements.

MEIDA has the following objectives:

1. Provide a forum for interchange of information and experience among industrialists in the metal sector and act as a link between the industrialist on the one hand and the government on the other.
2. To represent the interests of the sector in a combined forum to involve and recommend steps for development of the metal industries in the country.
3. To identify constantly problems facing the sector and evolve and recommend measures for the solutions of the problems.
4. To take an active role in the development of the metal engineering industry by promotion and investing in companies aimed at vertical and horizontal expansion of integration of the sector.

In February 1991, MEIDA had 180 members:

- 144 private metal manufacturers;
- 26 public metal manufacturers;
- 3 public holding corporations;
- 6 other institutions.

MEIDA members account for more than 90% of all production within the metal engineering sector in Tanzania.

The MEIDA secretariat is responsive to the needs and wishes of the sector. As a source or initiator of the activities, the secretariat attracts under standing and formes ad hoc committees from within the MEIDA membership. Currently they have 7 activity oriented committees:

- metal cutting;
- welding and fabrication;
- metal forming;
- metal finishing;
- foundry activities;
- air conditioning, refrigeration and electrical services;
- business committee.

Currently ad hoc committees include:

- TAMCO ancillary committee;
- ginnery spare parts manufacturers committee;
- MEIDA Habari editorial committee.

Secretariat activities are:

1. Training: a number of one or two weeks seminars is conducted.
2. Information network:
   - quarterly magazine MEIDA Habari;
   - some publications.
3. Conferences and seminars.
4. Coordination of local manufacturing of spare parts.
5. MEIDA cooperative warehouse, where industrial consumables and small equipment is stocked for sale to members.
6. Administration of import support funds.

MEIDA also has MEIDA Maintenance Services, a workshop which is located at the SIDO Industrial Estate.

Special projects and programmes in 1990 were:

- Gin Spare Parts Manufacturers;
- Dutch Aid Cotton Project;
- MEIDA Computer Services Bureau;
- MEIDA delegation to Sweden.

MEIDA gets its main income from the warehouse project, Swedish import support fund, training and other projects and membership entrance and subscriptions. The last three years the income exceeded the expenses clearly: in 1988 with 9.6 million TSH, in 1989 with 9.9 million TSH and in 1990 with 5.0 million TSH.

6.3. Metal industries for the agricultural sector in Tanzania

There are two main suppliers of agricultural implements in Tanzania which can serve the whole market if they are operating at full capacity. Both enterprises act under the National Development Corporation (NDC). They are:

- Ubungo Farm Implements (UFI) in Dar es Salaam;
- Zana za Kilimo in Mbeya.

They are producing hoes, ploughs for animal and powered traction, harrows, wheelbarrows and small quantities of other equipment. Some smaller numbers of agricultural implements are fabricated by: Vitanda Manufacturers (Mwanza), Tanzania Industries (Mwanza), Teknik Engineers (Dar es Salaam), Casements Africa (Dar es Salaam), Simon Engineering (Moshi). Finally Tanzania Mechanical Engineers Cooperation (Dar es Salaam), makes sisal knives.

Agricultural processing machinery is developed and produced by the following enterprises and institutions: IPI (Dar es Salaam), TEMDO (Arusha), CAMARTEC (Arusha), Jandu Industries (Dar es Salaam), Hanspaul and Sons (Arusha), Mang'ula Mechanical Machine and Tool Cooperation (Mang'ula, Morogoro), SIDO CFW Arusha, SIDO CFW Mbeya, Metal Industries (Dar es Salaam), United Engineering Works (Arusha).

Machinery which is produced includes: grain mills, hullers, shellers, oil-pressing equipment, sugar cane crushers, chips making machines. Some machinery is powered, but there are also manual types.

In Dar es Salaam there are some farm trailer manufacturers: Burn and Blane (T), Pan Africa Enterprise, State Motor Corporation (import), Trailers and Low-Loaders Manufacturing Company.

For tractors in Dar es Salaam there is the State Motor Corporation and the Tanzanian Motor Services Company, which take care of importing and distributing tractors and farm equipment. Tanzania Tractor Manufacturers Company can manufacture about 1000 tractors a year. They also have some implements (ploughs and harrows). The Tanzanian Automobile Manufacturing Company has a factory for assembling tractors.

It is likely that we now have included the most important manufacturers out of the metal industry of farm equipment, but nothing can be said about production of small workshops throughout the country, because all this information comes from the MEIDA publication (MEIDA, 1988), which includes only MEIDA members. Also the publication is only updated until 1987. As far as MEIDA was concerned, no more data were available.

6.4. Conclusions

From the small amount of information we got at MEIDA, it is difficult to make a judgement about the association itself. Only the fact that it has a lot of members may indicate that it has at least a positive impact.

In the diffusion process MEIDA stays in the environment. Of course, it can have its influence on producers of innovations and help to get foreign exchange to get machinery and raw materials from other countries.

At MEIDA we failed to obtain many useful data. From what we got it was concluded that the two big farm implement producers were not so interesting. This because they produced implements that have already be in existance for a long time and we did not get the idea that a lot of innovations came up there.

Furthermore, if we exclude tractor and trailer manufacturers, it could be said that the activities in the agricultural field in Dar es Salaam were not very intensive. One interesting institute was left, IPI, and around Arusha there are some interesting activities especially in the field of the agro-processing.

7. INNOVATION INSTITUTES

7.1. Introduction

Until now most attention is paid to production and industries. From the diffusion model we have seen that also the R&D part is very important. In Dar es Salaam one of the main institutes is IPI. We spend quite some time with IPI.

Another place for development of innovations is the SIDO Product Design Cell which has already been dealt with in Section 5.9.4. In this section will be treated further more TEMDO and CAMARTEC, which were visited shortly.

7.2. Introduction on IPI

7.2.1. Background and history of IPI

IPI was started after an agreement in 1979 signed by the governments of the United Republic of Tanzania and the Federal Republic of Germany. Three expatriates of the Faculty of Engineering (FoE) from the University of Dar es Salaam (UDSM) were selected for the first implementation phase. In 1981 two graduated engineers from FoE joined the expatriates team. In August 1984 a crew of 30 Tanzanians and 5 Expatriates moved into the new premises, a building with a workshop, engineering offices, administrative offices, seminar rooms, a library, a photography unit and a drawing office.

IPI was established under the University of Dar es Salaam Act of Parliament of 1970. The aims and objectives of the institute are stipulated as follows:

"The Institute shall be linked between the FoE and Tanzanian industry in order to foster the mutual utilization of knowledge and facilities. Three main objectives are:

a) Product innovation up to prototype production and subsequent transfer to a suitable industry.
b) Consultancy and services to industry.
c) The Institute will supply curriculum advice to FoE through its feedback from industry.

Close cooperation between IPI and FoE is presumed in all above mentioned aspects but individual technical developments on either side shall not be excluded."

7.2.2. Organizational structure

In the year 89/90 the staff has grown until 61 permanent members, containing two expatriates. They were organized as in the Figure 7.1. (IPI, 1990a).

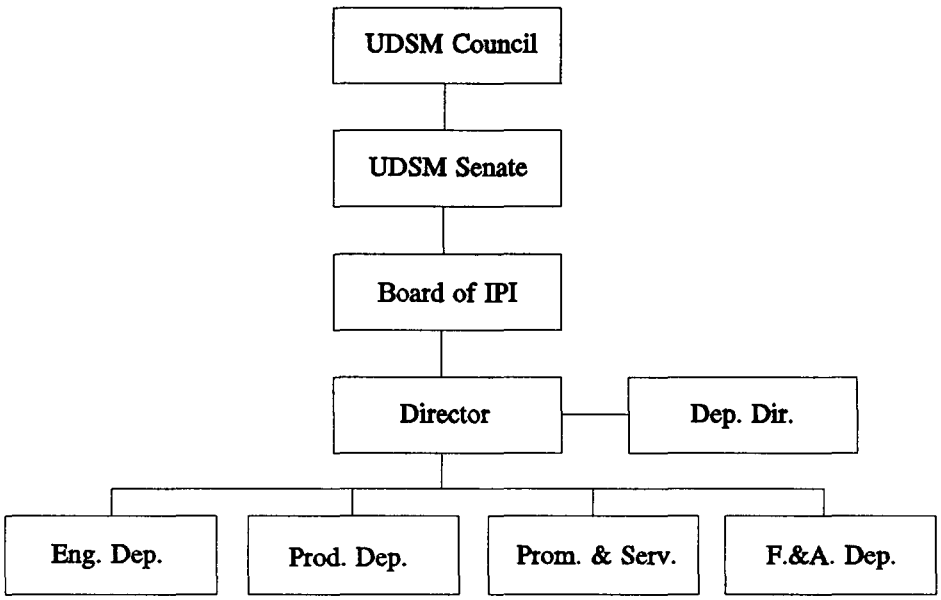


Figure 7.1. Organizational structure of IPI

The Engineering department consisted of 12 graduated engineers, three draughtsmen and a secretary. The main activities can be classified as follows:

- Research and development;
- Engineering consultancy projects;
- Service to industry jobs;
- Training assignments.

The Finance and Administrative Department consists of three sections. Administration, Accounts and Stores and purchases. The department employs 20 people. Four people graduated in accounts and some others followed courses. Also 10 drivers, messengers and cleaners are included.

The Production Department is meant for manufacturing of:

- Prototypes for the Engineering Department;
- IPI-developed products in small batches for field tests and sales;
- Custom tailored equipment for sale;
- Sophisticated spare parts for industries.

The two main sections are the Mechanical Workshop and the Electrical and Maintenance Workshop. The permanent staff members vary from highly qualified technicians, also trained abroad, to artisans. In total there were 18 people working in this department.

The Promotion and Services Department acts as the interface between IPI and the clientele. The Promotion Section was set up to focus on market research, advertising, extension, training activities and promotion consultancies. The Sales Section is concerned with the sales of serial products and unique customers. The Service Section is closely linked to the others and is set up to coordinate the provision of technical information and expertise. The department consisted of 5 members of which there are 3 graduated.

At the end of 1991 the number of permanent staff members had grown to 67 (IPI, 1991).

7.2.3. Financial consideration

IPI was started originally with help of German development aid. The Institute was set up with help of the German Agency for Technical Cooperation (GTZ). In 1984 IPI needed, to overcome the recurrent budgets, to embark into commercial activities like sales of marketable prototypes, services to industries and custom tailored products.

Last year re-orientation started towards more R&D. Prototypes are sold to pioneer customers, who will spearhead the promotion of the technology by serving as demonstration, testing and training sites. This makes emphasis on revenue earning R&D necessary. The sugar technology programme, which is the most important programme at the moment, is an example of this. It is for a large part financed by SUDECO (Sugar Development Corporation).

The financial realization for the year 90/91 was as presented in Table 7.1.

Table 7.1. Financial realization of IPI in the year 90/91

Revenues	Sales of products Services to industries Consultancy fees	19.5 10.9 1.0	million TSH
Other income	UDSM (including salaries) SUDECO (for sugar project) GTZ Other	8.9 9.5 1.7 3.7	
Total income			55.2
Costs of sales Operating costs		16.5 32.4	
Total costs			48.9
Surplus			6.3

Source: IPI, 1991.

7.2.4. Realized innovations and diffusion problems

The most important innovations realized by IPI are given in the following list:

1. animal feed processing equipment;
2. grain mills and hullers;
3. ethanol distillation column;
4. centrifugal water pumps;
5. wind water pumps;
6. solar refrigerator;
7. oil-processing equipment;
8. sugar producing equipment.

IPI also developed a lot of other innovations as a result of services for industries. Like vibrating block making machine, book binding nipping press, sea weed press, circular saw mill, etc.

According to its own experiences IPI mentioned the following factors that hinder diffusion of technologies developed in R&D-institutes in Tanzania (IPI, 1990a):

- release of immature products;
- incomplete information on the technology;
- low level of technical know-how of the end-users;
- lack of partners to take over the technology;
- failure to maintain standard products due to unavailability of materials;
- competition with existing and imported technologies;
- poor communication infrastructure;
- cumbersome bureaucratic procedures;
- local differences in technological development;
- poor financial position of R&D-institutes;
- poor financial position of end-users;
- difficulty in obtaining loan from lending institutes;
- unrealistic plans by aid-organizations;
- changing economic conditions;
- resistance to new technologies.

7.3. Other institutes

7.3.1. CAMARTEC

The Centre for Agricultural Mechanization and Rural Technology (CAMARTEC) was established by an act of Parliament in 1981. The centre is to improve quality of rural life through development, adaptation and implementation of appropriate technology in the fields of agricultural mechanization, water supply, building construction, sanitation, rural transport and energy.

CAMARTEC is a parastatal organization under the Ministry of Industries and Trade. It is in principal financed by the Tanzanian government. At the moment they execute a special energy programme with help of GTZ. One expatriate is working at the centre. CAMARTEC is situated 16 km from Arusha municipality. The functions of CAMARTEC include:

1. To carry out applied research designed to facilitate designing, adaptation and development of machinery and equipment suitable for use in agricultural and rural development.
2. To develop and manufacture approved prototypes, components, cultural techniques and technologies, and evaluate their suitability for local adoption.
3. To adopt foreign designs of agricultural machinery and equipment to suit local conditions of manufacture and maintenance.
4. To perform tests on all types of machinery and equipment intended for use in agricultural and rural development in Tanzania and to publish their results.
5. To conduct short training courses designed to provide practical training and knowledge to village communities in the use and maintenance of agricultural machinery and other appropriate technology devices.
6. To offer consultancy services on the designing, testing and other technical aspects of agricultural mechanization.
7. To act as national link with other national and international institutes engaged in activities related to the functions of the centre (CAMARTEC, 1991).

CAMARTEC has developed quite a number of technologies in the field of agriculture. They provide also field training and consultancy services. They manufacture some of their own products. Products developed or adapted range from ploughs, planters to biogas designs and from ox carts, wheel barrows to water pumps.

Looking around at CAMARTEC there was a clear sign of activity. Unfortunately at least two days per week they had no electricity. On these days the workers get theoretical training. Other days production and development are going on in the rather well equipped workshop. Most designs gave the impression to be simple but useful.

7.3.2. TEMDO

The Tanzania Engineering and Manufacturing Design Organization (TEMDO) was established through Act of Parliament No. 23 of 1980. It would promote the development of machine design capabilities in the country. The establishment of TEMDO was funded by the Tanzanian Government and the United Nations Industrial Development Organization. TEMDO is a parastatal organization. The functions of the organization can be summarized as follows.

1. To design and to promote the designing of machinery and equipment required in various sections of the national economy.
2. To adapt foreign designs of machinery equipment and spare parts for manufacture in the country.
3. To design tools, dies, jigs and fixtures required by the industrial sector.
4. To provide technical support services to industry aimed at raising production and capacity utilization of installed production equipment and facilities.
5. To give an on-the-job training to engineers, technicians, draughtsmen and artisans in design and production so as to increase the skills of technical manpower at all levels and establishments and enabling industry to produce machinery equipment and spare parts for mass marketing.

At the moment TEMDO has a small workshop. Initially they had no workshop at all. Their designs seem to be slightly more advanced than the CAMARTEC designs. Most are using motors. Some of the designs are: centrifugal pump, paddy thresher, oil expeller, sugar cane crusher, grain cleaner, maize sheller, animal feed mill and mixer, small scale soap plant, car trailer, bicycle trailer, fly press, wood planer and saw, sheet shear, roller and bender, hydraulic crane and hydraulic pipe bender. They have also completed a couple of consultancy jobs. For designing they have a CAD/CAM system which is one of the stronger points of this organization.

7.4. Conclusions

Although not all innovation institutes are treated in this chapter, some of the most important are included. All these institutes occur, of course, in the diffusion model as R&D-institutes. We shall treat them here separately to fit them more precisely in the diffusion model.

IPI is a very advanced institute in the Tanzanian context. It is able to make rather advanced machinery. IPI is not only busy with the development of innovation. The people from IPI do their own field tests and they also do some of the production to earn some money. Money is one of the problems for IPI. The institute could not concentrate all the time on development work, because it had to earn money with the production of well going innovations like maize mills and animal feed processing equipment. At the moment IPI tries to get more financed research projects. Another problem is that IPI is situated in Dar es Salaam which makes the after-sales service difficult because of the large distances to the users. IPI has experienced itself a lot of constraints for diffusion of their innovations. They are presented in Section 7.2.4.

TEMDO has its own strength in their design facilities, although the institute in other aspects has some limitations. TEMDO had its own testing facilities only for a short time. Before that it was a pure design institute. The visit at TEMDO was too short to get an idea about their diffusion problems.

CAMARTEC has very extensive construction and production facilities and seemed to be a rather active and running institute. They produced, like IPI, series of their own developed innovations to earn money. So also CAMARTEC we can see as researchers, field testers and producers. They really sold considerable quantities of wheel barrows, ox-carts, planters and other innovations. They had the problem that the target group, rather poor farmers, lives very widely distributed, so it is difficult and expensive to reach a lot of people because of transport. CAMARTEC is concentrating on cheap and simple technologies, more than IPI and TEMDO.

The three institutes together with TIRDO (Tanzanian Industrial Research and Development Organization) want to start a closer cooperation, something that seems to be very reasonable, but because of organizational and financial reasons it did not get off the ground very well.

8. OIL PROCESSING IN TANZANIA

8.1. Introduction

This section deals with the diffusion of oil processing technologies in Tanzania. Developers, producers and users are visited. Also some literature is studied. The most important studied technologies are the Bielenberg press and the IPI oil processing equipment. Also something is said about powered oil expellers. Furthermore, the oil processing possibilities per region are studied.

8.2. History of the oil-extraction technologies in Tanzania

At the end of the 70s and the start of the 80s, there was a significant shortage of edible oils in Tanzania. At that time in Tanzania one found large scale industries in towns, mostly producing oil from cotton seeds. Because of infrastructural problems this oil hardly reached the rural areas. In the rural areas women produced small amounts of oil for home use by a very labour intensive traditional kitchen method. They used different kinds of seeds like: sunflower, coconuts, groundnuts and sesame.

In 1982, IPI started the development of a manual system for oil extraction in villages which was aiming at a much higher production than the traditional method.

In 1985, SIDO started to import power driven expellers. The first three came from India as part of the Indo-Tanzania programme. They imported also one more from India and one from Japan in these early years. After this, they changed to two types of expellers from Europe: the Simon Rosedown Mini 40 from United Kingdom and the Komet Twin Screw Expeller from Germany.

In 1985, IPI had about 12 sets of manual equipment in the field, while KIT (Royal Tropical Institute in the Netherlands) had one manual system in the field. The IPI-equipment in that time had as pretreatment only: decorticating and preheating. The KIT-process also had size reduction and moistening. It became clear that the KIT process reached a much higher productivity than the IPI process, even without using as much pressure as the IPI process. After this study, IPI adapted its equipment in the direction of the KIT-equipment. After this the total equipment existed of a decorticator (manual/electric), a winnower (manual/electric), a crusher or roller (manual/electric), a scorcher, a press (20 ton/80 ton) and a boiling stand.

Also in 1985, the Village Sunflower Project started which wanted to use a much smaller and cheaper kind of equipment than the IPI equipment. Mr. Bielenberg developed the Bielenberg press which can press soft-shelled sunflower seeds without much pretreatment (cleaning and warming in the sun). The first results made clear that the press was rather difficult to operate. This was improved in the Bielenberg-Fischer model. Later, people from CAPU in Lushoto made a cheaper version using more wood and less steal. This version is mainly disseminated in the Village Sunflower Project which was taken over by SIDO under the name Village Oil Press Project (VOPP).

At the moment still a lot of activities are going on. Firstly, we look at the powered expellers. SIDO has until now imported about 30 medium scale expellers and goes on with this even more extensively than before. Besides, there are a number of privately imported expellers in the country. TEMDO and some manufacturers, like Themi Farm Implements Arusha and Iringa Manufacturing Company (IMCO), are developing and selling expellers, although the number of these expellers is still rather small (TEMDO has sold about 10, Themi 2) and they are very new.

Secondly, there are about 60 sets of IPI manual sunflower oil processing equipment in the field. Because of the high price and the stiff competition of the Bielenberg press, the production and selling is stopped at the moment. IPI tries to develop new ideas, like a powered Bielenberg press. In cooperation with the Natural Resources Institute (NRI), IPI will also be working at the possibilities of oil pressing equipment for coconuts.

Thirdly, there are nearly 500 Bielenberg presses in the country. The development of the Bielenberg press is still going on. CAMARTEC has succeeded to make a smaller version which can be operated by women, is cheap (TSH 25,000) and easy to manufacture (a lathe-machine is not needed anymore). CAMARTEC also simplified the big version so that the lathe-machine is not needed anymore for manufacturing. The costs are reduced from TSH 60,000 to TSH 35,000. From 1992, the SIDO Village Oil Press Project starts the third phase. They are going to promote the CAMARTEC versions of the Bielenberg press. The activities of the project will be extended. The regions Mbeya, Ruvuma, Rukwa and Morogoro are added to Arusha, Singida, Dodoma and Iringa.

8.3. Description of different technologies

This section deals mainly with the IPI manual sunflower oil-processing equipment, referred to as IPI-equipment and the Bielenberg press. Other technologies will be treated briefly. Sketches of some elements of the equipment are presented at the end of this chapter.

8.3.1. IPI-equipment

Before describing the development of the IPI-equipment, we show IPI's 'ideal' development flow diagram which has grown from their own experiences (Gordon, Swetman and Treasgust, 1991). According to this the development process is split up in 15 steps:

1. recognition of a need;
2. specification and requirements;
3. feasibility study;
4. creative design synthesis;
5. preliminary design;
6. detailed design;
7. prototype production;
8. preliminary testing;
9. prototype testing;
10. zero series production;
11. field tests;
12. review specifications and requirements;
13. design for production;
14. subsidized product release with promotion measures;
15. commercial production.

Of course, this process is not straight forward but frequently information has to be fed back into earlier steps. For example, if prototype testing is not satisfactory, one has to go back to one of the design stages. Or, if at a step no review is possible any more, or financial or other problems arise, the process can be stopped completely.

Development of the IPI-equipment

If we review the development of the IPI-equipment, we cannot say that it has been executed according to the 'ideal' flow diagram. That there was a need for oil in the early 80s, when IPI started the research, was very clear. That the situation in the villages was especially bad was also known. But after this was observed, a detailed set of specifications and requirements was not compiled. IPI started designing after getting an inquiry for a press, assuming that the people who made the inquiry had done a feasibility study.

First only a press was developed, but no oil could be extracted. Also after increasing the pressure, results were not satisfactory. So IPI started to develop a decorticator to hull the sunflower seeds before pressing. This increased the oil yield considerably. Although the equipment was still far from perfect and adequate testing had not been executed, two sets of equipment were supplied in June 1983 and the designs were given to Themi Farm Implements Arusha for manufacturing. In Dar es Salaam the manufacturing of 15 sets of equipment was subcontracted to a manufacturer, but the sets turned out not to be manufactured according to the specifications.

The research was going on and in 1985 it became clear, after a comparative study between the KIT (Royal Tropical Institute) manual oil processing equipment and the IPI-equipment, that the pre-processing of the seeds is very important (KIT, 1985). Therefore, a winnowing element was added to the decorticator. A scorcher for cooking the seeds was developed. After a roller for crushing the seeds was added, the yields became really good.

By the end of 1985, the financial pressure on IPI grew to an extent that they started to produce large series of equipment to earn money before good field-testing was executed. Rather a number of bottlenecks were discovered and corrected later. At the end of 1988, about 40 sets of equipment were in the field and from the feedback the weaknesses became clear. (There was perhaps a gap in the feedback, because it came mainly from clients coming back to IPI with problems and some women groups which were monitored more closely.) The main weaknesses were:

- the decorticator was tedious to operate;
- the rollers of the roller were wearing very fast;
- the scorcher was not hot enough in cold areas;
- the spindle-nut at the press was wearing;
- no boiling stand was provided for purification.

After this, the whole set of equipment has been reviewed. A new impeller at the decorticator, a separate winnower, a modified scorcher, a lighter roller and a smaller version of the 80-tons press were provided. Also a 40-ton tandem press was developed and a boiling stand was constructed. At the moment, however, the material costs of the whole equipment are so high that the equipment has become very expensive for a manual system.

Description of the equipment

At the moment the IPI-equipment consists of the following parts:

1. The decorticator: the seeds are fed first in the decorticator to remove the husks from the kernels.
2. The winnower: the husks and seeds are separated in the winnower.
3. The roller: the kernels are crushed in the roller.
4. The scorcher: water is added and the mixture is cooked in the scorcher. The stove is constructed in such a way that the husks can be used as a fuel.
5. The press: the warm kernels are put into the press now, where they are pressed together and the oil is coming out.
6. The boiling stand: finally the oil is refined in the boiling stand, for this a husk stove is used again, salt and water is added.

From field experiences it is clear that up to 480 kg of seeds can be processed in a 8 hours working day. After winnowing there are about 280 kg of kernels left. The oil you get from these seeds depends on the quality of the seeds. It can reach up to 120 litres collected in between 14 and 16 batches of pressing. This gives also about 170 kg of seed cake.

At the moment the price of the total equipment is about TSH 750,000 and there are about 60 sets of equipment in the field, from which a considerable amount is bought by NGO's for women groups and other cooperative societies.

The field experiences in this report are collected from visits to six villages with women groups operating the presses in Iringa Region. Four in the district Njombe: Mung'ereng'e, Luduga, Mayale and Uhenga; two in the district Iringa Rural: Magubike and Nyamihuu. In the following part the general problems that became clear from the field visits are listed.

1. Supply of seeds. The women groups face real problems to get seeds and to find funds to buy seeds when they are cheap. Seeds are cheapest in June and July, say TSH 1200 per bag (50-60 kg). When we visited the villages in February only 3 out of 6 groups had still seeds and the price had gone up to TSH 3000-TSH 4000. Mostly close to Iringa town, the women faced stiff competition from the large scale oil mills which were buying the seeds in the cheap period. In this period the women could not buy a lot of seeds due to a lack of resources. At the high prices the women had to pay at the moment of the visit, it was hardly profitable to press, because the price of oil did not go up as much as the seed price in the same period. (From TSH 150 to TSH 250 per bottle (±75 cl).) Most groups also tried to grow their own seeds, but the last two years the results were very bad due to a shortage of rain.

2. Technical problems. For spare parts the women groups are still depending mainly on IPI and although the groups are visited rather frequently this causes some problems because the distance is very large. That is why IPI now tries to find capable workshops in the region and to train people from these workshops so that they can make spare parts. The main technical problems mentioned were:

   - Decorticator: in different places we found backlash in the gearbox because of loose bolts, worn out driving shafts and worn out bearings. Furthermore, the decorticator was generally said to be heavy to operate.
   - Winnower: the winnower generally caused no problem. Only in one place they had problems: the feed pipe was loose and the winnow plates could not be repaired because the chamber around these plates was welded on the machine. The winnower was considered to be easy to operate.
   - Roller: the main problem with the roller was that the profile on the rollers wears out very quickly and for knurling the rollers have to come to IPI. In some places the roller was considered as heavy to operate.
   - Scorcher: generally there were no problems with the scorcher, only in the stoves the grill has to be replaced when worn out after some time.
   - Press: different problems occurred with the press, like a cracked spindle, worn out spindle nut, broken press cage. The press was everywhere considered as easy to operate.

3. Selling problems. At most places where there was a good production, the women had a problem to sell the seed cakes. Only in one place, which was situated just near the main road, the women had some problem to sell the oil due to competition from larger scale producers.

4. Financial problems. As mentioned, to get funds for buying seeds at the right moment is a problem. Then, three groups did not repay a considerable part of their loan until now, while there are left only between three and six months for the repayment.

5. Management problems. Although these problems were not discussed in the different villages, it became clear from discussions with people who have been following the women groups rather closely, that the management in various cases was and is a problem.

6. Religious problems. In one village the women were really afraid in the beginning that they could not get pregnant any more after operating the machines. After bringing them to other villages to show them women who got pregnant after operating and to let them talk together, they started operating.

Financial considerations

The costs of the total set of IPI-equipment at the moment is TSH 750,000. Then there need to be a building. From the field visits it became clear that you have already a good production if you reach four bags per day for 200 days a year. Because of the price differences all over the year, financial analysis are very difficult. Seed prices vary from TSH 1200 to TSH 4000, but let us put it on an average of TSH 2500 per bag. Also the price of oil varies from TSH 200 to TSH 400 per litre. We assume an average of TSH 300. Seed cakes cost everywhere TSH 50 per cake and you get eight cakes from one bag. (Also for other equipment we will count the price of cakes TSH 400 for what you get from one bag.) Labour costs also differ very much. It varied from some payment per day to food allowances. If we take the costs really high we can say that six people are working for TSH 200 a day, handling four bags. An average yield of oil is about 13 litres (varying from 10 to 15) per bag. We can now compute the variable costs per bag and the income per bag. The figures are given in Table 8.1.

Table 8.1. Variable costs and income for processing a bag of oilseeds

costs	seeds	2500	income	oil	3900
(TSH)	labour	300		cake	400
		2800			4300

This means that from TSH 1500 per bag you have to pay water, salt, maintenance, repairs and you have to repay the loan. That means that if we do not calculate interest and investment for building and working capital, you still have to process between 500 and 700 bags for repayment of the equipment. This means nearly one year production. But then, if you want to buy the 800 bags needed in the cheap period, you need a working capital of about TSH 1,000,000. This is very much if you know that the best working group we visited had about TSH 300,000 after 3.5 years of operation and that these groups started with a loan of TSH 270,000. (In 1988, the equipment cost TSH 150,000.) After all, we can now calculate the costs and income for a group if they get a loan of TSH 1,500,000, which has to be paid back in 3 years without interest. The figures are given in Table 8.2.

There is still some surplus if this production can be reached. But if the cakes are not sellable and there is no possibility of a soft loan it becomes already difficult. Also striking is the calculation given in Table 8.3. If you only build a shed, say for TSH 500,000, buy 800 bags of seeds in the cheap period, stock them and sell in the expensive period.

At the moment it is not even clear which investment is more profitable, investment in IPI-equipment or just in sunflower seeds. Of course, all these calculations will be affected every year by the availability of seeds that year in the country, the availability of oil in the country and note that if you invest in oilseeds you still do not have oil in the villages.

Table 8.2. Cost and income calculation for the IPI-equipment

costs	seeds	2500×800	=	2,000,000	(TSH)
	labour	300×800	=	240,000	
	loan		=	500,000	
	other (maintenance etc.)		=	100,000	
					2,840,000
income	oil	3900×800	=	3,120,000	
	cake	400×800	=	320,000	
					3,440,000
surplus					600,000

Table 8.3. Cost and income calculation for buying and selling oilseeds

costs	seeds	1200×800	=	960,000	(TSH)
	loan		=	500,000	
					1,460,000
income	seeds	3000×800	=		2,400,000
surplus					940,000

8.3.2. Bielenberg press

Development of the Bielenberg press

In 1985, C. Bielenberg started the development of a new press at CAMARTEC in Arusha, after he had got the task to evaluate the IPI-equipment. This equipment seemed to him too expensive, too bulky and too tedious. So he started with some Tanzanian engineers the development of the press which would be named after him later on. The Bielenberg press is an oil press from which the oil is obtained when the operator presses down on a long handle, which activates the ram. The ram moves into a cage containing the oil seeds. The oil is expelled under pressure from the ruptured seeds.

Although the first design was heavy to operate and rather costly, research went on. Also in other countries like Kenya and Zambia, research to adjust the press was done. In Tanzania, CAPU in Lushoto came with a cheaper and easier to handle design. The Village Sunflower Project in Arusha Region started in 1986 and was promoting this CAPU design. They sold until 1989 about 150 presses. Then SIDO, with help of some development aid, took over the project renaming it SIDO Village Oil Press Project (VOPP) and the project was extended with the regions Iringa, Morogoro and Dodoma. Three people are working full time at the project. They are going to the villages for demonstrations and supply soft shelled seeds for planting, because the press gives the best results and is easiest to handle with soft shelled seeds. Also short-term loans are provided. Production and distribution of presses is monitored in the whole country. There are about 10 producers in the country. They get their orders mostly from the people of the VOPP. They produce the presses after they have got the orders. Finally at selected sites in different regions the production of oil is registered. In 1990 and 1991 together nearly 350 presses were distributed throughout the country.

From the monitoring became clear that the press was rather durable and few technical problems occurred. But still the press was rather difficult to operate and certainly not adapted for operation by women. So at CAMARTEC the research was going on and with the start of 1992 they came with two new models:

1. A much cheaper and easier to manufacture model of the original size, but still rather heavy to operate.
2. A smaller version of the first mentioned, which is really much easier to operate.

To manufacture both models, only welding, cutting and drilling is necessary. No lathe-machine is needed anymore.

If we review the development process, we can say that the decision to start the development was based on the fact that from the experience of the IPI-equipment, it was clear that there was a demand for manual oil-pressing equipment. By evaluating the reactions coming from the field the requirements for the press were collected gradually. With the VOPP a lot of energy and resources was put in the distribution of the press. Of course, the distribution of 500 presses is a success, but probably if the extension costs were added to the price of the press, it would become much more expensive. The monitoring of a lot of sites can be judged as field tests for the equipment. Especially in the first year, when a lot of sites concentrated in Arusha were monitored, has given a lot of field experiences. It will be important to go on collecting field data especially now the VOPP starts to promote the new CAMARTEC models. So that after they finished the prototype testing, they also can do the field testing.

Further description of the Bielenberg press

The Bielenberg press is a small press which can process about one bag of seeds per day, producing about 18 litres of oil. Therefore, one has to use soft shelled seeds like the Record type promoted by the VOPP. Seeds with a hard shell can be processed if they are decorticated first, but the yield will be less. The original CAPU version costs about TSH 60,000. It has a tapered cage. Because the press is mobile there is no special building needed.

The CAMARTEC model costs TSH 35,000 and has a shorter straight cage. Furthermore, the whole construction is simplified. It can reach the same production as the CAPU version. The small CAMARTEC model costs TSH 25,000. The cage has a diameter of 40 mm instead of 50 mm. In one day about 40 kg of seed giving about 12 litres of oil can be pressed.

From the collected field data of the VOPP can be seen that the production in 1990/91 at the presses was mainly from July up to January and an average site produced nearly 2000 litres of oil. For the year 1991/92 the production already stopped in November and most sites did not even reach 1000 lites of oil. Because of a lack of rain the yields of sunflower seeds were very bad.

Financial considerations

Because of the low investment costs the Bielenberg press can be bought more easily by farmers in villages. We calculate with the old price of TSH 60,000. One farmer we consulted said he paid TSH 2500 for one bag of seeds in the producing period and processed it in one day getting 18 litres of oil. Because people use the Bielenberg presses mostly in the season, we say they produce 100 days per year. They get 40 kg of cake per day, worth TSH 10 per kg. For one year the figures are given in Table 8.4.

Maintenance and repair costs have proved to be very low and the press can be used much more than one year. In fact if you buy the press in June and 20 bags of seeds, you hire a labourer for 20 days and you sell oil and cake according to above prices you will spend TSH 114,000 and receive TSH 116,000, so you have earned back your press completely. When we compare the results with the results of the IPI-equipment, then it seems that the surplus of three or four Bielenberg presses is already more than that of one set of IPI-equipment. But the investment is much lower and the pay-back period much shorter.

Table 8.4. Cost and income calculation for the Bielenberg press

costs	seeds	2500×100	=	250,000	(TSH)
	press		=	60,000	
	labour	200×100	=	20,000	
					330,000
income	oil	18×300×100	=	540,000	
	cake	400×100	=	40,000	
					580,000
surplus					250,000

About the marketability of the oil we did not hear any problems and a big part of the production can already be used in the own household. About the marketability of the cakes we did not hear anything. The main constraint of the Bielenberg press is the supply of seeds. You need really the soft shelled seeds or otherwise you have to add a small decorticator to your press. The yield of the other seeds is considerably lower while the energy to press remains at least the same. The soft shelled seeds are originally not planted much in Tanzania so it is in fact a second innovation that has to be adopted together with the press. According to the one farmer we visited in Iringa, the soft shelled variety gave a much lower yield per acre than the original varieties (3.5 bags instead of 6 bags). So people did not like to plant the soft shelled seeds very much.

8.3.3. Powered expellers

Powered expellers are a kind of equipment for oil processing which is mainly imported until now, although TEMDO, IMCO, Themi Farm Implements and perhaps others have started development and manufacturing of oil expellers in Tanzania. Imported types are coming mainly from the United Kingdom (Simon Rosedown), Germany (KOMET), China and India. There are smaller and bigger expellers varying from a capacity of 25 kg of seeds per hour to 250 kg per hour.

The smaller expellers mostly have a capacity of about one bag of seeds per hour. The oil yield depends much on the seeds and on the machine and can vary from 10 to 20 litres per bag.

The principle of the powered presses is that a screw is turned into a cage made from small bars of metal with small spaces in between, through which the oil is coming out. The Themi-model is a slightly other model, which has a closed cage and only two holes in the cage. Furthermore it is not really a screw which is turning in the cage.

The costs of the small expellers vary very much: from TSH 3,500,000 for the European ones to TSH 1,500,000 for the Chinese. The local ones are even cheaper: TSH 1,000,000 or something less. The quality may differ very much. For example, the screw of the TEMDO expeller is from a much softer material than the screw of the KOMET and so wears out much faster. We saw some of the expellers, but did not collect data for good comparison.

SIDO has imported rather a number of expellers and imports at the moment mainly the Chinese machine. Seeds can be put directly in the expellers but they can also be decorticated and winnowed before. This diminishes the wear of the screw. Some of the people having these expellers have bought the IPI powered pre-processing equipment.

There are also larger expellers with a capacity of 150 or 250 kg of seeds per hour. All the expellers are working on electric motors and are therefore only useful in areas where there is electricity, so mainly in the urban areas.

The small expellers can be easily handled by one or at most two person(s). Let us assume that they are operated for 8 hours per day, at a capacity of 8 bags a day, for 200 days a year. The costs and income are as given before. We take the Chinese expeller with straight depreciation in three years and an oil yield of 15 litres per bag. The cost and income comparison is presented in Table 8.5.

Table 8.5. Cost and income calculation for a powered expeller

costs	seeds	2500×8×200	=	4,000,000	(TSH)
	labour	200×2×200	=	80,000	
	depreciation		=	500,000	
	maintenance etc.		=	200,000	
					4,780,000
income	oil	300×120×200	=	7,200,000	
	cake	400×8×200	=	640,000	
					7,840,000
surplus					3,060,000

From reactions of users it is clear that people in urban areas, where electricity is available, prefer the electric systems above the manual systems. Besides the fact that the expellers also seem to be more profitable than the IPI-equipment, this is a reason why the market has gone down for IPI-equipment in areas with electricity. During our stay in Dar es Salaam and Arusha, we found clear signs that there is a market for powered expellers. Imported oil costs TSH 500 per litre and the locally made oil between TSH 300 and TSH 400. There is, therefore a real price advantage and oil from powered mills showed to be able to compete with imported oil.

8.3.4. Other technologies

The most labour intensive method for oil-extraction is the very tedious household method, using very simple equipment. The different steps in the process for sunflower seeds are:

Roasting - Crushing - Sifting - Boiling - Settling - Skimming - Boiling/Drying - Filtration

The process is long and gives only yields a few litres of oil per day. It is one of the reasons why IPI started to search for productivity increasing and labour saving equipment. Where the household method is still used, it is a job executed by women. This makes it important that equipment which comes in place of the household method can be operated by women.

Until now we have mainly been talking about sunflower oil extraction. Other oil seeds are: cotton seeds, sesame, groundnuts, coconuts, palm kernels and soybeans. Cotton seeds are mainly processed in large oil mills in the cotton areas (Mwanza, Shinyanga and Mara). These oil mills are already very old and the utilization of the capacity is very low. Sesame can be pressed in all the mentioned equipment also, even without pre-processing.

Groundnuts are an important oil source but the whole nuts are more valuable than the oil. In spite of this, the research for extracting the oil from groundnuts is going on. Until now, with the Bielenberg press and the IPI-equipment, one gets out of the groundnuts only peanut butter instead of oil. The reason for this is that it is very difficult to make the space between the bars of the cage precise enough for groundnuts. Perhaps, like with sunflower, pre-processing is important. The pre-processing equipment for coconuts and palm kernels is different from the equipment for other seeds. The development of this equipment is going on at the moment.

8.4. Characteristics of the regions related to oil-extraction

First we give some general data about the regions of Tanzania. In fact Zanzibar consists of 5 regions, but for the moment we will treat it as one. Especially the number of people living in a region is important to get an idea about the demand for oil in the region and the quantity of oil needed to reach a satisfactory nutrition. Figures are given in Table 8.6.

Table 8.6. Some general data about the regions of Tanzania

region	# of inhabitants	surface
Arusha	1,351,675	82,306
Coast	638,015	32,407
Dar es Salaam	1,360,850	1,393
Dodoma	1,237,819	41,311
Iringa	1,208,914	56,864
Kagera	1,326,183	28,388
Kigoma	854,817	37,037
Kilimanjaro	1,108,699	13,309
Lindi	646,550	66,046
Mara	970,942	19,566
Mbeya	1,476,199	60,350
Morogoro	1,222,737	70,799
Mtwara	889,494	16,707
Mwanza	1,878,271	19,592
Rukwa	694,974	68,635
Ruvuma	783,327	63,498
Shinyanga	1,772,549	50,781
Singida	791,814	49,341
Tabora	1,036,293	76,151
Tanga	1,283,636	26,808
Zanzibar	640,578	2,460
total	23,174,336	883,749

Remark: From 1978 to 1988 the population growth of Tanzania has been 28%.

Source: Bureau of Statistics, 1989.

After this the production of some oil seeds is given for the different regions for different years in the 80s. The figures are presented in Table 11.7. Productions for sunflower, sesame, groundnuts and soybeans will be expressed in average number of tonnes produced in the years 83/84-85/86. For coconuts it will be the number of nuts produced in 1986 and for cottonseeds it will be the estimated number of tonnes produced in the year 86/87.

Table 8.7. Oil seeds produced in the regions

region	sunflower	sesame	groundnuts	soybeans	coconuts	cotton
Arusha	1859	63	510			
Coast		233			193622	298
Dar es Salaam		84	61		35038	
Dodoma	12466	300	9133			
Iringa	4644					
Kagera						4731
Kigoma			1200			
Kilimanjaro	2200		720			186
Lindi		12354	1509	58	48798	
Mara	930	240	590			9900
Mbeya	333	544	4076			228
Morogoro	423	1022		181		1363
Mtwara		15351	20720	2900	7957	
Mwanza	607	248	11846			37783
Rukwa	1184	137	6742			
Ruvuma	2903	4780	4780			
Shinyanga	2536		53280			37753
Singida	8068		1441			468
Tabora	2048	17	18520	28		3974
Tanga	24	7	295		85164	43
total	40225	35380	135423	3167	370579	96727

Source: (MDB, 1988)

The third category of data concerning presses, presented in Table 8.8., is the number of oil pressing units available in each of the regions as far as they could be identified. These data are collected from different sources. Firstly by interviews and checking project lists at SIDO. Secondly from the Quarterly Reviews of the SIDO village sunflower oil project. Thirdly from the Proposal for an Edible Oil Programme (Food Strategy Unit, 1987). Fourthly from data obtained at IPI in Dar es Salaam.

8.5. Conclusions

8.5.1. Problems with the diffusion of the equipment in Tanzania

IPI faced a whole range of problems which possibly hindered and slowed down the dissemination of the equipment in the country:

1. design problems;
2. lack of competent manufacturers;
3. large distance between themselves and the users;
4. lack of proper field testing;
5. cost of steel;
6. competition from powered expellers;
7. competition from the Bielenberg press;
8. imported oil diminishing the demand for oil;
9. poor financial position of the users;
10. low level of technical know-how of the users.

Table 8.8. Oil pressing equipment in the regions of Tanzania

region	Bielenberg[a]	IPI[b]	expellers[c]	large scale[d]
Arusha	166	1	1	450[e]
Coast	3		1	
Dar es Salaam	5	2	12	48300
Dodoma	38	3	3	
Iringa	39	11	2	2400[f]
Kagera	2			7200
Kigoma		2		
Kilimanjaro	29	1	2	5400
Lindi	1		2	15750
Mara	3		1	9000
Mbeya	11			6000
Morogoro	47	2	1	52200
Mtwara	2	3		
Mwanza	2		2	117300
Rukwa	6		3	
Ruvuma	18	1	1	
Shinyanga	2			75600
Singida	74	9		2700
Tabora	7	3	1	9000
Tanga	16		1	26100
Zanzibar		2		35000
total	471	40	33	402400

a) Bielenberg gives the number of Bielenberg presses in the region (SIDO, 1990-91).
b) IPI gives the sets of IPI-equipment in the regions.
c) Expellers gives the number of power driven expellers like the Komet and Mini 40 in the regions imported by SIDO.
d) Large scale gives the installed capacity measured in kilograms of oil seed that can be processed, assumed that the factory works 24 hours a day, 300 days a year. The figures are according to (MDB, 1988) for the financial year 1985/86.
e) In January 1992 the author visited Afro Multipurpose Products in Arusha, which had at that time an installed capacity of 2160 ton per year.
f) In February 1992 the author visited Iringa and find two new larger scale oil producers. One called Abri Oil Mill has a capacity of 7200 ton per year.

Source: See text.

If we reflect on the problems of the IPI-equipment, we can see immediately that the Bielenberg press has some advantages.

1. It is cheap and therefore better adapted to the financial position of the end-users.
2. It is very simple and therefore less technical know-how is needed.
3. It is easier to find partners capable of taking over the technology for production.
4. Users depend only on local manufacturers for repair and maintenance.

Specific problems of the Bielenberg press are the supply of soft shelled seeds and the energy needed to operate the press.

8.5.2. Review of the situation of oil and oil-processing equipment

At the moment the situation with respect to oil availability is quite different from the 80s. Due to increasing imports and numbers of expellers, the oil-supply in the urban areas has gone up very much. At the moment you can get oil as much as you want. Still an increase in local production would be positive because the imports can decrease. In the rural areas the situation is probably different. In Table 8.9. an estimate is presented of the oil-supply in 1990/91. Now if we say that everybody needs one spoon or 2 cl of oil per day that is 730 cl per year, say 7 kg. That means for 24 million people 168,000 tonnes. So it seems that there is still a lack of oil in the country of 79,000 tonnes.

Table 8.9. Estimated supply of edible oil in Tanzania

Industrial/semi-industrial production	tonnes
cottonseed oil	6,000
sunflower oil	3,500
copra oil	3,000
sesame oil	500
Village/household level production	
palm oil	2,000
sunflower oil	3,500
sesame oil	1,500
coconut oil (or oil in milk)	24,000
Imports	45,000
Exports	negligible
Total available	89,000

Source: (Gordon, Swetman and Treasgust, 1991)

With help of Table 8.9. and the figures of Section 8.4. we try investigate, in which places of the country the most important shortages of oil can be found. Firstly we look at people how have access to imported oil and oil produced in urban areas. In 1988 20% of the population was characterized as urban, but assume that at the moment 25% of the population has access to oil from urban areas. That means that they need 42,000 tonnes and the supply from import and industrial/semi-industrial production together is 58,000 tonnes, so indeed this seems to be enough.

Secondly we look at the coast regions which have the coconuts. According to Table 11.6. and Appendix E, in these regions between 3 and 4 million people live in rural areas. That means that with the 24,000 tonnes coconut oil there is a rather good supply of oil in these areas.

Thirdly we look at the other people in the remote areas in the other regions. For these 14 million people, there is according to the estimates only 7,000 tonnes left, so 0.5 kg per person, per year. For these people 98,000 tonnes should be needed. That means that these are the areas with a real shortage of oil. To produce the needed oil for these people, for example, about 50,000 Bielenberg presses and 400,000 tonnes of sunflower seed and sesame. That means, if the production of seeds has not gone up very much since 83/84-85/86, that the production of oil seeds is much too low for producing the needed oil. In addition to this must be said that the large and small scale expellers buy more and more sunflower, which leaves the quantity of seeds for home production even less. Concluding we can say that there is still a need for oil-processing equipment in remote areas. Because these areas are without electricity and engines are very expensive, the equipment would be preferably manual. It will also be important according to above analysis, to promote planting of sunflower, sesame or other oilseeds, together with the promotion of the press.

The Bielenberg press seems rather adapted to the situation, but there are two problems. First that the kinds of seeds which can be processed are very limited. Second that the first models could not be handled by women who are traditionally the producers of oil. The small CAMARTEC-model still has to prove its value, but perhaps it is the solution for the second problem.

At least two types of equipment can be used more in Tanzania:

1. expellers to decrease imports;
2. manual village or household level equipment which is cheap, simple, easy to handle and at least as productive as the Bielenberg press now.

Of course, also other things can be done: rehabilitation of the old large scale industries, which extract oil from cottonseeds, especially now the cotton yields are reaching new records. Searched can be also for new oil sources, like oil from maize husks, which are available all over the country.

8.5.3. Subjects of further research in the field of oil-processing in Tanzania

This chapter deals with most of the subjects concerning edible oil and oil-processing equipment, but a lot of subjects are treated only touched upon. For example:

1. The data regarding large scale oil mills are from 1985/86 and need to be updated.
2. There are many small scale expellers imported in the country which are not included in this study.
3. More research on the growing of oil-seeds and possibilities of growing special varieties in different areas could be useful.
4. Regional analyses of how many people have admission to which kinds of oil and oil-seeds in order to find the gaps between the demand and supply and needs for special equipment.

Also on the side of the equipment some research can be done:

1. A powered expeller of the quality of the imported ones has not yet been developed in Tanzania.
2. Possibilities of the Bielenberg press to make it more easy to handle, more productive and better suitable for more kinds of seeds.

Some things have to be kept in mind, if one is thinking about further research on the presses. The strong points of the Bielenberg press are that it is cheap and portable. If the press is going to be powered it will become expensive and less mobile and, hence, much less attractive in rural areas. A weak point is of the Bielenberg press is its low capacity and, hence the competition from expellers. Perhaps there are possibilities for a Bielenberg press with a gearbox which can be operated like the IPI-decorticator.

For the IPI-equipment it will be very difficult to recapture the market. The price has to be brought down very much to become as profitable as a set of Bielenberg presses.

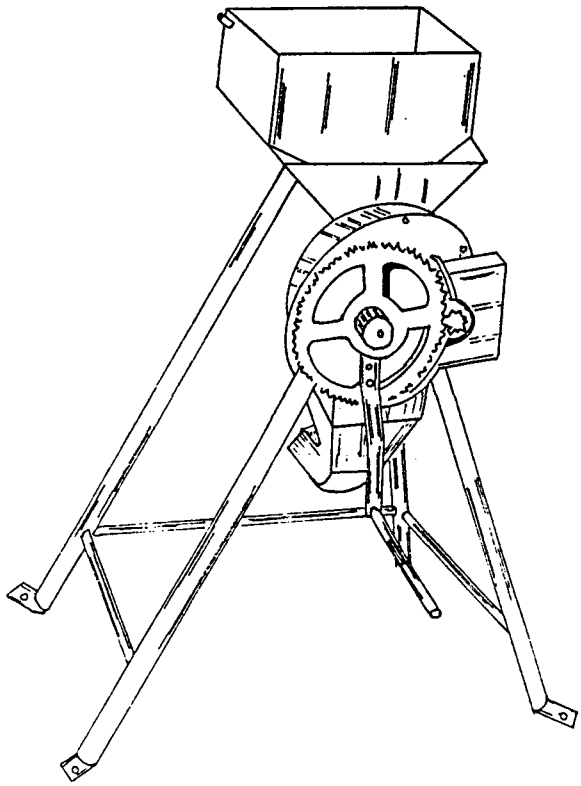


Figure 8.1. IPI-decorticator

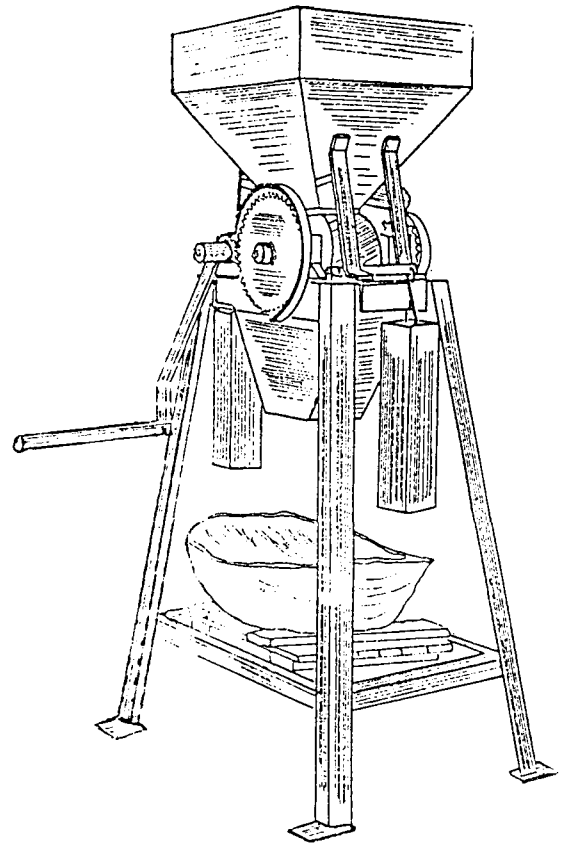


Figure 8.2. IPI-roller

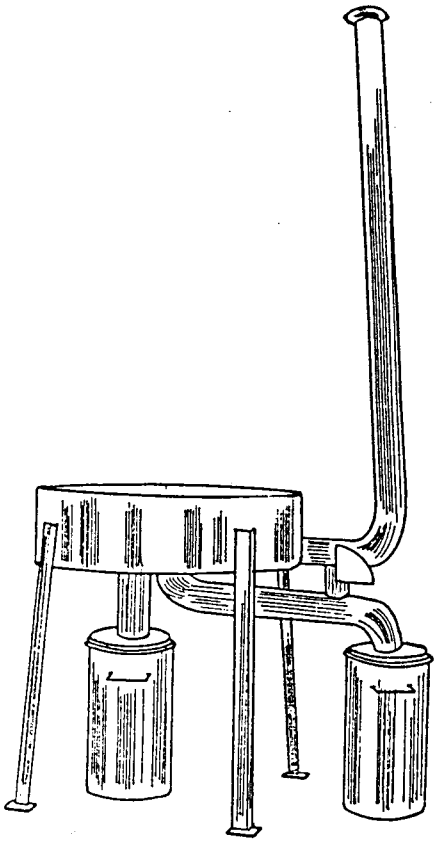


Figure 8.3. IPI-scorcher

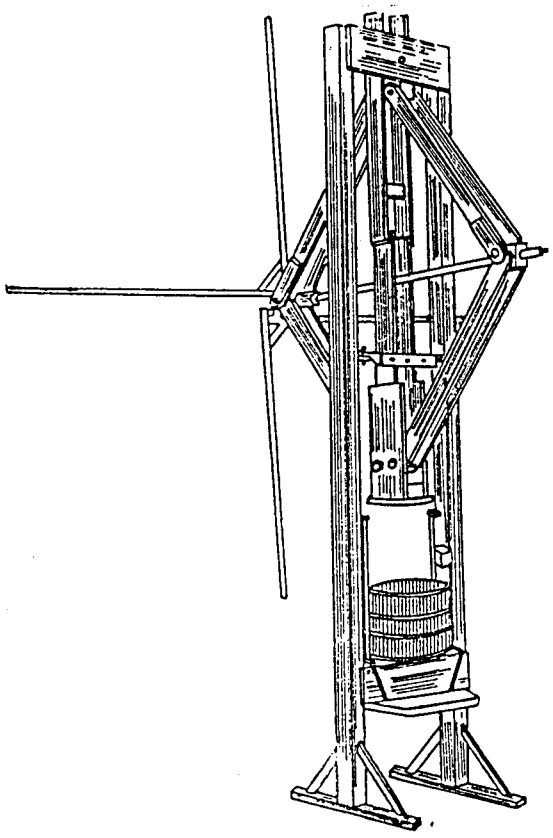


Figure 8.4. IPI-oilpress

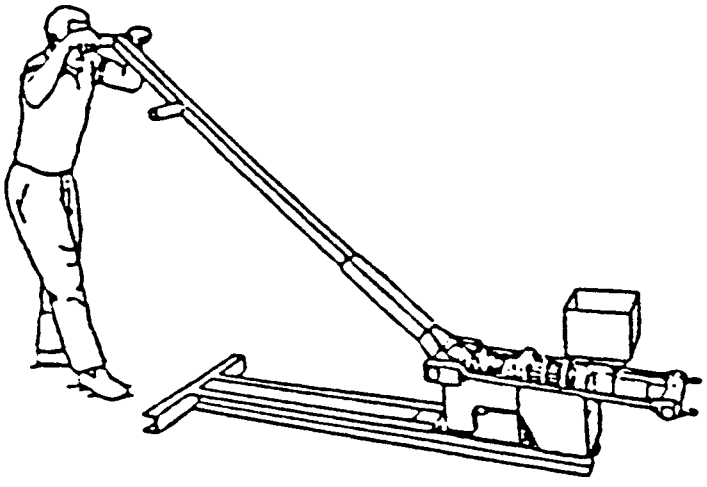


Figure 8.5. Bielenberg press

PART III CONCLUSIONS AND FURTHER RESEARCH

9. CONCLUSIONS AND FURTHER RESEARCH

9.1. Introduction

In Part I we dealt with the theoretical background of this study. A model was developed with a list of variables. After a study of Tanzania, a problem definition for the field work was defined. Research questions, aim of research and working hypotheses (about the model and about the agricultural sector in Tanzania) were drawn up. In Part II the practical experiences were treated. The two parts are related in Part III. This means that the conclusions and research proposals as given in this chapter are related to the model developed in Chapter 2. Conclusions given in Part II, which have no relation with the diffusion model, are not repeated and can be found at the end of each chapter in Part II.

This chapter deals with conclusion concerning the research questions and working hypotheses as presented in Chapter 4. This is done in reverse order because we want to build up the system from Part I again from the point where we finished: the agricultural sector in Tanzania. Furthermore, the chapter gives some analysis not directly connected with the research questions and working hypotheses. Finally, some recommendations for further student research are presented.

9.2. Reviewing the hypotheses and research questions

9.2.1. Hypotheses with respect to the agricultural sector in Tanzania

We start with reviewing the working hypotheses with respect to the agricultural sector in Tanzania, as presented in Section 4.3.3., because these can be supported with direct observations in the field. For each of the hypotheses we give some examples to state that the mentioned variables cause problems in the diffusion processes in Tanzania.

Hypothesis 5. The physical infrastructure, especially roads, telecommunication, electrification, mass media channels and technical support systems, in Tanzania is rather bad. This will cause important problems during diffusion processes, especially in the rural areas. (Confirmed.)

The roads in Tanzania are bad, so it is not easy to bring a spindle for an IPI oil-press from Dar es Salaam to some village in Iringa, 700 km away. It is certainly not something you will do every day. If you cannot even reach a village in the rainy season, you have to wait until the roads can be used again. The fact that IPI tries to set up a technical support system in the country with help of existing workshops is a clear sign that the existing system does not work efficiently and that the transport of all items and services from Dar es Salaam is a real problem.

CAMARTEC lacks electricity two days a week. That is certainly putting restrictions to its possibilities.

Hypothesis 6. The financial position of the small farmers is rather bad, so innovations have to be cheap or possibilities for financing must be given for a good diffusion. (Confirmed.)

For the IPI-equipment the financial restrictions were clear. The women groups had problems to repay their loans and had never had the possibility to buy the equipment without a soft loan. They also lacked financial resources to buy sunflower seeds when they were cheap. Even for the Bielenberg press the price was at a level that loans were often necessary and the decrease in price from the CAMARTEC design will probably speed up the diffusion process.

Another example concerns wheelbarrows. SIDO is not able to sell its expensive multi-purpose wheelbarrow, while CAMARTEC sells rather easily a simple and cheap wooden wheelbarrow.

Hypothesis 7. The industrial level in Tanzania is very low, especially in the rural areas, this will present restrictions to the level of technology that can be diffused easily and it will give problems with repair and maintenance. (Confirmed.)

We saw already problems with the low industrial level at hypothesis 5 as part of the technical support system. IPI faced problems when it gave an engineering workshop an order to produce some of the oil-presses. The produced presses turned out not to be manufactured according to the given drawings.

The rather poor capabilities of the Tanzanian industries can also be seen from the fact that the quality of the expellers produced in Tanzania is still less than the quality of the imported ones.

Hypothesis 8. The education level is relatively low in rural areas in Tanzania, which makes good and adapted demonstrations and manuals very important when an innovation is introduced. (Could not be confirmed in this research.)

Concerning education we could not see such a clear constraints. In the women groups in Iringa there were some management problems, but on the other side we met clever technicians who were able to keep the IPI-equipment going in spite of considerable technical problems. It must be said that the studied innovations are not difficult to operate and mostly demonstrations and manuals are provided.

Hypothesis 9. Innovations that need a lot of foreign exchange for their production are more difficult to diffuse than similar innovations that do not. (Confirmed.)

For the construction of the IPI-equipment a lot of imported steel is needed. That caused a significant increase in the material costs and the price of the equipment which made further diffusion nearly impossible.

On the other hand the imported expellers are doing rather well. It seems that since the economy became more open, there are some people that get money somewhere for investments that seem to be profitable. This may even increase because the foreign exchange market is getting more open now.

Hypothesis 10. Innovations that disturb the kinship structure are more difficult to diffuse than innovations that do not. (Confirmed.)

This hypothesis in fact is a very difficult one. Kinship structures play an important role in Tanzania. One can see that everywhere, but nobody will tell you that he or she does not want an oil press, because it will affect his or her position in the family. The only thing that can be said is that women are traditionally the producers of oil. From the field tests the reaction on the Bielenberg press was continuously that it was heavy to operate, especially by women.

After reviewing these hypotheses we can at least suspect that the mentioned variables play a role in the diffusion processes in Tanzania. The first three seem to be rather important, the last three are less clear. For two there is still so much evidence that we concern the hypotheses to be confirmed. Only hypotheses 8 could not really be confirmed in this research, but it is also impossible to conclude it is not true.

Looking to Table 9.1. (see page 112-113), we see that a majority of the variables causing the observed problems in the studied cases are related to hypotheses 5 to 10. That means that we have found an important part of the constraints just by taking a careful look at the situation in Tanzania. The hypotheses, however, do not give us a complete picture. For a complete picture we should have drawn up hypotheses for all the variables occurring in Table 2.1. to 2.14. This was not possible within the framework of this research. To get a more complete picture we return to the model and to the variables presented in Chapter 2.

9.2.2. Hypotheses with respect to the diffusion model

The hypotheses with respect to the diffusion model find their argumentation already in the literature research. Also from the field work new arguments for the value of the model and the variables can be found.

Hypothesis 1. It is possible to prepare, follow and evaluate the diffusion process of a lot of innovations with the model presented in Figure 2.1. Especially innovations in developing countries eventually introduced by technology transfer from developed countries. (Confirmed.)

When reviewing Rogers (1983) we saw already that he distinguishes more or less the same steps in the diffusion process as we do. He does, however, not pay much attention to the forward and backward linkages presented in our model.

Also at IPI they divide the diffusion process in different steps more or less like in our model. They put more emphasis on the development part, which is not strange knowing that they are developers.

If we start studying the diffusion process of the IPI-equipment, we see that the 'ideal' process is not followed strictly:

- preparatory work is minimal;
- the design is transferred very fast to the producers;
- field testing is hardly executed.

From our model, however, it is possible to follow and evaluate the process. In places where we get problems to find out in which phase of our model the process is, it seems that the problems for IPI start.

Examples:

- They give their design to a producer, while we are expecting field tests. The results turn out to be not very good and new research is needed.
- They say that they are lacking complete field data because they only had data from sets of equipment that had problems. Indeed, when we are studying the process at a moment it was not clear if we were still *field testing* or already at the end of the process at the *interaction with the target group.*

Looking at the Bielenberg press, the situation is more clear. A point of discussion can be: is this a complete new innovation or is it just a next step to diffusion of manual oil-pressing equipment?

This is just a formal discussion. The need was still the same as before the IPI-equipment, but now a completely other design came out of the research. After prototype testing, some presses were put in the field and studied there. So real field testing was executed. Good results caused the decision to find producers and set up a real promotion team. In the same time research for the improvement of the design went on and the promotion team collected data as a kind of field tests for evaluations. Interesting is, that the promotion team started in a small area of the country, which decreased travelling costs. After some success they slowly increased slowly their radius of action.

What is missing in the research until now and what does not become clear from my field experiences either is a good argumentation for all the backward and forward linkages in the model. At least in the R&D part they seem to exist. That was also stated by Helsloot (1986).

Hypothesis 2. The list of variables presented in Table 2.1. to 2.14. contains the most important variables playing a role in the diffusion process for most innovations, especially in developing countries. Not all variables have the same importance. (Confirmed.)

Like hypothesis 1, hypothesis 2 finds an important part of its argumentation in the literature research. The variables found in literature are included in Table 2.1. until Table 2.14. Besides of that, all the elements occurring in the model are dealt with and are described in detail with help of these variables.

It is interesting to study which variables we have found in field practise because it gives a first idea about which variables can be expected to be important and in which form they occur. The last aspect is important for further research to make more precise operationalizations. In Table 9.1. we list the problems as they are found in the field practise and in the second column we give the related variable. The related variable is presented by the number of the table in which it occurs, followed by its description. Variables occurring in Table 9.1. which are shaded in Table 2.1. until Table 2.14., meaning that they are underexposed in literature, are indicated with (!). Some variables which are questionable are indicated with (?). More attention is paid to this afterwards.

Table 9.1. Observed problems related to the list of variables

observed problem	related variable(s)
sorghum dehulling (Section 5.7.)	
- management problems	2.1. educational background
- spare parts	2.1. infrastructural properties
- stolen parts	2.1. economical background(?)
	2.1. cultural background(?)
- supply of sorghum	2.5. structural influences
- break downs	2.9. technological level(?)(!)
- promotion problems	2.11. scale
	2.11. directness
producers (Section 5.9. and 5.10.)	
- spare parts/raw materials	2.8. infrastructural properties(!)
	2.8. origin of means(!)
- marketing	2.8. activity concentration(!)
- electrification	2.8. infrastructural properties(!)
- under-utilization of machinery	2.9. profitability(!)
- productivity	2.9. profitability(!)
- poor machinery	2.9. technological level(!)

Table 9.1. Observed problems related to the list of variables (continued)

observed problem	related variable(s)
product design cell (Section 5.9.4.)	
- poor facilities	2.3. technological means(!)
- few manpower	2.3. disciplinary background(?)(!)
- little information about field tests	2.3. infrastructural properties(!)
	2.6. scale
	2.6. feedback(!)
- poor preparation	2.4. problem solving techniques
- price of innovations	2.5. economic properties
- forgetting promotion	2.11. scale
innovation institutes (Chapter 7.)	
- low level technical know-how end users	2.1. educational background
	2.1. cultural background
- difficulty in obtaining loans	2.1. economical background
- transport	2.1. infrastructural properties
- distribution of the target group	2.1. communicational structures
- poor communication infrastructure	2.1. communicational structures
	2.3. infrastructural properties(!)
- resistance to new technology	2.1. cultural background
	2.5. cultural properties
- problems with cooperation	2.3. infrastructural properties(!)
- bureaucratic structures	2.3. infrastructural properties(!)
- incomplete information	2.3. infrastructural properties(!)
- financial position of R&D-institutes	2.3. source of finance(!)
- unrealistic plans by aid-organizations	2.3. source of finance(!)
- release immature product	2.6. scale
- lack of partners to take over the technology	2.8. infrastructural properties(!)
- failure to maintain standard products	2.8. infrastructural properties(!)
- local differences in technology development	2.8. infrastructural properties(!)
- changing economic conditions	2.8. infrastructural properties(!)
- competition of existing and imported technologies	2.8. competitive situation(!)
oil-processing equipment (Chapter 8.)	
- distance to customers	2.1. communicational structures
	2.1. infrastructural properties
- changing availability of oil	2.1. infrastructural properties
- technical problems	2.1. infrastructural properties
- cultural problems	2.1. cultural background
- financial problems	2.1. economical background
- management problems	2.1. educational background
- relative advantage	2.5. economic properties
- competition with large scale oil-mills	2.5. economic properties
- supply of seeds	2.5. structural influences
- physical power needed for operation	2.5. cultural properties(?)
- lack of field testing	2.6. scale
- competition with other technologies	2.8. infrastructural properties(!)
- finding competent producers	2.8. infrastructural properties(!)
- costs of steel	2.8. competitive situation(!)

In Table 9.1. we see that it is possible to indicate for every observed problem a variable that is expected to cause the problem. There are some question-marks in the table. In fact one can place many more question-marks, but the given ones give us some good examples to illustrate the use and problems of our list of variables.

Sorghum dehulling
With the sorghum dehulling it is difficult to say why parts of the machinery are stolen. Obviously it finds its reason in the environment of the target group which is included in the variables. Maybe it can be carried back to the economical or cultural background. Possibly even other variables play a role. Another possibility is that it is only an important problem because it is so difficult to get spare parts. In that case it is just a consequence of another problem.

Break downs is also a problem that can have different reasons:

1. poor production quality (it depends on the technical level of the production);
2. problems to get spare parts (it depends on the infrastructural characteristics of the target group);
3. poor product quality (it depends on the testing by the developers or the quality of the field tests).

Product design cell
At the product design cell there is a problem with manpower. It is clear that the reason for this problem can be found in the variable *disciplinary background* of the developers. The point of attention is that in the operationalization of this variable it is important to include quantities and qualities.

Oil-processing equipment
With the oil-processing equipment there is a question-mark put at the problem of physical power needed for operation of the equipment which is carried back to cultural properties of the innovation. This seems questionable, but we have to recall that mostly women have to operate the equipment and especially for them the equipment is heavy to operate. So there is a problem with the compatibility of the innovation in the social system of the target group. After this, one can also argue that the cultural background of the target group can be the related variable. We prefer the first one, because we deal with a specific property of the innovation, but we agree on the fact that the two variables are very close together in this case.

Returning to hypothesis 2, we can conclude that the practical experiences do not give any reason to assume that important variables are missing. Some variables which are important in the observed problems can also be indicated:

- infrastructural properties of different actors;
- economic positions of the target group;
- technical level/profitability of the production;
- educational background of the target group;
- cultural background of the target group;
- scale of the field tests and promotion;
- different properties of the innovation.

It is interesting to see that hypotheses 5 to 10 nearly all return in these variables. It has to be kept in mind that the variables found perhaps depend very much on the chosen cases and the institutes studied. We cannot say that other variables, not occurring in the cases, are not important.

Hypothesis 3. With help of the diffusion model in Figure 2.1., in combination with the description and Tables 2.1. to 2.14. containing the variables, it is possible to indicate important variables that did not occur in literature (Table 1.1.) until now. (Confirmed.)

The cases indeed yielded important variables that did not occur in literature. They are presented in Table 9.1.:

- variables concerning producers and production;
- variables concerning developers.

Hypothesis 4. Production aspects, impacts and the cyclic character of the diffusion process are aspects that are underexposed in literature until now. (Confirmed.)

Concerning hypothesis 4 it can be said that production aspects seem to be really important. Furthermore, the cyclic character of the diffusion process can be seen if we look at the diffusion of manual oil-processing equipment. IPI started in Tanzania and after some research cycles they reached a very first step of diffusion. But the impacts were not as positive as expected. This led to new R&D and the development of the Bielenberg press. A new cycle of field testing, production and promotion started.

9.2.3. Research questions and the aim of research

The research questions and the aim of the research can be dealt with together because they are closely related. They will be treated in the same order and numbered the same way as they are presented in Section 4.2.3. and 4.2.4.

1. The usefulness of the model at this moment is of course difficult to prove, but we can at least mention some facts that support the usefulness:
   - It assisted to indicate variables that can be important in the diffusion process and that were not mentioned in the literature before.
   - It helped to set up questionnaires which enabled us to indicate problems in the diffusion process in the studied cases.
   - The logic of the model seems to correspond with the general idea about how diffusion processes should work.
2. With the second research question we have to be careful because the bottlenecks found and mentioned when dealing with hypothesis 2, can be expected to be very specific for Tanzania. Probably even for the studied cases. This especially because we already predicted most of the bottlenecks with help of the general description of the Tanzanian environment. The cases did not give us possibilities to indicate bottlenecks in the model in general, only for the cases itself.
3. For the precise description of the activities in Tanzania concerning the treated subject we refer to Part II, where all the data that are collected in this study are presented.
4. Concerning the subjects for further research, we refer to Section 9.4. at the end of Part III.

9.3. Further conclusions

In the foregoing sections we kept strictly to the hypotheses and research questions. Now, we analyze some other aspects more freely. This section is divided in two parts: one for Tanzania and one for the diffusion model in general.

9.3.1. Further conclusions concerning Tanzania

Although we have said that our cases do not allow generalizations for innovations in the agricultural sector in Tanzania, some of the problems can also be expected to involve other innovations.

The reason for this is that a lot of the problems can be carried back to the Tanzanian environment. If somebody wants to diffuse innovations in the agricultural sector and then especially for small farmers, he has to reckon with the:

- poor financial situation of the small farmers;
- low educational level of the small farmers;
- difficult transport possibilities;
- low level of industrialization.

While introducing an innovation, one cannot expect to change the Tanzanian environment. This means that one has to adapt the innovation to this situation. Looking at the Bielenberg press we see that, as far as the constraints mentioned are concerned, the innovation and the diffusion process seem to be rather adapted.

- it is cheap and credit facilities are provided;
- operation is easy;
- diffusion is started in a concentrated area which decreased travelling kilometres;
- manufacturing is easy, so the press can be manufactured in many workshops all over the country, which also decreases travelling kilometres.

On the other side, there appear to be possibilities for the studied institutes themselves to improve some aspects of their environment. It is a fact that rather some facilities are present in Tanzania, but that organization and cooperation is a problem. Just to illustrate this we present an 'ideal' allocation of tasks in such a way that double-acting and working at cross-purposes can be reduced:

1. IPI, CAMARTEC and TEMDO take care of preparatory research and development of innovations. CAMARTEC has specific experiences in simple and cheap innovation while IPI and TEMDO are more directed to slightly more complex innovations.
2. TEMDO has its design specialization, from which the others can benefit if it is organized well.
3. IPI and CAMARTEC have the best facilities for prototype testing, lab as well as field testing.
4. After we have a well tested design, SIDO has the experience to find entrepreneurs and to start enterprises for production (especially the SIDO technology transfer programmes are good examples).
5. MEIDA could help in the production, because they are supporting metal industries.
6. For repair and maintenance facilities, the CFWs and CFFs of SIDO seem to form an ideal network to bring these facilities rather close to the people. We think that with some improvement in this network (e.g. productivity of the workshop and expanding the network to all regions), it can really play an important role in the diffusion process.
7. Also the training centres of SIDO can assist to increase education of the target group by providing managerial and technical training programmes.
8. What remains is the promotion. At this point all the institutes are not very strong. The example of the Bielenberg press is rather cost and labour intensive, but it gives at least an idea about the activities to be executed.

9.3.2. Further conclusions concerning the diffusion model

It became clear from the treatment of the hypotheses and the research questions that the field work did not give good reasons to change the model. Also the list of variables will not be adapted.

Two points of criticism that seem valid are:

1. a lot of variables do not occur in the practical experiences;
2. there is no use of such an extensive list of variables.

The first point can be dealt with, as is done before, by saying that our practical experiences are very limited, but we want to say something more about this. In the practical experiences much more variables occur than the ones given as causes of observed problems. In the first place there is a lot of discussion possible if the given causes are right. In the second place a lot of variables are obscured, because they do not cause problems directly but indirectly.

For example, if we look at the needs of the target group, in the case of the oil-processing equipment we have a need for an essential element of nutrition. Or, one can say that there is a need to produce the oil in a far more productive way as it could be done before. This would lead to better nutrition with less effort. This need can be described as basic, material, felt, individual, substitutional and clear. These variables can be identified, but their significance in the diffusion process is not clear at the moment. That there can be any importance can be seen if we look at the attitude of governmental institutes. This attitude is positive for the oil-processing equipment. Therefore, no problems have to be expected from this variable, but it certainly affects the diffusion process because an important part of the developing costs are paid with government help.

It is a fact that the list of variables is long and perhaps until know rather inscrutable. A first reason for the length of the list is that the diffusion process is a long process and during that process there are other variables important at the beginning then at the end. A second reason is that the list is general if we look at the innovation. It can be found in literature that the kind of innovation determines to a large extent which variables can be expected to be important. The list of variables will become less inscrutable if we have succeeded to find relations between the importance of the variables, the concerned innovation and the time aspect. Even in a more general form this is an important task for further research: to find relations between all the variables given.

9.4. Recommendations for further research

After this report it is clear that this is not the end but only the beginning of a number of studies. Assuming that this study is a good basis for further research about the diffusion processes we formulate a number of possibilities for this research. Therefore, we first give some questions that are not answered by this report:

1. Which variables are important:
   - in which steps of the diffusion process?
   - for a certain type of innovation?
   - for a specific type of target group?
   - in a specific environment?

2. Which steps in the diffusion process are difficult or, in other words, what are the bottlenecks in the diffusion process:
   - for a certain type of innovation?
   - for a specific type of target group?
   - in a specific environment?

   and why?

From the difference made above it may become clear that important variables and variables causing problems are not concerned to be the same. Important variables are variables having important effects on the diffusion process. This can be negative but also positive.

For example, if one develops a very cheap oil-press for poor farmers, the fact that this press is cheap will be essential for diffusion. So in this case the variable is important, but it will not cause problems.

To investigate whether a variable is important one should like to experiment with changing one variable and measuring the difference of the rate of adoption. Several problems occur here:

1. Diffusion cannot be tested in laboratory situations. The diffusion process takes place in a social system in an open environment. In fact the variables are changing continuously.
2. The variables in the diffusion process are usually interrelated, so changing one variable will cause changes in other variables
3. The rate of adoption is difficult to measure and certainly small changes will be hard to prove.

Of course, this does not mean that there are not any possibilities for further research. On the contrary, a lot of case studies, in-depth studies on different aspects of the diffusion process and a lot of theoretical research work will be necessary, before the model gives real insight in the problem of diffusion.

Therefore, we recommend the following research subjects:

1. Finding good and useful operationalizations of the given variables.
2. Developing questionnaires and other techniques for data collection according to the operationalizations.
3. Executing case studies with all kinds of innovations in different environments.
4. Improving the results of 1. and 2. with the experiences of 3.
5. Executing in-depth studies for the different elements of the diffusion process, also with help of 1. an 2. to get an idea about the specific role of the elements in the diffusion process and the specific problems per element.
6. After all the case studies, analyzing the relation between different variables and problems occurring in the diffusion process.
7. Improving the model in such a way that it perhaps can help to predict diffusion processes with help of a list of related variables.

The given research subjects are all very general. From our practical experiences in Tanzania, we can give some specific subjects in this country. The Tanzanian environment seems to be important for diffusion processes, at least from our experiences. So interesting research subjects are:

1. The role of the Tanzanian environment for other innovations.
2. The possibilities to adapt innovations, in such a way that it will be easier to diffuse them in their environment.
3. The possibilities to improve the Tanzanian environment in such a way that it will be easier to diffuse innovations, e.g.:
   - physical infrastructure;
   - communication and cooperation between different actors in the diffusion process;
   - industrial facilities.

Finally, the general research recommendations can be used directly in Tanzania.

REFERENCES

Agarwal, B. (1983), *Diffusion of Rural Innovations: Some Analytical Issues and the Case of the Woodburning Stoves*, World Development, Vol 11, No. 4, 359-376.

Agnew, J.A. (1979), *Instrumentation, Realism, and Research on the Diffusion of Innovation*, Professional Geographer, Vol. 31, 364-370.

Appropriate Technology International (1990), *The Bielenberg Ram Press and Small Scale Oil Processing, Proceedings of the Conference 10/11 September 1990,* Washington.

Barnett, A., Bell, M., Hoffman, K. (1982), *Rural Energy and the Third World*, Pergamon Press, Oxford.

Barnett, A. (1990), *The Diffusion of Energy Technology in the Rural Areas of Developing Countries: A Synthesis of Recent Experiences*, World Development, Vol. 18, No. 4, 539-553.

Bassili, A.V. (1989), *Trends and Problems in the Introduction of New Technologies in the Wood Processing Industries in Developing Countries*, Public Enterprises, Vol. 9, No. 1, 3-11.

Bhola, H.S. (1988-89), *The CLER Model of Innovation Diffusion, Planned Change, and Development: A Conceptual Update and Applications*, Knowledge in Society, Vol. 1, No. 4, 57-66.

Biggs, S.D. (1990), *A Multiple Source of Innovation Model of Agricultural Research and Technology Promotion*, World Development, Vol. 18, No. 11, 1481-1499.

Blaut, J.M. (1977), *Two views of Diffusion*, Annals of the Association of American Geographers, Vol. 67, 343-349.

Bonair, A., Rosenfield, P., Tengvald, K. (1989), *Medical Technologies and Developing Countries: Issues of Technology Development, Transfer, Diffusion and Use*, Social Science and Medicine, Vol. 28, No. 8, 769-781.

Bossché, N. (1983), *The Dissemination of Woodburning Stoves in the Sahel Countries*, University of Technology, Eindhoven.

Brown, L.A. (1981), *Innovation Diffusion: A New Perspective*, Methuen, London.

Bunders, J.F.G. (ed.) (1990), *Biotechnology for Small-Scale Farmers in Developing Countries: Analysis and Assessment Procedures*, V. U. University Press, Amsterdam.

Bureau of Statistics (1989), *1988 Population Census: Preliminary Report*, Ministry of Finance, Economic Affairs and Planning, Dar es Salaam.

Burmeister, L.L. (1987), *The South Korean Green Revolution: Induced or Directed Innovation?*, Economic Development and Cultural Change, Vol. 35, No. 4, 767-790.

CAMARTEC (1991), *Centre for Agricultural Mechanization and Rural Technology (pamphlet)*, Arusha.

Chattopadhyay, A., Singh, S.N. (1986), *The Role of Interpersonal Communication in Effective Transfer of Agricultural Technology*, Interaction, Vol. 4, No. 1, 20-26.

Chen, C.L., Hansen, D.O., Flinn, W.L. (1989), *Farm Size and the Adoption of Rice Production Technologies in Taiwan*, Journal of Asian and African Studies, Vol. 24, No. 3-4, 239-246.

Chungu, A.S. (1990), *Adaptation of Manually Operated Oil Expellers by Rural Women in the Iringa Region in Tanzania,* Asian Institute of Technology, Bankok.

Cotrill, C.A., Rogers, E.M., Mills, T. (1989), *Co-Citation Analysis of the Scientific Literature of Innovation Research Traditions: Diffusion of Innovations and Technology Transfer*, Knowledge, Vol. 11, No. 2, 181-208.

Engel, P. (1976), *De Kleine Boer en de Ontwikkelingssamenwerking: De Agrarische Structuren en de Verspreiding van Vernieuwingen*, Internationaal Agrarisch Centrum, Wageningen.

Feder, G., Just, R.E., Zilberman, D. (1982), *Adoption of Agricultural Innovation in Developing Countries: A Survey*, World Bank Staff Working Papers, No. 542.

Food Strategy Unit (1987), *Proposal for a National Edible Oil Programme,* Planning and Marketing Division, Ministry of Agricultural and Livestock Development, Volume One: Executive Summary, Volume Two: Sector Review, Tanzania.

Gordon, A. Swetman, A. Treasgust, S. (1991), *Report on a visit to Tanzania to carry out a survey of household coconut processing, 14 September.-5 October.,* Natural Resources Institute, Chatman, UK.

Hardeman, J. (1984), *Selectieve Innovatie door Kleine Boeren in Mexico*, Vrije Universiteit, Amsterdam.

Helsloot, H. (1986), *Design of Small Scale Farm Equipment for Rural Zambia*, University of Technology, Eindhoven.

Heynen, J.D. (1978), *Tanzania,* Romen, Bussum.

Howes, M. (1980), *Factors affecting the Dissemination of Innovations and Partially Monetised Economics: Some General Principles and the Implications for the Woodstove Programmes*, International Workshop on Woodstove Dissemination, Wolfheze, Holland.

Hyman, E.L. (1987), *The Strategy of Production and Distribution of Improved Charcoal Stoves in Kenya*, World Development, Vol. 15, No. 3, 375-386.

IPI (1990a), *Prospectus '90/91,* University of Dar es Salaam, Dar es Salaam.

IPI (1990b), *Operation Manual IPI sunflower Oil Processing Equipment, Revised Edition,* University of Dar es Salaam, Dar es Salaam.

IPI (1991), Report on the 25th Board Meeting, University of Dar es Salaam, Dar es Salaam.

James, J. (1989), *Improving Traditional Rural Technologies*, Macmillian.

Kimambo, C.Z.M., Kaunde, O.K. (1990), *Dissemination of Technology in Tanzania: Constraints and Solutions based on IPI's Experience,* IPI, University of Dar es Salaam, Dar es Salaam.

Kliest, T.J. (1984), *Tanzania,* KIT, Amsterdam.

Korten, D. (1980), *Community Organization and Rural Development: A Learning Process Approach*, A Ford Foundation Reprint from Public Administration Review.

Kussendrager, N. (1991), *Tanzania,* KIT, Amsterdam.

Lapperre, P.E. (fall 1992), *Man, Technology, Society and Development,* Eindhoven University of Technology, Eindhoven.

Lemmens, L. (1987), *Technology Assessment for Projects in Developing Economies: Sugar Cane Industry in Western Kenya as a Case Study*, University of Technology, Eindhoven.

Mahajan, V., Sharma, S. (1986), *A Simple Algebraic Estimation Procedure for Innovation Diffusion Models of New Product Acceptance*, Technological Forecasting and Social Change, Vol. 30, 331-345.

Mahajan, V., Peterson, P.A. (1985), *Models for Innovation Diffusion*, Series: Quantitative Applications in Social Sciences, Sage, London.

Mbora, F. (1990), *"Report on Practical Training about IPI and Coconut Oil Processing Equipment on Zanzibar",* IPI, University of Dar es Salaam, Dar es Salaam.

MDB (1988), *Annual Review of Oilseeds 1988,* Marketing Development Bureau, Ministry of Agricultural and Livestock Development, Dar es Salaam.

MEIDA (1986), *Directory of Facilities and Resources,* Dar es Salaam.

MEIDA (1988), *Directory of Products and Services,* Dar es Salaam.

MEIDA (1991), *8th Annual General Meeting,* Dar es Salaam.

Meir, A. (1979), *A Disparity Based Diffusion Model*, Professional Geographer, Vol. 31, 382-387.

Melkote, S.R. (1988), *Agricultural Extension and the Small Farmer: Revealing the Communication Gap in an Extension Project in Kenya*, Journal of Developing Areas, Vol. 22, No. 2, 239-251.

Mung'ong'o, C.G. (1988), *A Sub-Report to the WHO/UNICEF Nutrition Support Programme (JNSP)*, Institute of Resource Assessment, University of Dar es Salaam, Dar es Salaam.

Nowak, P.J. (1987), *The Adoption of Agricultural Conservation Technologies: Economic and Diffusion Explanations*, Rural Sociology, Vol. 52, No. 2, 208-220.

Onkvisit, S., Shaw, J.J. (1989), The Diffusion of Innovation Theory: Some Research Questions and Ideas, Akron Business & Economic Review, Vol. 20, No. 1, 46-55.

Post Production Food Industry Advisory Unit (1988), *Proceedings of the Sub-Regional Workshop on Small Scale Oil Expression* (Congress Held at Zanzibar 21st to 27th November 1987), Harare.

Richard, G., Mandara, R., Chungu, A.S. (1990), *Draft: for Consultations to Develop Recommendations and Workplan for 1990 on Socio-Economic Field Operational Research Project on Sunflower Oil-Seed Processing in Iringa Region, Tanzania*, IPI, University of Dar es Salaam, Dar es Salaam.

Rogers, E.M. (1983), *Diffusion of Innovations*, The Free Press, New York.

Röling, N., Ascroft, J., Wa Chege (1976), *The Diffusion of Innovations and the Issue of Equity in Rural Development*, Communication Research, Vol. 3, No. 2, 155-170.

Röling, N., Zeeuw, H. de (1983), *Improving the Quality of Rural Poverty Alleviation, Final Report of the Working Party on "The Small Scale Farmer and Development Cooperation"*, Internationaal Agrarisch Instituut, Wageningen.

Royal Tropical Institute (1985), *Assessment of Vegetable Oil Production Equipment Developed at the Institute of Production Innovation Dar es Salaam*, Amsterdam.

Ruthenberg, H., Jahnke, H.E.(ed.) (1985), *Innovation Policy for Small Farmers in the Tropics: The Economics of Technical Innovations for Agricultural Development*, Clarendon Press, Oxford.

Ruttan, V.W. (1989), *Institutional Innovation and Rural Development*, World Development, Vol. 17, No. 9, 1375-1387.

Ryan, B., Gross, N.C. (1943), *The Diffusion of Hybrid Seedcorn in Two Iowa Communities*, Rural Sociology, Vol. 8, 15-24.

Schmidt, P., (ed.) (1976), *Innovation: Diffusion von Neuerungen im Sozialem Bereich*, Hoffmann und Compe Verlag, Hamburg.

SIDO (1983), *Ten Years of the Small Industries Development Organization (SIDO) 1973 to 1983*, Dar es Salaam.

SIDO (1990a), *Small News*, March 1990, Dar es Salaam.

SIDO (1990b), *Small News*, June 1990, Dar es Salaam.

SIDO (1990c), *Small News*, September 1990, Dar es Salaam.

SIDO (1990d), *Small News*, December 1990, Dar es Salaam.

SIDO (1991a), *Small News*, March 1991, Dar es Salaam.

SIDO (1991b), *Small News*, June 1991, Dar es Salaam.

SIDO (1991c), *Technology for the People through Small Scale Industries* in Tanzania, SIDO-Kibaha, Tanzania.

SIDO (1990-91), *Quarterly Progress Reports Village Oil Press Project*, Small Industries Development Organization, Arusha, last quarter 1990 up to third quarter 1991.

Skiadas, C.H. (1986), *Innovation Diffusion Models Expressing Asymmetry and/or Positively or Negatively Influencing Forces*, Technology Forecasting and Social Change, Vol. 30, 313-330.

TEMDO (1991), *Machinery Information and Engineering Consultancy Services from TEMDO,* Arusha.

Triandis, H.C., Brislin, R.W. (1984), *Cross Cultural Psychology*, American Psychologist, Vol. 39, No. 9, 1006-1016.

University of Technology (1988), *Het Proces van Overdracht van Technologie en Kennis naar Derde Wereld Landen*, proposal, Eindhoven.

Weinstein, J., McIntyre, J.R. (1986), *Multinational Corporations and the Diffusion of World Standards: A Theoretical Exploration*, Studies in Comparative International Development, Vol. 21, No. 3, 51-84.

World Bank (1990), *World Development Report,* Washington DC.

Yambo, M. (1982), *Socio-Economic Factors in the Development and Diffusion of New Wood/Charcoal Stoves: Some Theoretical and Methodological Consideration*, African Journal of Sociology, Vol. 2, No. 2, 159-185.

Yapa, L.S. (1977), *The Green Revolution: A Diffusion model*, Annals of the Association of American Geographers, Vol.67, 350-359.

Zonneveld, M. (1985), *Overdracht van Technologie en Kennis naar Derde Wereld Landen*, University of Technology, Eindhoven.

APPENDICES

A. SIDO ACTIVITIES PER REGION

Guide

First column: activity.
Second column: number of units involved.
Third column: specification of activities as far as found in literature.

Abbreviations used:

RHP	Rural Hire Purchase
WP	Women Projects
MHP	Micro-project Hire Purchase
IE	Industrial Estate
TCP	Training cum Production Centre
CFW	Common Facility Workshop
CFF	Common Facility Foundry
SI	Sister Industry
SD	Sister Daughter Industry

1. Arusha (SIDO, 1991a)

RHP	47	16 grain milling 10 carpentry 5 general engineering 16 others
WP	10	10 grain processing
MHP	13	
IE	12	CFW (Bielenberg press, Azimio grain mill) cutleries (ACCO) (SI) waterpipe valves and fittings (AMI) (SI) galvanised products (AGACO) (SI) disinfectants (CAI) (SI) grey iron casting (GIFCO) (SI) aluminium wares (KIMESHA) (SI) furniture and wooden rulers (Meru Wood) (SI) electrical distribution boards etc. (NEM) (SI) roofing and ordinary nails (SHUMA) (SI) wooden screws, rivets etc. (UHANDISHA) (SI) tin lamps (GALKIN) (SD)

2. Coast (Pwani) (SIDO, 1990b, 1991b, 1991c)

RHP	38	13 grain milling 3 tailoring 1 carpentry
WP	8	
MHP	23	

SIDO/NORAD Rufiji programme
Kibiti Blacksmiths/Metal
Ikwiriri Blacksmiths/Metal
Muyuyu Blacksmiths
Chumbi Blacksmiths
Ikwiriri Women Pottery Unit
Rwahure Repair Workshop
Jaggery Plant Mkongo Handloom Weaving

Mafia-Gotland programme
fish smoking
fishing
carpentry
2 auto garages
boat building

TCP Kibaha Handmade Paper

3. Dar es Salaam (SIDO, 1990c, 1991b, 1991c)

RHP 145 33% food and food processing
26% textiles
21% wood and wood processing
8% metal products
12% others

WP 121 48% food and food processing
34% textiles
18% others

MHP 50

IE 22 (See Section 5.9.1.)

4. Dodoma (SIDO, 1990b, 1991b, 1991c)

RHP 25 12 grain milling
2 carpentry
1 screw rivets
1 air letter forms
1 black smithery

WP 6

MP 23

TPC cobblery, woodwork/joinery, metal fabrication

5. Iringa (SIDO, 1990c, 1991b, 1991c)

RHP	64	30 maize milling 19 carpentry 3 tailoring 2 welding 2 farm implements 1 dry cleaning 1 oil mill 1 printing 1 garage
WP	7	5 maize milling 1 oil expeller 1 laundry
MHP	5	
IE	6	Iringa Maintenance Company (IMAC) (SI) Iringa Manufacturing Company (IMCO) (grain mills, oil expellers, sugar cane crushers) aluminium utensils canvas leather goods ceramics
TCP		tailoring, sisal crafts, bamboo crafts (Njombe)

6. Kagera (SIDO, 1990c, 1991b, 1991c)

RHP	30	11 maize milling 4 tailoring 2 handloom weaving 2 metal fabrication 1 laundry
MHP	12	3 carpentry 3 tailoring 2 handloom weaving 1 bakery
		Printing press (SI)

7. Kigoma (SIDO, 1990c, 1991b, 1991c)

RHP	61	34 maize milling 3 metal fabrication 2 carpentry 2 fishing 1 laundry
WP	5	3 tailoring 1 maize milling
MHP	31	

IE	5	CFW soap making palm oil wood working and farm implements exercise books printing (SD)

8. Kilimanjaro (SIDO, 1990d, 1991b, 1991c)

RHP	99	44 maize milling 19 carpentry 5 metal fabrication 4 tailoring 2 fruit canning 1 soap making 1 stone crushing 1 oil extraction
WP	22	18 maize milling 2 tailoring 1 bakery
MHP	11	
IE	9	CFW CFF hand tools (MOTO) (SI) forging (SI) eyelets (TECO) (SI) scissors (KIBO) (SI) lens grinding with laboratory (SI) mortise locks (Afrilocks) (SI) hammers (HAMAX) (SI)

9. Lindi (SIDO, 1990d, 1991c)

RHP	55	40 maize milling 3 carpentry 2 shoe making 1 benchines 1 metal fabrication
WP	1	
IE	3	CFW PVC Cables handmade paper unit

10. Mara (SIDO, 1990d, 1991b, 1991c)

RHP	33	16 maize milling 3 carpentry 2 metal fabrication 2 tailoring 1 handlooms

WP	7	3 maize milling 1 animal food 1 welding and joinery 1 tailoring
MHP	14	
IE	5	CFW aluminium utensils (Zembwela) (SD) bakery wood working handmade paper

11. Mbeya (SIDO, 1990d, 1991c)

RHP	76	41 maize milling 6 tailoring 4 blacksmith 2 beehives 1 printing 1 handlooms 1 shoe laces 1 saw mill 1 carpentry 1 power ghanis
WP	15	14 grain milling 1 oil expeller
IE	6	CFW (SI) electric motors (SI) knitting (SI) clogs (SI) plastic items (SI) wooden furniture (SI)

subsidiary company: Mbeya Ceramics Company (SI)

TCP	brick making, pottery, ceramics

12. Morogoro (SIDO, 1990b, 1991b, 1991c)

RHP	63	19 grain milling 4 carpentry 2 cobblery 1 farm implements 1 mini sugar plant 1 tailoring 1 metal fabrication 1 general engineering 1 printing press
WP	11	
MHP	7	

IE	3	CFW experimenting sisal-fibre and cement roof tiles fruit canning unit (SI)
TCP		oil extraction, soap making, sorghum dehulling/milling

13. Mtwara (SIDO, 1991a, 1991b)

RHP	42	32 grain milling 2 carpentry 2 salt making 2 blacksmith 1 metal work 1 soap making 1 power ghani 1 shoe making
MHP	10	

14. Mwanza (SIDO, 1991a, 1991b)

RHP	41	9 grain milling 7 metal fabrication 6 tailoring 4 carpentry 3 fishery
WP	11	7 grain milling 2 bakery 1 animal feed 1 hotel bitings
MHP	32	
IE		(just starting) share holder in Engineering and Foundry Company (NEFCO) electric motor rewinding unit (SD)

15. Rukwa (SIDO, 1991a, 1991b, 1991c)

RHP	87	71 grain milling 6 beehives 3 manual oil pressing 2 tailoring 1 handloom weaving 1 carpentry 1 brick making
WP	2	2 grain milling
MHP	12	
IE	5	CFW 2 carpentry motor vehicle repair animal feeds

16. Ruvuma (SIDO, 1991b, 1991c)

RHP	85	63 maize milling 4 carpentry 3 metal fabrication 2 soap making 13 others
WP	2	
MHP	20	
IE	15	(See Section 5.10.1.)

17. Shinyanga (SIDO, 1991b, 1991c)

RHP	29	14 grain milling 3 dehullers (sorghum) 2 blacksmith 2 tailoring 1 carpentry 1 printing press 1 file covers and clips 1 wire nails 1 auto injector pump
WP	3	3 grain milling
MHP	42	
IE	4	CFW CFF wood works farm implements

18. Singida (SIDO, 1990b, 1991b, 1991c)

RHP	37	4 grain milling 4 carpentry 3 handloom weaving 3 lime 2 tailoring 1 metal fabrication 1 sisal carpets 1 oil extraction
WP	15	
MHP	14	
IE	5	CFW general engineering printing press mini shoe factory carpentry

19. Tabora (SIDO, 1991b, 1991c)

RHP	47	34 maize milling 3 metal fabrication 2 carpentry 2 fishing 1 laundry
WP	5	3 tailoring 1 grain milling
MHP	18	
IE		(first phase finished)
TCP		weaving, metal fabrication, carpentry (Azimio)

20. Tanga (SIDO, 1991b, 1991c)

RHP	73	21 grain milling 5 carpentry 5 salt extraction 2 shoe making 2 general engineering 1 brick making 1 tailoring 1 soap making 1 carpet making 1 oil expeller 1 general workshop
WP	7	3 grain milling 1 juice extraction 1 mini bakery 1 tailoring 1 macaroni and spaghetti
MHP	15	
IE	11	CFW acacia roofing sheets grey sheeting material and bed sheets handmade paper garage packing boxes shoe laces tin containers carpentry narrow tapes pencils
TPC		food and fruit preservation
Indo-Tanzanian cooperation		2 food processing units 1 production of fine salt

B. SISTER AND SISTER-DAUGHTER INDUSTRIES

1. Sister Industries

Name and address	Senior Sister (Swedish)	Products	No. of employees
Fabrication and Wire Manufacturers Arusha	AB Finnveden Development	fencing wire, mosquito wire, gauze, wire mesh, coffee tray wire,	17
Northern Electric Manufacturers P.O.Box 979 Arusha	Eldon BV	distribution fuse board, fluorescent fittings, decorative lamp shades, switch fuses, busbar chambers, sub-fuse boxes, square metal boxes, multi box power, distribution panel, low voltage switch gear mcl.	59
Kilimanjaro Metal Shapers P.O.Box 2166 Arusha	AB Finnveden Development	sufuria, wash basins, tumblers, serving trays, serving spoons, water jugs, dabbas electrical wire clips, soup plates, serving dishes	23
Arusha Metal Industries Arusha	Tour and Andersson AB Ljung	switch boxes, gravity die, casted products, globe and gate valves, water taps	35
Arusha Cutlery Company P.O.Box 1214 Arusha	GAB Gense	soup ladles, serving spoons, salad forks etc.	48
Arusha Galvanizing Company P.O.Box 6113 Arusha	DEFAB International	galvanized buckets, dust bins, water storage tanks etc.	11
Shirika la Uchumi na Arusha P.O.Box 1102 Arusha	NTS Spik & Trad AB	nails (all types)	30

Meru Wood Arusha	Hultafors AB	wooden rulers, furniture	
Uhandisi P.O.Box 1278 Arusha	Nitfabriken Walkan AB	wood screws and rivets	8
GIFCO P.O.Box 1278 Arusha	Hybe Makin AB	foundry products	35
Chemical and Allied Industries P.O.Box 1278 Arusha	AB Blifa	des-infection detagents	34
Tanzania Eyelets Company P.o.Box 1719 Moshi	Gotarps Industri AB	shoe eyelets, tent eyelets reverts etc.	9
TAN Optic Company P.o.Box 1001 Moshi	Optileks	optical lenses, spectacles	12
Simon Engineering Works P.O.Box 480 Moshi	GAB Gense	sufuria, spatlers, jembes etc.	60
AMOCO Moshi	GUTEX	polishing buff and wax	6
MAFOTCO P.O.Box 1719 Moshi	GAB Gense	weighing scales, plough shares, other forged products	32
HAMAX P.O.Box 1719 Moshi	GAB Gense	hammers	8
Moshi Handtools Moshi	GAB Gense	coffee shears and pliers, combination plier	16
Afrilocks P.O.Box 1719 Moshi	Lasbolaget AB Mobellas AB	locks	26
Kibo Scissors P.O.Box 1719 Moshi	GAB Gense	surgical instruments	19
NORRAPACK P.O.Box 1719 Moshi	GAFS Kartong AB	packing material	10

Kilimanjaro Electro-Plating P.O.Box 1719 Moshi	Stenberg Galvano AB	electroplating	14
Mbeya Wood & Joinery Works Ltd. P.O.Box 1420 Mbeya	Karl Andersson & Soner AB	sofa sets, dining tables, coffee tables, coffee stools, arm chairs	10
Pioneer Electric Industries P.O.Box 200 Mbeya	EL AB BEVI	electric motors	22
Mbeya Clogs Manufacturers P.O.Box 780 Mbeya	Hultgrens Tra Toffelfabric	clogs, implement handles	26
Mbeya Ceramics Mbeya	Gabrielverken	ceramic household items	25
Mbeya Plastic Industries P.O.Box 1120 Mbeya	Green & Co	plastic toys, plastic bowls	20
Highlands Kniwear Manufacturers Ltd. Mbeya	Bolgo AB	knitted garments	28
Iringa Maintenance Cooperative Ltd. Iringa	Maintec AB	repair and maintenance	30
KODAWA Company P.O.Box 1515 Tanga	National Fibre Concrete AB	acacia roofing sheets	17
M/S Morogoro Food Processing Ind. P.O.Box 1816 Morogoro		fruit juices	

2. Sister-Daughter Industries

Name and Place	Tanzanian Sister	Products
M/S Mwanga Printing P.O.Box 8 Mwanga	NORRAPACK	printing work
M/S SAMADA P.O.Box 8614 Moshi	MAFOTCO	forged products
M/S Zembwela General Stores P.O.Box 464 Musoma	KIMESHA	aluminium utensils
GALKIN Arusha	NEM/AGACO/KIMESHA	lamps
Bigroup Printing Press Kigoma	NORRAPACK	printing work
Singida Printing Press Singida	NORRAPACK	printing work
SIDO Kibaha Kibaha	NORRAPACK	printing work
Kagera Writers Kagera	NORRAPACK	printing work
Mwanza Electric Repair Mwanza	PAMECO	motor rewinding

Source: Consultation at SIDO.

C. PROPERTIES OF OIL EXTRACTION TECHNIQUES

1. IPI manual sunflower oil-extraction equipment

Investment costs	:	TSH 750,000
Building	:	needed
Capacity (kg seed/day)	:	240 kg/day
Oil yield per day	:	48 kg (6 hours)
By-products	:	94 kg of oil cake
Process steps	:	decortication, winnowing, crushing, scorching, pressing, boiling, filtration
Number of labourers	:	6
Kind of seeds	:	sunflower
Oil yield	:	65%
Pressure of press	:	100 kg/cm^2
Use in Tanzania	:	60 units

2. Traditional method

Investment costs	:	-
Building	:	not needed
Capacity (kg seed/day)	:	16 kg/day
Oil yield per day	:	1 kg
By-products	:	-
Process steps	:	roasting, crushing, sifting, boiling, settling, skimming, boiling/drying, filtration
Number of labourers	:	
Kind of seeds	:	sunflower, groundnuts, coconuts
Oil yield	:	20%
Pressure of press	:	-
Use in Tanzania	:	??

3a. Bielenberg press / CAPU-design

Investment costs	:	TSH 60,000 (TSH 35,000 CAMARTEC design)
Building	:	Not needed
Capacity (kg seed/day)	:	50 kg/day (6 hours)
Oil yield per day	:	14 kg
By-products	:	36 kg oil cake
Process steps	:	cleaning, pressing, refining
Number of labourers	:	1 (2)
Kind of seeds	:	soft shelled sunflower, (sesame, groundnuts)
Oil yield	:	75%
Use in Tanzania	:	± 500 units (growing)

3b. Bielenberg press / small version

Investment costs	:	TSH 25,000
Building	:	-
Capacity (kg seed/day)	:	30 kg
Oil yield per day	:	9 kg
By-products	:	oil cake
Process steps	:	warming in the sun, pressing, refining
Number of labourers	:	1 (2)
Kind of seeds	:	soft shelled sunflower (sesame, other sunflower must be decorticated)
Oil yield	:	
Use in Tanzania	:	10

4a. Powered Expellers / Simon Rosedown Mini 40

Investment costs	:	TSH 3,500,000
Building	:	needed
Capacity (kg seed/day)	:	240 kg/day (6 hours)
Oil yield per day	:	50 kg
By-products	:	oil cake
Process steps	:	milling, pressing, filtration
Number of labourers	:	3
Kind of seeds	:	sunflower, sesame, coconuts, groundnuts
Oil yield	:	50%
Use in Tanzania	:	8 units (as far as known)

4b. Powered Expellers / Komet Twin Screw Expeller DD85G

Investment costs	:	TSH 1,700,000
Building	:	needed
Capacity (kg seed/day)	:	90 kg (6 hours)
Oil yield per day	:	25 kg
By-products	:	oil cake
Process steps	:	milling, pressing, filtration
Number of labourers	:	3
Kind of seeds	:	sunflower, sesame, coconuts, groundnuts
Oil yield	:	60%
Use in Tanzania	:	5 units (as far as known)

4c. Powered Expellers / Chinese expeller

Investment costs	:	TSH 1,500,000
Building	:	needed
Capacity (kg seed/day)	:	300 kg (6 hours)
Oil yield per day	:	150 kg (sunflower likely between 60 and 70 kg)
By-products	:	oil cake
Process steps	:	pressing (dried copra)
Number of labourers	:	3
Kind of seeds	:	coconuts, (sunflower, sesame, groundnuts)
Oil yield	:	75%
Use in Tanzania	:	5 units (as far as known/growing)

5. KIT Manual oil-extraction

Investment costs	:	TSH 400,000
Building	:	needed
Capacity (kg seed/day)	:	144 kg/day (6 hours)
Oil yield per day	:	27 kg
By-products	:	48 kg oil cake
Process steps	:	decorticating, winnowing, crushing, scorching, pressing, boiling, filtration
Number of labourers	:	8
Kind of seeds	:	sunflower, (groundnuts)
Oil yield	:	65%
Pressure of press	:	45 kg/cm^2
Use in Tanzania	:	??

D. QUESTIONNAIRES

1. Questionnaire for visiting an oil mill

Date:
1. General data:
Name of interviewee:
Status of interviewee:
Name of the mill:
Address of the mill:
Ownership of the mill:

Type of the mill (brand name and kind of process):

Date of buying the mill:
Date of start of the production:
Capacity of the mill (number of kilograms processable per day):

If there is a press, possible pressure (kg/cm^2):

2. Production process
Make while looking around and asking some specific questions a diagram and small description of the production process combined with inputs and outputs.

3. Inputs

Fill in the following scheme:

material inputs	type	costs	quantities	source
seeds				
fuel				
spare parts			*****	
water				*****
other				

Personnel Inputs
- number of people in permanent employment:
- other kinds of employment (eventually ask for some description):
  - type of positions:
  - male/female:
  - skills:
  - costs:
- total labour costs:
- number of hours working per day:
- number of days working per week/month/year:

Financial Inputs
- costs of machinery:
- costs of building:
- other investment costs:
- source of financing (eventually some description):

4. Outputs

output	quantity	price	quality	use/application
oil				*****
cake			*****	
husks		*****		
other				

5. Miscellaneous

Marketing:
- Who are your customers?
- Do they approach you or you them?
- Are there any competitors (large scale/import)?
- Are you ever left with unsellable oil?

Other:
- How you get knowledge about the technology?
- Why or on what ground did you start the unit?
- Has it affected your other activities?
- Has it changed your spending pattern?
- Are there any problems in executing the pressing process?
- Do you have contacts with other units?
- Do you have access to extension officers and for which reasons?
- Can you modify and adjust the technology for specific purposes?
- Did you have problems with break downs?
- What possibilities for repair are there?
- Do you get back stopping from the producer?
- Do you use other "technologies" ?
- Other remarks/problems/comments.....

2. Questionnaire for Research and Development

Date:
Name and address:
Name of interviewee:
Technology concerned:
1. Where did the idea originate?

2. How did the idea originate?

3. Was a need-assessment study carried out?
- Which system was used?
- How did the need-assessment connect with the start of the R&D programme?

4. Why was the R&D programme started?

5. Who did the R&D?

6. Where was R&D done?

7. Give a short description of the R&D unit:
   - personnel:
   - skills:
   - machine facilities:

8. Give a short description of the R&D cycle.
   - developing:
   - laboratory testing:
   - find test places in the field:
   - field testing:
   - cycle elements:

9. What are the sources of finance and are these project or general oriented?

10. What policy do you adopt to bring innovations in batch production?
   - When is a product ready for batch production?
   - Are there any activities concerning marketability and feasibility of technology?
   - Is it done by the organization itself or by external enterprises?
   - What policy you use to find external entrepreneurs and how do you assist them (twinning, advertising (news papers/trade fairs))?

11. Do you have any comments or remarks on factors that hinder or help the R&D process?

3. Questionnaire for producers

Date:
Name and address:
Name of interviewee:
Technology concerned:

1. How did you learn about and from whom did you receive the technology (commercial organizations, non-profit organizations, literature, trade fairs, advertisement, other entrepreneurs, invented yourself etc.)?

2. Under which conditions were you allowed to produce the technology (free of charge, under license, patent)?

3. If you acquired the innovation from a development and/or research unit, does this unit provide back-stopping in the fields of:
   - production training
   - repair
   - maintenance
   - modification of hard ware
   - management

4. How did you finance the setting up of the production line?
(own capital, bank loans (commercial/other), development aid (gift), other means)?

5. What policy do you adopt to market/sell your products?
How did you estimate your potential customers?
If you did not estimate, how did you determine your wanted production capacity?
How did you reach your customers with the news that you have an important innovation?

Do you provide back-stopping to users?
- demonstration days:
- field visits:
- other:

Do others, e.g. extension officers, provide back-stopping to users?

6. Give a short description of the production process.
(diagram, inputs, outputs, personnel, skills, machinery).

7. Are their any constraints for the construction and selling of the technology in the following fields?
- inputs (materials, personnel, machinery, finance):
- government laws and regulations: e.g. is the government consistent in its support?
- poorly of users:
- religious matters:

8. Do you have any further comments or problems you want to discuss about obtaining, producing and selling of the technology?

Examples of answers from two interviews

1. Answers from a women group owning a set of IPI-equipment

(Note: this is just an example and certainly not one of the most positive ones.)

Date: 22-2-1992.
1. Interviewee: chairman of the oil-mill.
Village: Nyamihuu; region: Iringa.
Ownership: women group.
Equipment: manual IPI-equipment with a 80-ton press, without winnower.
Started: May 1988.

2. Production process:

decorticating - winnowing (by hand) - crushing - scorching - pressing - boiling

The husks are used in husk stoves for scorching and boiling.
During scorching water is added and during boiling salt and water.

3. Inputs
Mainly black seeds; price TSH 2500 per bag (1 bag = 50-60 kg).
Spare parts have to from IPI; water is available free; salt is available.

Normal production is 2 bags and three buckets per day (1 bucket = ±15 kg).

The women group consists of 11 members and they employ one man.
Three members are working per day, 6 days per week, 7 hours per day.
They pay themselves TSH 150 per day.

Total investment was TSH 480,000, from which TSH 150,000 for the equipment.
They got a soft loan from TSH 271,920. The rest of the money came from equity and from the village.

4. Outputs
Oil: about one tin (1 tin = ±20 litres) and 10 bottles (1 bottle = ±75 cl) per day.
Price of oil is TSH 300 per bottle.
Cake is sold as pig food.
Husks are used as fuel and as fertilizer.

5. Miscellaneous
The customers are the villagers.
There is little oil in the village so there are no selling problems.
A problem is to get seeds. Since August there is no production, because there are no seeds. The larger oil-mills in Iringa are buying a lot of seeds when they are cheap and they pay a price that the women can not afford.
Knowledge about the IPI-equipment came from the Iringa Nutrition Programme.
The aim was producing oil as high energy food and strengthening the position of the women.
The machines are rather heavy to operate, especially the decorticator and the roller.
There were some problems with the machinery:
- the decorticator was not decorticating properly after it was repaired last time;
- there were problems with the roller;
- a grill in a husk stove was worn out.

Other points mentioned are:
- they had a problem to repay the remaining part of the loan (TSH 150,000) before the deadline (May 1992);
- they also asked for a new loan (TSH 500,000) to buy seeds ;
- the women group planted 6 acres of sunflower and the other villagers planted 60 acres for this season.

2. Answers from a producer

Date: 27-1-1992.
Place: CFW-Arusha.
Interviewee: Workshop foreman.
Equipment: Bielenberg press.

1. A man from America came with the ready design to the workshop.

2. There was no charge to get the design, but they had to copy it according the sample.

3. Copying was possible with the knowledge available at the workshop. They made themselves the drawings at the workshop.

4. No machinery had to be added to the workshop.

5. The people of the workshop wait for customers. They have one sample of the press in stock to show the customers. If anybody wants to have one, they will produce. They showed the design at some Trade Fairs.
The workshop gives a period of guarantee of three months and can repair the presses. Demonstrations are given and information about oil seeds is presented. There is a users manual.

6. The production process is not very complicated. It is straight forward putting together pieces of steel. The cage is the most difficult part. It is difficult to get the small square bars ground in the good angles and to put them together with the needed spaces in between.

7. Inputs, manpower and machinery is no problem. Individuals with some own business or villagers with some cash crops can buy the press.

8. Perhaps the price from other producers is lower, but they may have lower quality.

E. POPULATION IN REGIONS AND DISTRICTS IN TANZANIA

01 Dodoma	**1,237,819**
011 Kondoa	340,554
012 Mpwapwa	339,954
013 Dodoma Rural	353,478
014 Dodoma Urban	203,833
02 Arusha	**1,351,675**
021 Monduli	109,292
022 Arumeru	321,835
023 Arusha (Urban)	134,708
024 Kiteto	127,360
025 Babati	208,385
026 Hanang	113,191
027 Mbulu	268,129
028 Ngorongoro	68,775
03 Kilimanjaro	**1,108,699**
031 Rombo	200,859
032 Mwanga	98,260
033 Same	170,053
034 Moshi Rural	342,553
035 Hai	200,136
036 Moshi Urban	96,838
04 Tanga	**1,283,636**
041 Lushoto	357,255
042 Korogwe	217,810
043 Muheza	231,394
044 Tanga (Urban)	187,455
045 Pangani	37,867
046 Handeni	251,855
05 Morogoro	**1,222,737**
051 Kilosa	347,233
052 Morogoro Rural	431,795
053 Kilombero	187,062
054 Ulanga	138,887
055 Morogoro Urban	117,760
06 Coast (Pwani)	**638,015**
061 Bagamoyo	173,918
062 Kibaha (Urban)	83,018
063 Kisarawe	195,709
064 Rufiji	152,316
065 Mafia	33,054
07 Dar es Salaam	**1,360,850**
071 Kidondoni (Urban)	621,389
072 Ilala (Urban)	333,708
073 Temeke (Urban)	405,753
08 Lindi	**646,550**
081 Kilwa	150,212
082 Lindi Rural	284,523
083 Nachingwea	118,017
084 Liwale	52,211
085 Lindi Urban	41,587
09 Mtwara	**889,494**
091 Mtwara Rural	169,436
092 Newala	307,998
093 Masasi	335,428
094 Mtwara Urban	76,632
10 Ruvuma	**783,327**
101 Tunduru	170,235
102 Songea Rural	254,367
103 Mbinga	271,845
104 Songea Urban	86,880
11 Iringa	**1,208,914**
111 Iringa Rural	363,605
112 Mufindi	229,304
113 Njombe	315,976
114 Ludewa	99,689
115 Dodoma Urban	115,480
116 Makete	84,860
12 Mbeya	**1,476,199**
121 Chunya	164,554
122 Mbeya Rural	332,430
123 Kyela	135,645
124 Rungwe	272,008
125 Ileje	88,436
126 Mbozi	330,282
127 Mbeya Urban	152,844
13 Singida	**791,814**
131 Iramba	290,260
132 Singida Rural	285,092
133 Manyoni	135,475
134 Singida Urban	80,987

14 Tabora	**1,036,293**
141 Nzega	295,613
142 Igunga	203,097
143 Tabora Rural	256,641
144 Urambo	187,436
145 Tabora Urban	93,506
15 Rukwa	**694,974**
151 Mpanda	256,487
152 Sumbawanga Rural	236,340
153 Nkasi	110,175
154 Sumbawanga Urban	91,972
16 Kigoma	**854,817**
161 Kibondo	176,262
162 Kasulu	320,518
163 Kigoma Rural	273,390
164 Kigoma Urban	84,647
17 Shinyanga	**1,772,549**
171 Bariadi	382,383
172 Maswa	221,194
173 Shinyanga Rural	405,605
174 Kahawa	503,204
175 Shinyanga Urban	100,724
176 Meatu	159,439
18 Kagera	**1,326,183**
181 Karagwe	292,589
182 Bukoba Rural	343,956
183 Muleba	274,447
184 Biharamulo	209,524
185 Ngara	158,658
186 Bukoba Urban	47,009

19 Mwanza	**1,878,271**
191 Ukerewe	172,893
192 Magu	310,918
193 Mwanza (Urban)	223,013
194 Kwimba	428,135
195 Sengerema	304,121
196 Geita	439,191
20 Mara	**970,942**
201 Tarime	341,146
202 Serengeti	113,284
203 Musoma Rural	247,106
204 Bunda	200,870
205 Musoma Urban	68,536
51 Unguja Kaskazini	**97,028**
511 Kaskazini "A"	59,992
512 Kaskazini "B"	37.036
52 Unguja Kusini	**70,184**
521 Kati	45,037
522 Kusini	25,147
53 Mjini na Magharibi	**208,327**
531 Magharibi	50,693
532 Mjini (Urban)	157,634
54 Pemba Kaskazini	**137,399**
541 Wete	76,258
542 Konde	61,141
55 Pemba Kusini	**127,640**
551 Chake	60,131
552 Mkoani	67,509

Source: Bureau of Statistics, 1989.