The implementation of an innovation for sustainable economic development in rural areas the case of solar fruit & vegetable drying in rural Tanzania

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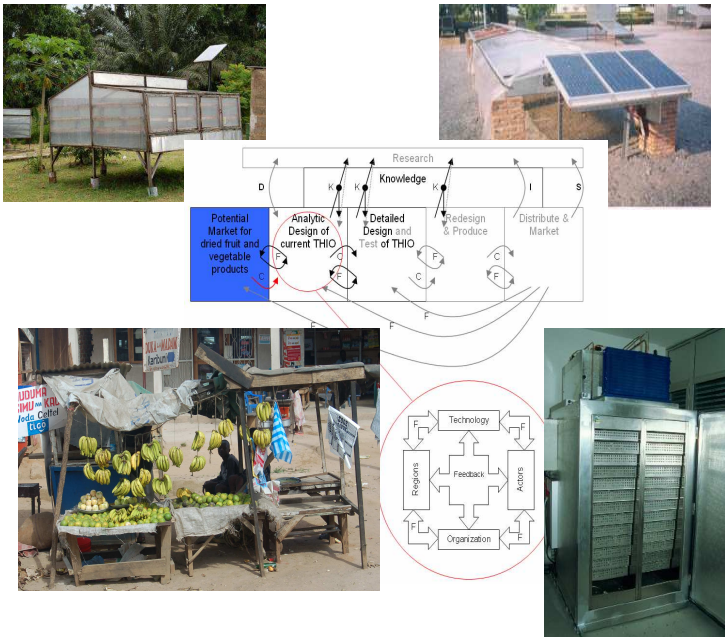

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May, 2007

“If you give me rice, I will eat today, if you teach me how to grow rice, I will eat every day”

M. Gandhi

Preface

This thesis is written for the fulfilment of the Master program in Technology Development Studies at the University of Technology in Eindhoven. The data collection for this thesis was executed in Tanzania for a period of six months, from June till December 2006.

Doing research in a developing country is always a guarantee for the occurrence of a lot of new experiences and unexpected events. To mention a few: power shutdowns, language-problems, malfunctioning equipment, huge numbers of insects, cultural differences, and so on. We have experienced it all, but we have to say our stay here has been unforgettable. We were able to see and talk to numerous people in Tanzania, sometimes in very remote areas, which provided us with great experiences.

First of all, we would like to thank Henny Romijn and Henk Toersen, as our first en second supervisors, for their help and guidance throughout our graduation project.
Furthermore, we received great cooperation from the faculty of Mechanical and Chemical Engineering from the University of Dar es Salaam. We would like to thank Dr. Njau in particular for who has been our supervisor during our stay here and provided us with information about the project and not in the least with the facilities to conduct our research.
We would also like to thank the rural farmers and the other people we were able to interview. They all received us and the project with great enthusiasm and we sincerely hope that the outcome of this research will benefit them.
Last, but certainly not least, we would like to thank the other employees at the department for Technology Development Studies at the Eindhoven University of Technology, who have helped us with our project.

We have learnt a lot from our stay in Tanzania and the experience has been an essential input for our research. We have seen the great potential of the (dried) fruit and vegetable sector and we hope that our research will contribute to the development of this sector, which, in turn, will create numerous benefits for the people of Tanzania.

We hope that you will enjoy reading this thesis.

Jan van Diesen
Edwin Vriens

Eindhoven, May 22nd, 2007

Summary

A lot of fruits and vegetables are produced in Tanzania. These fruits and vegetables are grown by small individual farmers scattered over a large area of land who seem to have become fruit and vegetable farmers by tradition and their choice seems not to be based on any commercial motive. On a domestic scale, however, Tanzania produces a lot of fruits and vegetables. Especially when comparing Tanzania with Uganda, Kenya and South Africa in this respect. Nevertheless, Tanzania is unable to really benefit from this natural resource as an export product. This is caused by poor infrastructure, low education levels etc.

The University of Dar es Salaam tackled this problem by introducing a preservation technology for fruits and vegetables, namely: solar drying. They started the solar drying project with the aim of helping the rural farmers to conserve their fruits and vegetables and thus enabling them to sell the usual part of their harvest as fresh products and the other part of the harvest, which would otherwise be spoilt due to the problems mentioned above, as dried products.

The way of disseminating the fruits and vegetable drying technology by the University of Dar es Salaam could be questioned because the fruit and vegetable drying projects were all largely unsuccessful. The dissemination of the technology has all the characteristics of a top-down or technology push model, whereas different literature point out that an innovation cannot be taken as exogenously given fact but must be adopted in the field itself with close interaction with the end user during the development. This is an evolutionary type of model and the chain-linked model by Rosenberg and Kline is a good example of this type of model.

This research is to determine a suitable technology for solar fruits and vegetables drying in Tanzania including an appropriate project set-up. Furthermore, this research is to see if this chain-linked model is applicable in the case for fruit and vegetable drying in Tanzania. This was done by determining a promising potential market for the dried fruits and vegetables, which resulted in requirements for the dried produce which had to be met in order for Tanzania to be able to export to this market.

Then the currently available technologies for drying had been analysed and in which ways these technologies were or were not able to meet the requirements of the export market. What followed was a comparison between the different technologies and two technologies were recognised as being the most suitable technology given the set of preconditions in Tanzania. These technologies were the tunnel dryer and the heavy duty cabinet dryer.

After this analysis, the focus shifted to the actors involved in the fruit and vegetable drying project. From this analysis we concluded that the roles of the different actors are very chaotic. They are all involved in a lot of aspects concerning the drying project, i.e. they are involved in training, machine building, regulating, information, etc. without concentrating on a few core competencies. They seem to be able to pinpoint the difficulties concerning drying but are unable to solve these problems.

During the research, it became clear that individual drying by individual farms is not a suitable organisation structure if Tanzania is aiming to generate money for development from this project. Therefore different organisation structures have been analysed, which resulted in a cooperative organisation structure where a group of individual farmers cooperate voluntarily to deliver fresh fruits and vegetables to an elected and skilful group leader who will deliver the fresh produce to a centrally located drying facility which is owned by the cooperation of farmers. This drying facility is owned by the farmer group, and profits will be distributed among the participating farmers according to delivered quantity.

In line with the model of innovation by Rosenberg and Kline, the solar drying technology has to be tested in combination with a suitable organisation structure with clear roles for the different actors involved. For testing, the most suitable regions for fruit and vegetable drying have to be identified. The choice on particular drying places is based on the presence of popular crops for drying, transport infrastructure and the availability of electricity and water. As the four most suitable locations, Tanga, Morogoro, Kagera and Mwanza were identified.

The analyses of the technologies, actors, organisation structures and the regions resulted in a so called detailed design. This is the obvious next step in the chain-linked model. This detailed design consists of a choice for two possible technologies and a particular organisation structure. Furthermore, recommendations are given for the roles of the different actors and a financial analysis is given for the tunnel dryer and heavy duty cabinet dryer technology in each of the four regions. The phase of testing which is included in the chain-linked model will be at the responsibility of the University of Dar es Salaam which initiated the introduction of solar drying technology and will play a key role in the dissemination of this technology following this new type of implementation model. Whether this model will prove to be successful will remain subject to research when the test phase is completed and will therefore be outside the scope of this research.

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Conceptual Definitions and Abbreviations

Conceptual Definitions

Sustainable development: Development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts: the concept of "needs", in particular the essential needs of the world's poor, to which overriding priority should be given; and the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and the future needs. (Brundtland Commission, 1987).

Rural Area: Places (incorporated or unincorporated) with fewer than 2,500 residents and open territory (USDA)

Rural population: persons living in the open country or in towns of less than 2,500 people. It is subdivided in the rural farm population which comprises all rural residents living on farms, and the rural non farm population which includes the remaining rural population. (John D. Rockefeller, 1972)

Dried fruit: is fruit that has been preserved by drying, either naturally or through use of a machine

Organic food: in general, is food that is produced without the use of artificial pesticides, herbicides, and genetically modified organisms (GMOs). (Wikipedia, 2006)

List of abbreviations

APT	: Alleviating Poverty Together
AREED	: Africa Rural Energy Enterprise Development
BDS	: Business Development Services
CAC	: Codex Alimentarius Commission
CARMATEC	: Centre for Agricultural Mechanisation and Rural Technology
CBA	: Cost Benefit Analysis
CBI	: Centre for the promotion of Imports from Developing Countries
CBO	: Community Based Organisation
COET	: College Of Engineering and Technology
CTI	: Confederation of Tanzanian Industries
DFID	: Department For International Development
EBA	: Everything But Arms agreement
EU	: European Union
EurepGap	: Euro- Retailer Produce Working Group for Good Agricultural Practice
FAO	: Food and Agriculture Organization
GMP	: Good Manufacturing Practice
GSP	: Generalised Scheme of Tariff Preferences
HACCP	: Hazard Analysis and Critical Control Points
IRR	: Internal Rate of Return
Kg	: Kilogram
Km	: Kilometers
LDC's	: Least Developed Countries
m	: Metres
MECHE	: Faculty of Mechanical And Chemical Engineering
NEDF	: National Entrepreneurship Development Fund
NGO	: Non-Governmental Organisation
NICo	: National Investment Company limited
NMB	: National Microfinance Bank
NPV	: Net Present Value
NRI	: National Resource Institute
PRIDE	: Promotion of Rural Initiative and Development Enterprises Limited
SCF	: Small & medium enterprise Competitiveness Facility
SELF	: Small Entrepreneurs Loan Facility
SIDO	: Small Industries Development Organisation
SME	: Small and Medium Enterprises
TaTEDO	: Tanzania Traditional Energy Development and Environment Organisation
TBS	: Tanzania Bureau of Standards

TDTC	: Technology Development Transfer Centre
TFDA	: Tanzania Food and Drugs Authority
THIO	: Technoware, Humanware, Infoware, Orgaware
TIRDO	: Tanzania Industrial Research and Development Organisation
TOT	: Trainer of trainers
ToT	: Terms of Trade
Tsh	: Tanzanian Shilling
TU/e	: Technische Universiteit Eindhoven
UDSM	: University of Dar es Salaam
UK	: United Kingdom
UN	: United Nations
UNIDO	: United Nations Industrial Development Organisation
USAID	: United States Agency for International Development
USP	: Unique Selling Point
VAT	: Value Added Tax
WED	: Women Entrepreneurship Development
WHO	: World Health Organisation

Structure of the Report

The reports start with an introduction that defines the need, the aim and the potential of the project, to clarify the significance of the project.

The structure of the report will be based on the used research framework, founded on Rosenberg and Kline's chain linked model, this model, the choice for this model and the interpretation of this model regarding to this specific project will be discussed in chapter 1.

The used model is composed of several elements that will serve as a guide for the rest of the report, the used elements in the model are defining a potential market, analyse the currently available designs and elements dealing with the fruit and vegetable drying project and a detailed design proposal for the start up of the project.

Chapter 2 handles with potential markets for dried fruits and vegetables. The relevant requirements to serve these markets are discussed as well and will later be used in the research.
Chapter 3, which is part of the analytic design, discusses questions like: What suitable technologies are available for sun-drying of fruits and vegetables in rural areas? What suitable technologies are able to meet the market requirements stated in the previous chapter? From these questions the most suitable technologies will be analyzed.
Chapter 4, also part of the analytic design, discusses the different organisation structures for the fruit and vegetable drying project in Tanzania. The actors who are involved in the project will be analysed in chapter 5 and the regions which are suitable for starting up the fruit and vegetable drying project are discussed in chapter 6.
The detailed design consists of a plausible and founded method to successful implementation of the project. Not only the most suitable technology, but also with the best geographical areas for implementation, and a suitable organization set-up in conjunction with recommendations for the roles of the important actors. The financial viability will be tested by means of a cost-benefit analysis for this project. This is discussed in chapter 7

In Chapter 8 a conclusion is drawn based upon the initial research question raised in chapter 1. A discussion about the model for implementation of innovation is discussed in the light of this research and further research issues are brought forward.

1. Introduction

This chapter starts with the reasons for conducting this research and background information about the importance of this research. This chapter continues with discussing the research theories which are important for the dissemination of solar drying technology. Then a suitable theory for this thesis is explained more thoroughly and how it is used in this particular research. The chapter continues with explaining which information was used for this research and why this information is relevant. This chapter end with elaborating on the research limitations.

1.1 Aim of the Solar Drying Project by the UDSM

The aim of the University of Dar es Salaam (henceforth: UDSM) was to introduce solar drying technology in the rural areas of Tanzania to enable farmers to generate more income from the fruits and vegetables that are grown in Tanzania. This should result in a higher income for the rural farmers and thus raising a large part of the rural population from subsistence level.

1.2 The Research Aim

The initiator of the project for the implementation of solar drying technology in Tanzania is the UDSM. However, the UDSM failed to implement a suitable technology for solar drying. The primary research aim is to determine the following:
What is a suitable technology and project set-up for solar drying of fruits and vegetables in Tanzania?

This UDSM appears to be using a linear[1] implementation model (see paragraph 1.4.1) for the solar drying technology. A promising model of implementation for technologies is the Chain-Linked[2] model by Rosenberg and Kline.

Another aim of this research is therefore to use and adapt the Chain-Linked model by Rosenberg and Kline (this model will be further discussed in paragraph 1.4.2) to implement solar drying technology in a sustainable way in Tanzania. This research aim results in the following research question:
Is it possible to use the Chain-Linked model by Rosenberg and Kline for the sustainable implementation of solar drying technology in Tanzania?

When this model is proven to be successful for the sustainable implementation of a low-tech innovation like the solar drying technology, this research can be used as a guideline for the sustainable implementation of other innovations in developing countries. If this model is indeed proven successful, a logical follow-up research question is:
Is the Chain-Linked model by Rosenberg and Kline a suitable model for the sustainable implementation of innovation in developing countries?

1.3 Research Background

Agriculture is of great importance to the Tanzanian economy, it is the main contributor to the 7 percent (2005) average growth of GDP in the country[3].

	2000	2005
GDP (current billion $)	9,1	12,1
GDP growth (annual %)	5,1	7,0
GDP implicit price deflator (annual % growth)	7,5	3,7
Value added in agriculture (% of GDP)	45,0	44,5
Value added in industry (% of GDP)	15,7	17,8
Value added in services (% of GDP)	39,2	37,6
Exports of goods and services (% of GDP)	14,4	17,1
Imports of goods and services (% of GDP)	22,7	26,3

Table 1.1: Economic data of Tanzania

[1] Stephan J. Kline and Nathan Rosenberg "An Overview of innovation" ,1986, in Ralph Landau and Nathan Rosenberg (eds.), *The Positive Sum Strategy: Harnessing Technology for Economic Growth, Washington*, DC: National Academy Press, p 285-6
[2] Ibid
[3] IMF world bank economic data of Tanzania, 2007

A contributor to this sector is the seasonal fruit and vegetable sector. The products of this sector are mainly grown by small scale farmers in rural areas. Because of the bad infrastructure in Tanzania, and the lack of organisation of the smallholder fruit growers, the farmers are highly dependent on middlemen who transport the fruits to the main markets. The high transportation costs of fruit makes up a significant portion of the total fruit price in the urban areas. Furthermore, prices of fruit vary tremendously since production is seasonal. This results in a high fraction of produce that is spoilt at farm level (approximately 50%) and a slump of prices for fruits during the harvest seasons.
To counter these problems the UDSM decided to develop a machine that is capable to do "onsite processing". With this "onsite processing" farmers will be capable to produce semi finished products themselves, which could be further processed in urban centres. The UDSM proposes a technique for "onsite processing", which, according to the UDSM, is very suitable and could be easily adapted for the rural areas, namely solar drying of fruit to produce dried fruit.
Moreover, the project of solar drying technology could provide an opportunity for graduated BSc. Mechanical engineers to start their own workshops in producing these small scale fruit dryers.

With the help of statistical data obtained from the FAO, the large potential for the fruit-drying project is emphasized in the figure below. However, the graphs also reveal that Tanzania has shortcomings in comparison with important countries in the fruit sector near Tanzania[4].

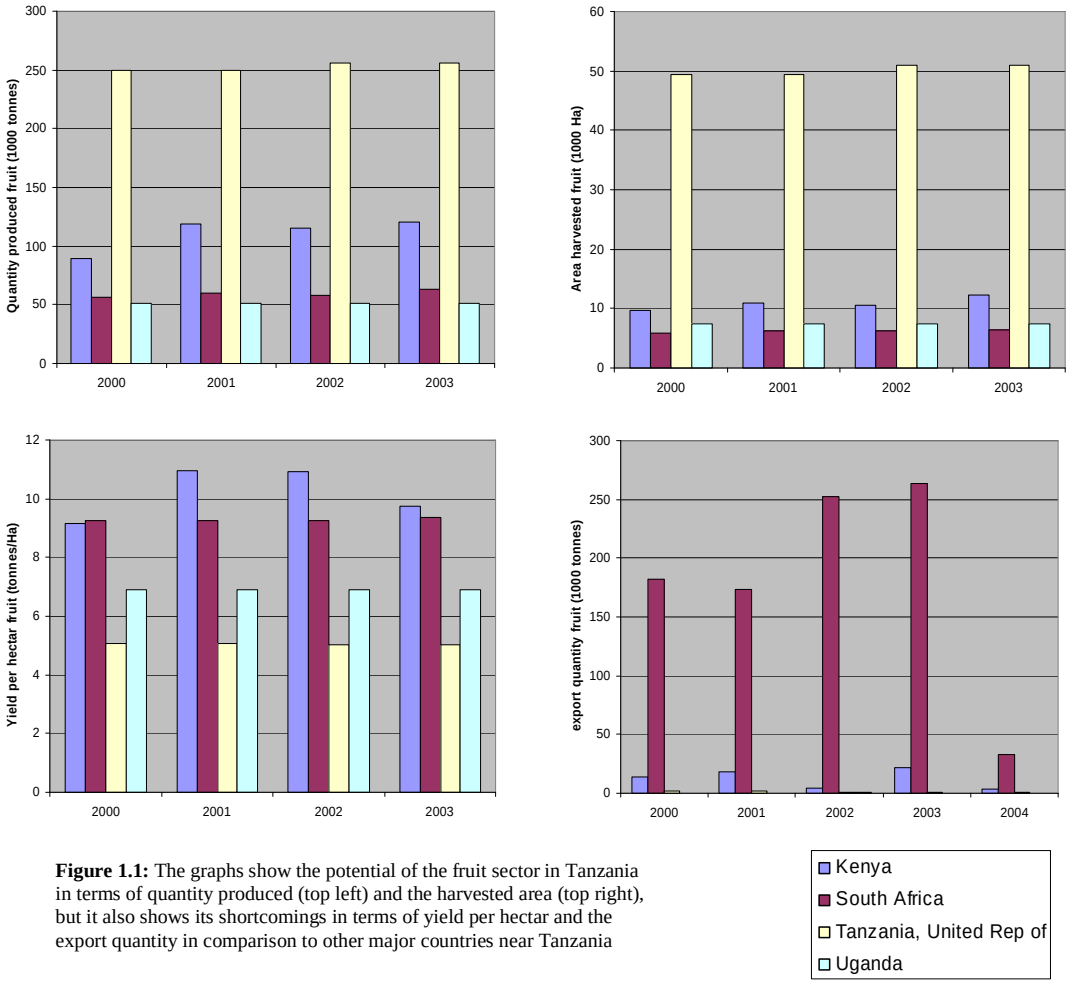


Figure 1.1: The graphs show the potential of the fruit sector in Tanzania in terms of quantity produced (top left) and the harvested area (top right), but it also shows its shortcomings in terms of yield per hectar and the export quantity in comparison to other major countries near Tanzania

At the moment the project of fruit drying technology is experiencing problems in disseminating the technology to its proposed users. Part of the solution for this problem lies in the model of commercialization used for this technology. At the moment the UDSM uses the so called top-down, or linear model of commercialization. This model is still frequently used with innovation implementation

[4] FAO Statistics, 2006

projects in developing economies. The initial proposal of the UDSM briefly discusses market demand for this specific machine and its products as well as promotion of the used technology.
However, many experiences with development of new technologies, including several post harvest technologies in developing countries, point to serious limitations of the linear model. Successful innovation projects have followed a rather different approach, in which success in innovation is conceptualized as a result of long-term relationships and close interaction with agents external to the innovator. This is the so called chain-link model. In the chapter of the research set up in this report, this model will be discussed extensively.

1.4 Research Framework

The research framework that will be used for this thesis is presented in paragraph 1.4.3. However, it is important to understand which model is currently used by the UDSM (paragraph 1.4.1) to understand why they encounter problems when trying to implement their technologies, but it is equally important to understand the basics of Chain-Linked model by Rosenberg and Kline (paragraph 1.4.2) to see where our research framework is based on.

1.4.1 The linear model

The initial framework chosen by UDSM for the implementation of the new technology can be defined as a top-down, or linear model, where there is a specific technology developed which then has to find its way to a certain existing market. In other words, it is assumed that the market will readily accept the particular solution that is being offered. According to USDM, the next step will be to investigate the size of the potential market for dried fruits locally and abroad. After that, the commercialization of the new technology can start.

Agarwal (1983), Rothwell (1992), Rosenberg and Kline (1986) among others pointed to the serious limitations, in diffusing an innovation with the top down model. Agarwal especially pointed out the limitations of this model in developing economies. She argues that close involvement of the end user of the innovation is required to successfully implement an innovation. In the top down model or linear model (figure 1), the end user of the innovation only gets closely involved in the last step of the model.

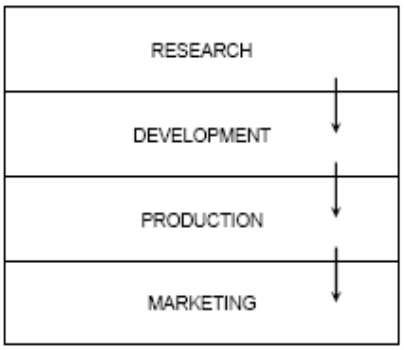


Figure 1.2: Linear Model of Innovation,

Projects in developing economies often suffer problems with sustainability, when the projects stops the innovation is stopped being used by the user. In a linear model this problem is usually seen as an "information-communication and persuasion"[5] problem, thus policies are often aimed at these issues. In other words: the failure of sustainable innovation adoption is seen to be caused by a lack of knowledge of the end users. Aspects of unsuitability of the innovation itself are little emphasized. Another problem with the linear model, according to Agarwal, is the unequal and hierarchal approach of promoters of the innovation and the adopting rural poor, they are seen as "those who do not know what is good for them"[6].

Several studies, e.g. Agarwal's, point out that an innovation cannot be taken as exogenously given but must be adapted in the field itself. Close interaction with, and involvement of the end user of the innovation, in the course of its development, is very much desired. The point of interaction of the end user is open to discussion, an end user could be immediately involved with the design of the innovation, the innovation itself could be obtained from end users themselves, or the designed prototype is discussed with the end users.

Besides the necessity for sustainable innovation implementation Agarwal points to several beneficial aspects of end user involvement: "preventing indigenous skills and knowledge from dying out"[7]; by using this knowledge and skills in the innovation and further develop them; indigenously-generated innovations can in this way be enhanced through the "learning by doing effect". It can also "ensure that the innovation is appropriate to user' needs: this together with the users' increased sense of involvement and understanding of the technical aspects underlying the innovation, could bring about a

[5] Agarwal, B. (1983), "Diffusion of Rural Innovations", *World Development*, 11 (4), p 360
[6] Ibid., 360
[7] Ibid., 361

more ready acceptance and hence successful diffusion of the innovation"[8]. Agarwal concludes that if one wants to diffuse a rural innovation one is "likely to be conditioned by the technical, economic and social characteristics of these innovations"[9]. An engineer and an economic historian co-author, called Stephen J. Kline and Nathan Rosenberg describe their "Chain linked model of innovation" in an essay called "An overview of Innovation" (1986).

In this essay the cherished linear model is criticized by illustrating the viewpoint that innovations must and can not be implemented in a smooth well behaved and linear process, as if the fixed steps in this linear model were "the "begats" of the bible"[10]. The authors found several limitations with the linear model. For example, they pointed out that there were no so called feed back loops in the process, which are inherent in the development process, "forms of feedback are essential to evaluation of performance, to formulation of the next step forward, and to assessment of competitive position"[11]. Further their view was that design, not science, was the central process of innovation. Their overall critique: "Thus, the notion that innovation is initiated by research is wrong most of the time."[12] They conclude by saying that there is "no choice but to abandon the linear model"[13]. Rosenberg and Kline present the Chain linked model as a suitable alternative.

1.4.2 The Chain Linked Model

The chain linked model is shown in figure 1.4. Although a central chain of innovation (C) generally follows the direction of the linear model, the chain linked model is a much richer representation of an innovation process. It features many enhancements including extensive incorporation of feedback loops, and perhaps most importantly, it reflects research (or scientific knowledge) as not the driver, but a common resource available throughout the innovation process.

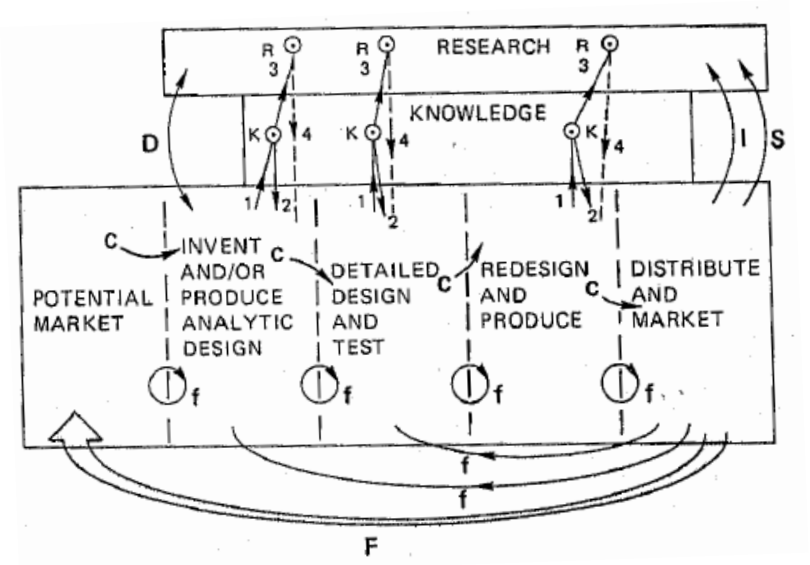


Figure 1.3: Chain-Linked model showing flow paths of information and cooperation.
Symbols on arrows:
C = central-chain-of-innovation;
f = feedback loops;
F = particularly important feedback.
K-R: Links through knowledge to research and return paths. If problem solved at node K, link 3 to R not activated. Return from research (link 4) is problematic – therefore dashed line
D : Direct link to and from research from problems in invention and design.
I : Support of scientific research by instruments, machines, tools, and procedures of technology.
S : Support of research in sciences underlying product area to gain information directly and by monitoring outside work. The information obtained may apply anywhere along the chain.

[8] Ibid., 361
[9] Ibid., 372
[10] Stephan J. Kline and Nathan Rosenberg "An Overview of innovation" ,1986, in Ralph Landau and Nathan Rosenberg (eds.), *The Positive Sum Strategy: Harnessing Technology for Economic Growth, Washington,* DC: National Academy Press, p 285-6
[11] Ibid., 286
[12] Ibid., 288
[13] Ibid., 288

There is no explicit market push or pull because each market need entering the innovation cycle leads in time to a new design, and every successful new design, in time leads to new market conditions.
As stated the model does not reflect research as a driver but a resource needed; "When we confront a problem in technical innovation, we call first on known science, stored knowledge, and we do so in serial stages. Only when all stages fail to supply the needed information, as often happens, is a call for the second part of science, research, needed and justified"[14]. Rosenberg and Kline conclude: "In sum, the use of accumulated knowledge called modern science is essential to modern innovation; it is a necessary and often crucial part of technical innovation, but it is not usually the initiating step. It is rather employed at all points along the central-chain-of-innovation, as needed. It is only when this knowledge fails, from all known sources, that we resort to the much more costly and time-consuming process of mission-oriented research to solve the problems of a specific development task"[15].

Rosenberg and Kline' chain-linked model was originally developed for a high-tech environment, and now has to be implemented in the local (low-tech) context. The Rosenberg and Kline model can be considered as a typical example of a Technology and Policy framework, in which an innovation is studied from an integrally technologic societal perspective.

1.4.3 Adopting the chain link model

In order to utilize the chain link model as described in the previous paragraph, the theoretical model has to be transformed to a practical model, which will be used in the research. In the figure below, the operational model of the chain link model is given.
In the central chain of innovation, the analysis of a potential market will result in a couple boundary conditions in terms of requirements for the products to be sold in this particular market. These requirements will have to be achieved with a particular set-up for solar drying technology projects in Tanzania. The boundary conditions from the potential market will therefore serve as an input for the analyses of the technologies, organisation set-ups, actors involved in the research and possible drying locations in the country. After analysing the different technologies it will be clear which technologies (the Technoware) will be able to produce products which comply with the boundary conditions of the potential market, the focus will shift to: the analyses of the actors which are involved in fruit and vegetable drying and how and why they should have a particular role to be successfully in solar drying (the so called Humanware), the analyses of facilitating organizations who provide certain knowledge about the fruit and vegetable sector (the Infoware) and the analyses of the organizational structures which are suitable in combination with a particular technology (the Orgaware). These four (Technoware, Humanware, Infoware and Orgaware) together are abbreviated with THIO[16]. The interaction between THIO is represented in figure 1.4, in the lower right corner.

[14] Ibid., 291
[15] Ibid., 291
[16] United Nations (1989)A framework for technology-based development a publication of the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP), Bangalore : United Nations

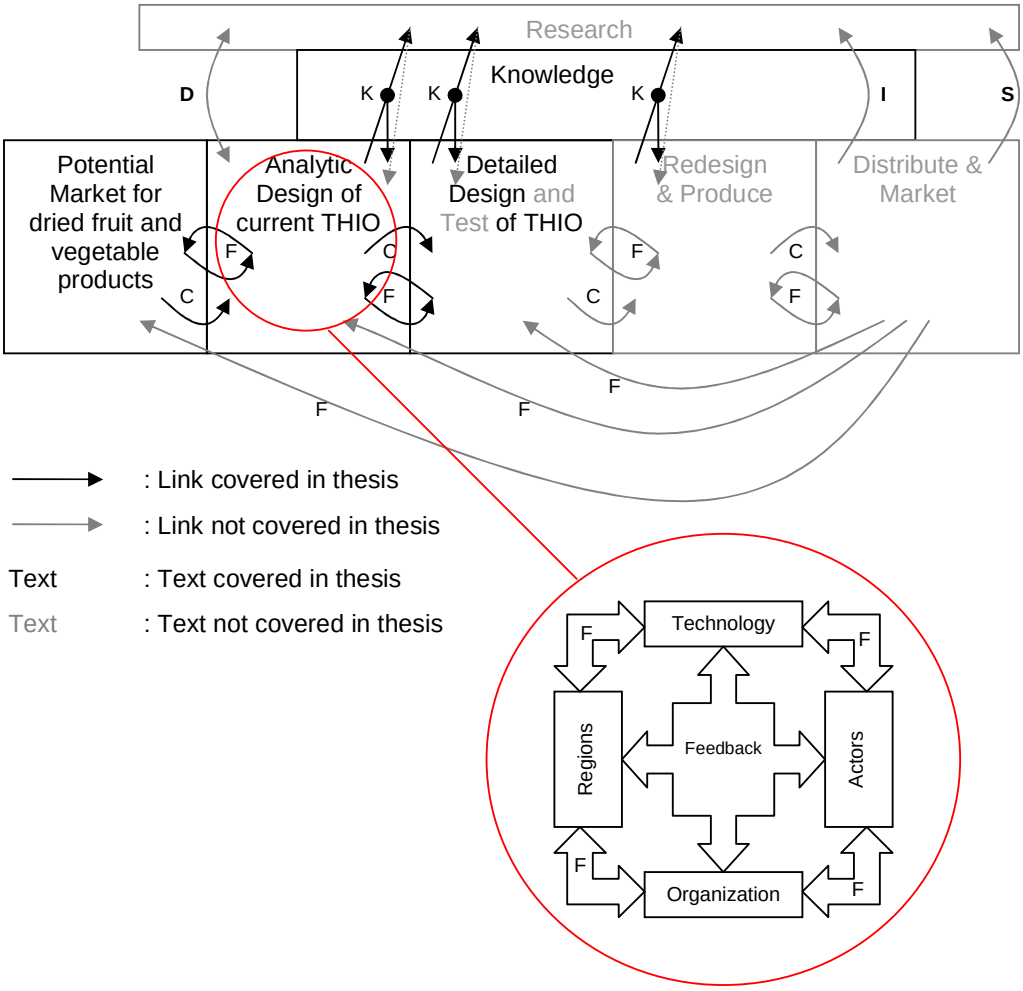


Figure 1.4: The figure shows the Chain-Linked model of Rosenberg and Kline adjusted to serve as a framework for this research

Links in the model

Link D: A direct link from research to the design in order to solve the problem in conserving fruits and vegetables. However, since the goal was to provide conservation possibilities through solar drying, this link is not relevant. In this case the design will be based on knowledge of existing technologies.

Link I: Link I would be relevant if we were able to market a new solar drying technology in practice. Since we are not able to market the technology ourselves, this link will not be covered by our research. The link itself implies the benefits to research when the new innovation has been distributed in terms of instruments, machines, tools, and procedures of technology.

Link S: Link S would be relevant if we were able to market a new solar drying technology in practice. Since we are not able to market the technology ourselves, this link will not be covered by our research. The link itself implies the benefits to research when the new innovation has been distributed in terms of sciences underlying product area to gain information directly and by monitoring outside work.

F-links: These are the feed back loops in the model

C-links: Central chain of innovation

K-links: These are the links between the central chain of innovation and research through the knowledge area. The design innovation will be based on existing knowledge, hence the dotted line from research to the central chain.

Research
The part research of the chain link model will not be used. Knowledge of solar drying systems are widespread available, it is therefore not necessary to initiate research or development work to solve the problem of solar drying.

Knowledge
When for example the analytic design of an innovation proves to be insufficient to reach a certain goal, one can rely on existing knowledge on processes and experiences related to the subject. In other words: "Do I know a current device that will do the job?" (the analytic designs). To explain the relevance of knowledge, the answer will initially be "No!". Now one can gather knowledge by asking your knowledgeable colleagues, looking into literature, experts in the field[17].
Knowledge concerning THIO of solar drying, will be gathered using literature studies, interviews with experts and all relevant actors in the field.

Potential market for dried fruits and vegetable products
The potential markets for dried fruits and vegetables will be based on existing market researches for these products. The found potential markets define particular standards for equipment and produced products, which have to be met. These demands will correlate with the detailed design.

Analytic designs
The analytic design can be composed from currently used principles, designs and various arrangements of existing components and modification of current designs, so that it can accomplish the task of fruit drying, given the preconditions of the different input boxes. The analytic design in this research will comprise of the available technologies, the actors involved, the different organisation structures and the regions in Tanzania where it is most suitable to start a drying project.

Detailed design and test
Now we have established what the preconditions for the design are and what possible current solutions are available, one can extract a detailed design for a technology, the most suitable role for the actors, the most suitable regions and the best organisational structure for fruit and vegetable drying. When a particular solution is chosen, this concept will be tested whether it is financially viable or not. This is done by carrying out a costs-benefits analysis. If a particular solution is not financially viable, another solution has to be derived from the analytic designs. The solution(s) will be presented by possible scenario's which comply with all mentioned preconditions. The scenarios then have to be tested and will inevitably result in issues that were overlooked in the theoretical model.
The testing part is unfortunately not included in the project, because of obvious constraints, like money and time. It is up to the UDSM to test carefully selected scenarios so they can proceed with the chain-linked model, and so generate the most suitable innovation.

Redesign and produce
The central chain of innovation declares that the previous mentioned "design and test" box will give input to the "redesign and produce" box. When a scenario is tested and gives the impression of being qualified it can be used to produce or can, if necessary, be adjusted to the possible inadequate results found in testing. At that stage, there is a complete design for THIO that is able to produce according to the stated preconditions.

Distribute and market
When following the central chain of innovation the produced design can now be marketed and distributed so it can be used in the "real world", the machine will be sold to end users of the machinery. It is quite plausible that this use in the field, which is more elaborate than a scenario test, will create new demands and markets, which subsequently gives input to the chain linked model to further improve the innovation.

[17] Stephan J. Kline and Nathan Rosenberg "An Overview of innovation" ,1986, in Ralph Landau and Nathan Rosenberg (eds.), *The Positive Sum Strategy: Harnessing Technology for Economic Growth, Washington*, DC: National Academy Press, p 291

1.5 Research Method

With the adjusted chain link model, the implementation process of solar drying technology will be guided within the boundaries of the research. In this way, it will be possible to determine the appropriate technology in this specific case.
The different basic designs of solar drying equipment in combination with other aspects of the Technoware, Humanware, Infoware and Orgaware status and possibilities within Tanzania will be analysed in the light of the boundary conditions which have been established with market information and market possibilities of dried fruit and vegetable products of Tanzania and the market for solar drying equipment.
Each basic design of solar drying equipment will follow the central chain of innovation, used in the chain link model, where it will be tested on suitability and adjustability, following the different feed back loops in the model. This will result in (different) adjusted designs of basic solar drying technologies, which should be further tested in the field.

To get all the data which is important for this research, explorative research of six months was conducted in Tanzania. Primary data was gathered by interviewing all (possible) relevant actors for the dissemination of solar drying technology. The following actors were interviewed for this research:

- **Rural farmers:** The first interviews were carried out with the rural farmers who were not (yet) involved in a solar fruits/vegetables drying project. The reason to interview these farmers was because these people should be the potential end-user of a drying technology. The aim of these interviews was to gather information about the appropriateness of the location in terms of crops, available facilities like water and electricity. Furthermore questions were asked to determine what the common level of education is, which is used to see if a potential drying technology could be operated or maintained by these people. It was also important to get insight in the attitudes of the end user towards cooperation structures and change of agro-processing. Another important aspect of the interviews was to see what the average income of the farmers was to see if they could afford a particular technology for drying or if they were able to get loans to invest and what the conditions for these loans were. All this information is used in the analytic design part of this thesis which eventually is an input for a detailed design for the solar drying project.
- **Farmers involved in fruit/vegetable drying projects:** The interviews with these farmers were important to see how successful current projects were. The farmers in these projects were using 2 of the technologies which were analysed for this research.
- **Village representatives:** The representatives of a village were interviewed to get an overview of a village as a whole. Important information was about facilities like water supply, infrastructure, electricity, etc. These people were also able to tell whether the government was making plans to upgrade the facilities in the village.
- **Agricultural centres:** The people working at the agricultural centres were able to provide statistical data about the region, concerning crops, amount of fruits and vegetable produced. The agricultural centre was also able to provide us with socio-economic reports of the region. This information was used in the analyses of the regions.
- **National Microfinance Bank:** This bank was consulted to determine in which way they could contribute to the dried fruits and vegetables sector in Tanzania. The obtained information was used as input for the organisation structure for the fruits and vegetable drying project.
- **SIDO:** SIDO was interviewed to see what their role was and could be in the future, regarding the fruits and vegetable drying project. They were also asked about the costs of the solar dryers they were producing.
- **AMKA:** The discussion with AMKA focussed on why the current solar drying projects had failed and how a future solar drying project should be organised to be successful. It was also important to know which part in the actor network had been played by AMKA.
- **Ministry of Agriculture:** This interview was carried out to establish the role that is played by the ministry and to see which information was known by the ministry concerning training, income of rural farmers and food processing regulation.
- **UNIDO:** UNIDO was involved in a fruits and vegetable drying project in Tanzania. They used a different type of technology than other projects. However, this project was also not very successful. The interview showed where the difficulties lied in the project.
- **SCF:** This organisation was interviewed to determine the role they could play in financing a project and which terms and conditions were applicable for the solar drying project.

- **TDTC:** The interview with TDTC showed the role of this department within the UDSM in developing and transferring the solar drying technology. It also revealed problems with the solar drying projects carried out by the UDSM.
- **TIRDO:** TIRDO was interviewed to see how they design solar dryers and how they provide training. It was also to determine if they were complying with any food processing standards.

The secondary data for this thesis was collected from internet, literature and databases. This data was used to determine the difference between technologies, organization structures, innovation models and key statistics, etc.

1.6 Research Limitations

This research was conducted to fulfil the requirements of an MSc degree. Inevitably, that created time and financial constraints which affected the extent and depth of the research.

Questions whether solar drying is the most suitable technique to preserve fruits, will not be discussed. The UDSM gave the assignment to implement and diffuse the solar drying technology, not to implement the most suitable and sustainable technique to preserve fruits.

The report can be used as a guideline for a possible successful implementation of a solar drying technology in Tanzania. This implies that no ready to use design for a solar-dryer will be presented, but rather conditions one should value when implementing a project like this. However, scenarios will be provided that comply to the conditions for successful implementation of solar drying technology according to the research model. These scenarios will consist of a specific solar drying technology with recommendations for organization, financing and scenario profitability.

This framework will be based on all information that was found and received in literature, on the internet, and through interviews. Because of the massive amount of available literature on this subject and the vastness of the country, it is impossible to be aware of all information available. However, we are confident that this research gives a reasonable thorough insight into the sector.

The innovation model by Rosenberg and Kline also consists of a practical component dealing with issues which will arise after implementation of the project. But, as has been discussed in paragraph 1.4.3 these components will obviously not be covered in this research, due to time, money and resource constraints.

2. A Potential Market: The EU[18]

The first step in the chain linked model is the definition of potential markets and the corresponding demands and standards in these markets. The data was for a large part obtained from the EU-market for dried food.

The choice for an export market was made because the market for dried fruits and vegetables seems to be non-existent or a very small niche market. The fruits and vegetable farmers of Tanzania are already in a very competing market so there is no reason to set up a new market for more expensive dried products where there is abundance of fresh produce. Moreover, data about the market for dried fruits and vegetables in Tanzania is available, however, this information was not made available for this research. And research by AREED showed that people in Uganda have a dismissive attitude towards dried fruits and vegetables[19] because they are not used to eating dried fruits and vegetables.

For this research, data was obtained from the Centre for the Promotion of Imports from Developing Countries (henceforth: CBI). This is data from the EU market for dried fruits and vegetables.

The characteristics of the EU market for dried fruits and vegetables will serve as a main input for the analytic design of the available technologies. To a lesser extend the export preconditions for the USA will serve as an input.

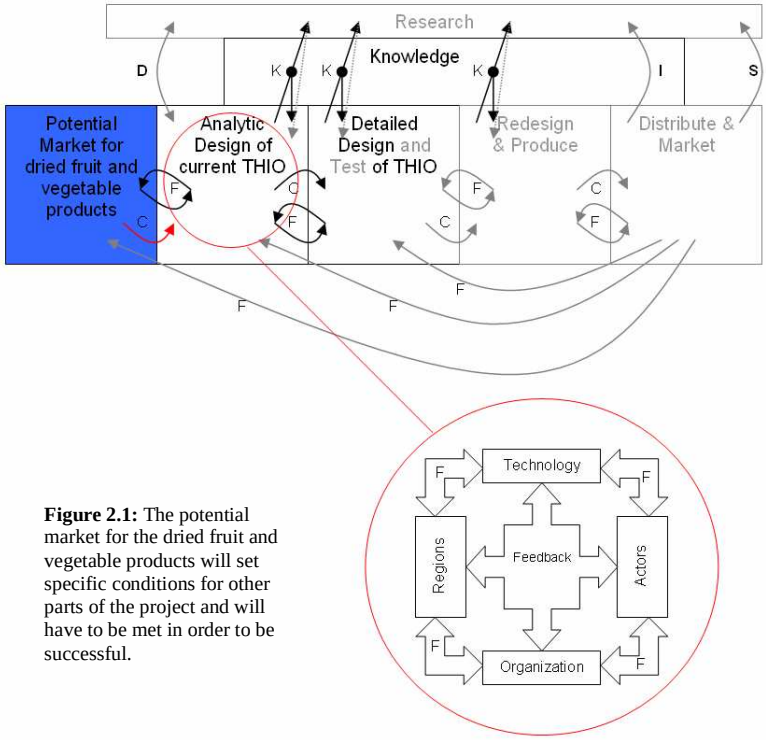


Figure 2.1: The potential market for the dried fruit and vegetable products will set specific conditions for other parts of the project and will have to be met in order to be successful.

The characteristics of the EU market are given in the paragraphs of this chapter below. It should be noted that this market is already being served by other countries and that it is not clear if it is possible for other countries to enter this market due to contractual commitments. This section of the thesis is merely an indication what a potential market looks like and what the implications for the Tanzanian dried fruit and vegetable sector are if they strive to enter such a market. This chapter also comprises preconditions to enter the market of the USA.

[18] Appropriate information about EU market for dried fruits and vegetables was obtained from: CBI, *"Preserved fruit & vegetables, EU Market survey 2005"*, Ceres Company, 2005

[19] Arfaoui Y.(year of publishing unknown) Improving the welfare and increasing the income generation by the commercialization of sustainable energy technology: Commercialisation of Solar dryer for Agricultural Products, UNEP & AREED, Annex 1

Regarding the research set-up: the boundary conditions that will be identified in this chapter will serve as an input for the analytic designs (the red marked C-arrow in the figure above). The analytic design will be analysed in the light of these conditions.

2.1 Possibilities and Constraints for Tanzania

2.1.1 Dried Food Consumption

In 2003 the dried food sector had a value of €7,9 billion and a volume of 3.839.000 tonnes. It was estimated that the value of this sector increased to €8,2 billion (increase of 3,8%) and a volume of 3.954.000 tonnes (increase of 3,0%). Unfortunately, there are no data about the consumer markets for dried fruit and vegetables as these products are mainly used as ingredients for food processing.

Country	2002	2007 (estimate)
Italy	24,7 kg	24,8 kg
Portugal	14,6 kg	15,3 kg
Hungary	13,6 kg	14,4 kg
Czech Republic	13,6 kg	16,3 kg
Sweden	11,4 kg	12,6 kg
Slovakia	11,1 kg	11,7 kg
Denmark	10,8 kg	11,7 kg

Table 2.1: Per capita consumption of the major dried food consuming EU countries and estimated consumption for 2007

2.1.2 Demand

Dried fruit is used in consumer or food service packing, mainly consumed as a snack and as an ingredient for breakfast cereals, healthy ready-to-eat snacks and desserts. Bakeries and breakfast cereal mixes are one of the largest end users of dried fruit. The market for bakery products in the EU-15 had a value of € 70,3 billion and a volume of 26,8 million tonnes in 2003.
Considering the imports of dried fruit, sultanas are the most popular (mainly for industrial use) dried fruit in the EU, accounting for more than a quarter of the total imports by EU member countries of dried fruit. Sultanas, other raisins, dates, prunes, apricots and figs are the major imported dried fruit species. This could also pose a constraint, because the solar drying technology project is concentrating on different kind of fruits. However, a potential area for growth and an opportunity for Tanzania, is the increasing demand for exotic tropical fruit.

Import share	2001	2002	2003
Import share in value	50%	53%	54%
Import share in volume	62%	64%	65%

Table 2.1: Import share of dried fruits from developing countries

	2001		2002		2003	
	Value (x €1.000)	Volume (kg tonnes)	Value (x €1.000)	Volume (kg tonnes)	Value (x €1.000)	Volume (kg tonnes)
Total	840.709	587.823	889.555	605.307	879.623	611.293
Extra-EU	614.774	464.203	646.207	478.550	646.271	494.323
Developing countries	423.028	366.284	470.266	387.706	474.680	395.068

Table 2.2: The volume and value of dried fruits into the EU

The dried vegetables are mainly imported by the food producing industries in the EU for use as an ingredient in their products. The most commonly used species of vegetables are: potatoes, onions, tomatoes, leek, carrots and peas. This could be an opportunity for Tanzania as these species are grown on a large scale in Tanzania.

Import share	2001	2002	2003
Import share in value	33%	34%	32%
Import share in volume	28%	31%	34%

Table 2.3: Import share of dried vegetables from developing countries

	2001		2002		2003	
	Value (x €1.000)	Volume (kg tonnes)	Value (x €1.000)	Volume (kg tonnes)	Value (x €1.000)	Volume (kg tonnes)
Total	475.955	200.277	507.708	219.993	466.061	209.921
Extra-EU	253.940	85.276	267.648	97.834	229.494	98.358
Developing countries	154.724	55.631	170.965	68.121	147.204	71.031

Table 2.4: The volume and value of dried vegetables into the EU

Most markets are showing the growing popularity of ready-to-eat healthy snacks, muesli, and processed foods using more healthy ingredients like dried fruit. As such the demand for dried fruit and vegetable products poses an opportunity for the Tanzanian dried fruit and vegetable sector.
The import of dried fruit and vegetables into the EU shows less favourable figures, as the value of imports of dried fruit decreased by 1 percent while the volume increased by 1 percent in 2003 compared to 2002. In the case of dried vegetables, both import value and volume decreased in 2003, compared to 2002, by 8.2 and 4.5 percent respectively. These figures might pose a threat to the Tanzanian dried fruit and vegetable sector as it could indicate that the market for dried fruit and vegetables is experiencing increased supply whereas the demand can not keep up.

2.1.3 Trends and patterns

The trend to demand safe food, requires producers in the food, and thus in the dried fruit and vegetable industry, to adopt the HACCP system. This system is a Food Safety methodology that relies on the identification of Critical Control Points in food production and preparation processes. The critical control points are closely monitored in order to ensure that food is safe for consumption. See appendix 2 for a full overview of the HACCP system. Producing by the principles of HACCP is, however, not common practice in Tanzania and the fruit and vegetable drying industry has not fully implemented this system. This fact poses a big obstacle to the export sector of dried fruits and vegetables in Tanzania.

Increasing awareness of healthy food has a positive effect on the demand for fruit and vegetables in the EU food market. This is caused by the fact that fruit and vegetables contain vitamins and natural antioxidants, which help to prevent heart diseases and cancer. Properly dried fruit and vegetables can be considered as health food products. This increased demand is an opportunity for dried fruit and vegetables producers in Tanzania

Many people are concerned about the safety of food and the effects of intensive farming on the countryside as well as on the environment in general. These factors, combined with the increasing awareness of the importance of diet and nutrition, have intensified interest in organic foods. Organic food is produced according to legally regulated standards. This means they were grown without the use of conventional pesticides, artificial fertilizers or sewage sludge, and that they were processed without ionizing radiation or food additives[20]. Increased attention for these products might be an opportunity for dried fruit and vegetable producers in Tanzania, because organic farms tend to be small family-run farms, which are widely present in Tanzania. However

Consumers in the EU are becoming more and more environment-conscious. This is why crop cultivation should be environment-friendly. Waste, including packaging waste, should be avoided or at least reduced. In the wake of this increased environment-consciousness in the EU, the EurepGap Protocol was launched. The objective of EurepGap is to raise standards for the production of fresh fruit and vegetables by promoting food safety, sustainable use of natural resources and more environment-friendly production. This trend could be an opportunity as current crop cultivation would need little adjustment to fully comply with EurepGap standards.

Consumers in the EU demand open, honest, and informative labelling. This has resulted in the requirement of “tracking and tracing” by the EU General. This tracking and tracing should contribute to good chain management and control within the chain. Tracking and tracing is becoming even more important in production of organic products, where fully documented tractability is required from the raw material to the final product, to ensure the organic character of the product.

[20] Wikipedia (http://en.wikipedia.org/wiki/Organic_food), 2007

Tracking and tracing for now is not in operation in the Tanzanian dried fruit and vegetable sector at the moment. Also the labelling needs a lot of adjustment to meet this demand and is therefore a potential hurdle for the exports from Tanzania.

2.1.4 Supply Chain

Due to the characteristics of the preserved fruit and vegetable sector, the opportunities for exporters in developing countries lie in the following positions in the supply chain:

- Suppliers of preserved fruit and vegetable ingredients to the food processing industry in the EU countries
- Suppliers of preserved fruit and vegetables in bulk to packers in the EU, who pack in consumer and food service units
- Subcontractors for the food processing industry and retail organisations. These subcontractors process fruit and vegetables and pack them in consumer and food service units according to strict specifications and under their customers' labels in the EU. For example, beans and peas are harvested in African countries, sorted and washed immediately after harvest, processed and packed in consumer packing under the label of a UK retailer, then shipped to the distribution centre of the retailer in the United Kingdom and from there directly to the retail outlets.

2.2 EU trade structures

From the above we can conclude that a large part of the preserved fruit and vegetables used in the EU food industry is imported, often as ingredient from other EU countries and from outside the EU. These products are then repacked or processed for re-export.
Preserved fruit and vegetables can reach their final destination by passing through different trade channels. The selection of the trade channel and the trade partner depends on the requirements of the final customer, which usually is the food processing industry. By selecting one specific channel and trade partner, other trade partners are often automatically included. It is important that a potential exporting country such as Tanzania is aware of the different channels in the market.
The following major business partners can be distinguished for exporters of most preserved fruit and vegetables.

2.2.1 Agents

Agents are intermediaries executing the buying and selling orders of a customer against a commission (between 2 and 5 percent of the purchasing price). The agents never actually take possession of a shipment. Moreover, the products do not pass physically through the agents' hands and often not even through their countries of operation.
Two types of agents can be distinguished: buying agents and selling agents. The former represents the buyers, such as the food processing industry, compound houses or re-exporters. The latter represents the sellers, mainly exporters. Agents are usually well informed about the current market trends, prices and users.

2.2.2 Importers

Importers buy and sell preserved fruit and vegetables on their own account, mainly to the food processing industry and for re-export. Importers take 'long' or 'short' positions in the market depending on their expectations of future price trends. If an importer sells 'short', he is contracting to sell products, which he does not yet possess, while taking a 'long' position means that he has unsold products in his trading account.

2.2.3 Processing industry (processing importer)

Processing manufacturers/processing importers buy raw materials and semi-finished products to process them further, with the goal of selling these to the end-product manufacturers. For example, in the case of dried vegetables the processing importers clean, grade, reduce the humidity content and bacteria count before selling to the food industry. The processing manufacturers purchase preserved fruit and vegetables either directly or from importers or through the services of an agent. Specialised fruit processing industries supply semi-manufactured products to the bakery, dairy and ice-cream industry.

2.2.4 End-product manufacturers

Some end-product manufacturers who need large quantities (on a regular basis) of ingredients purchase their ingredients directly from producers abroad, such as the beverage industry in the case of fruit juice and fruit juice concentrate.
Leading importing manufacturers in EU countries are Unilever, Cadbury Schweppes and Danone. Many end-product manufacturers use processing importers or agents, as these offer a reference point situated within their own country.

2.2.5 Retail and food service organizations

Retailers carry out the final stage of selling preserved fruit and vegetables to consumers, accounting for a very large share of the total sales. The retail sectors hardly ever import directly, but buy from wholesalers or importers. In the EU, large supermarket buying groups are Ahold (The Netherlands), Carrefour (France), Metro (Germany), Tesco (United Kingdom) and Aldi (Germany). Because of their much smaller size, the food service sectors do not usually import directly from source.

2.2.6 Packers

These organisations pack goods in standard packs for the European market. The (re) packers keep the goods on stock in their warehouse, at their own risk, and sometimes under their own brand or the

private label of a customer. These packers sometimes function as importers as well. Many importers, agents, or repackers are specialised in more than one product group. For example, Catz Int. is specialised in dried fruit and frozen fruit and vegetables. Some importers also act as an agent. Moreover, most importers trade in preserved fruit and vegetables in consumer packs and catering packs, but also in preserved fruit and vegetables for industrial use.
Potential exporters in developing countries should contact importers, agents and packers in the EU. These intermediaries have long established links with their customers and are in a better position (than foreign processors) to know the requirements of the local market and of individual end users. They supply the food processing industry and supermarkets chains and are financially able to support exclusive contracts and advertising campaigns, as well as to service special requirements.
There are few agents for juice, although they are involved in the juice trade throughout Europe (Amsterdam and Rotterdam serve as the gateways to Europe for Brazilian orange juice concentrate). Before a large share of the imports is re-exported, the concentrate is often processed by compound houses, which mix, pack and/or standardize the product into the basis for the manufacturing of a wide range of products. The four biggest compound houses or importers (Döhler-Eurocitrus, SVZ, Cargill and Hiwa) and the beverage industry are mostly supplied directly from the source or from tank farms. The activities of agents/importers are generally limited to responding to spot purchases from stock and searching for products of a different nature or of a special quality.

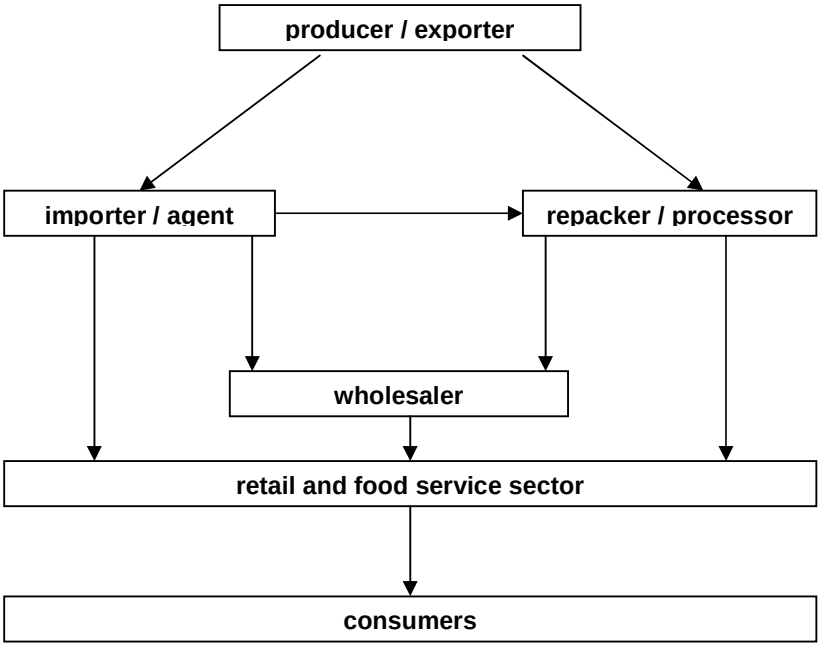


Figure 2.2: Overview of EU trade channels

2.3 EU Market requirements

Besides requirements, which are initiated by EU or national authorities, the end-users may have their own specifications, which should be met by the suppliers. These specifications may vary from demands concerning colour, correct and constant quality, to labelling, packaging, etc. Compliance with the quality standards demanded by the importer is essential, and failure to do so results in goods being refused or only accepted at considerably lower prices for further processing.

2.3.1 Environmental market requirements

Product legislation has been developed in order to reduce the negative environmental impact of products. This results in standards on the presence of pollutants, such as hazardous substances in products. Whereas environmental legislation is mainly product-based, environmental market requirements can go further; product labels such as eco labels can be product- and process-related. Environmental management systems are process-related.

The hallmarks for environmentally friendly products are normally referred to as eco labels. This hallmark indicates that the product (including its full manufacturing process) has a reduced impact on the environment when compared to similar products. Ecolabels have been developed at various levels, applicable throughout Europe. Participation in such an ecolabel scheme is on a voluntary basis. In the case of preserved fruit and vegetables, organic labelling indicates that the product has been certified as being organic.

In order to make agricultural products from organic sources easily recognisable to consumers, EU "organic" labels have been introduced.

2.3.2 Quality related market requirements

Quality is not only product-related, it relates also to:

- Constant and on-time delivery of products
- Traceability of products
- Compliance with EU, member states and customer standards
- Adequate labelling and packaging
- Use of materials and production methods
- Consumer health and safety

2.3.3 Packaging, marking and labelling requirements

The general trend in Europe is towards facilitating re-use and recycling of packaging through incentives and disincentives, such as levies and taxes, and through mandatory or voluntary restraints. In order to harmonise the different forms of legislation, the EU has issued a directive for packaging and packaging materials in which minimum requirements are regulated. Among other measures, the directive sets maximum levels of concentration of heavy metals in packaging and describes requirements specific to manufacturing and composition of packaging. The maximum concentration of lead, cadmium, mercury and chromium (VI) in packaging is 100 ppm.
Most requirements for packaging and packaging materials can be found in the legislation of individual member states, or in additional buyers requirements.
Many EU countries (but not all) now have legislation requiring that packaging for consumer products is taken back and collected by retailers and producers. If that is not possible (i.e. for one-way packaging) a contribution has to be paid, for each package, to a central co-coordinating organization that has taken over the responsibility of collecting and re-processing.

Exporters in developing countries targeting the European market have to be aware of these legislative requirements and take appropriate measures, in order to become or remain well matched trading partners for European businesses. Most of the time, packaging policy does not affect 'foreign' manufacturers because importers will be held responsible for the packaging. However, sensible marketing requires taking the obligations of the importer into consideration. That means that packaging (transport packaging, surrounding packaging and sales packaging) materials should be limited and re-usable or recyclable. Otherwise, the importer will be confronted with additional costs, thus reducing the competitiveness of the exporter.

The EU has set new phytosanitary measures for all wooden packaging material that is used for the import of goods into the EU from third countries. The background for this legislation is to protect the EU from the introduction of organisms harmful to plants and plant products via wood packaging material.
The Directives require heat treatment or fumigation and marking of wooden packaging materials (including for example packing cases, boxes, crates, drums and similar packing, pallets, box pallets and other loader boards, pallet collars).

Packaging of dried fruit and vegetables

Bulk-packaged, dried tropical fruit is usually packaged in export carton boxes lined with polyethylene, containing two or four 5 kg boxes. Dried vegetables are nowadays mostly packed in polyethylene. It is generally used in the form of a closed bag inside paperboard cartons, fibreboard corrugated boxes (bag-in-box system) or multi-wall sacks. Polyethylene liners may be heat-sealed to give an airtight closure, although some air permeates gradually through the polyethylene itself. Vacuum packaging is also used, but on a small scale.
Packages suitable for palletisation are gaining in popularity, since they reduce handling costs and damage to the product. Rectangular boxes are more suitable for palletisation than paper sacks or drums. Packages normally vary between 5 kg and 25 kg.

Labelling of dried fruit and vegetables

The labelling requirements listed below generally apply to all preserved fruit and vegetables. Nevertheless, there are some exceptions, depending on the kind of product or type of fruit or vegetable.

If the dried fruits and vegetable sector is to target the EU as a possible market for its products, the labels on food products for **industrial use** in the EU should include the following information (in English or in the language of the importing country):

- Product name
- Batch code/lot identification
- Name address of manufacturer/exporter
- Net weight
- Recommended storage conditions.

The labels on food products in **consumer and food service packing** in the EU should be in the language(s) of the country where the product is put on the market and should include the following information:

- Product name, variety and type;
- 'Best before' date and storage conditions where necessary;
- A list of ingredients, including food additives; quantitative labelling (in %) is required for those ingredients mentioned in the name of the product or pictured on the label;
- Net weight (and leak weight when applicable);
- Usage instructions, in the case the products cannot be consumed or prepared properly without these instructions;
- Name, address of the packer/exporter/importer located in the EU;
- An indication of the batch of production, which may be specified in code;
- Country of origin
- Substances that can cause food allergy, and might by consequence be dangerous to health, have to be mentioned explicitly on the label.

Substances that may cause food allergy, have to be labelled explicitly. The substances most important for dried fruit and vegetable products are:

- cereals containing gluten (wheat, rye, barley, oat, spelt, kamut) and products made thereof
- celery, root or leaf, and products made thereof
- sulphur dioxide and sulphite

Regarding the exports of preserved fruit and vegetables in consumer and catering packs, all details of labelling should be agreed and specified in consultation with the importer or end product supplier (supermarket, wholesaler, etc.), who has the correct information regarding the legal requirements.

Furthermore, the accompanying documentation must provide details of any treatment the product has undergone and any further information specified in the contract with the importer.

2.4 Tariffs and Quotas

In general, all goods entering the EU are subject to import duties. The level of tariffs depends on the country of origin and product.
Tariffs and quotas regulation from the EU includes the so called "Everything But Arms" (EBA) initiative in favour of the Least Developed Countries. Under the EBA initiative, quota and import tariffs have been abolished for all product groups, except arms and ammunition, for the Least Developed Countries. Restrictions applied to sugar, rice and bananas; however these have been lifted during the period leading up to 2007.

Exporters in Least Developed Countries wishing to benefit from the 'EBA' agreement should take the following 5 steps:

1. Establish product classification (CN)
2. Establish product eligibility
3. Check the origin criteria applicable to the product. These criteria are product dependent (Form A or EUR 1).
4. Check the transport conditions, from the exporters' country to the port in the EU, as direct shipment is a prerequisite for qualification.
5. Prepare documentary evidence for proof of origin.

2.5 Requirements for exporting dried fruit and vegetable products to the US

Similar sets of regulations apply to exports of dried fruits and vegetables to the US. However, in the US the terms used for food processing are slightly different. In general food processing has to comply with Good Manufacturing Practice (GMP).

GMP is a set of regulations, codes, and guidelines for the manufacture of drug substances (also known as active pharmaceutical ingredients (APIs)) and drug products (known as medicinal products in Europe), medical devices, in vivo and in vitro diagnostic products, and foods. In the United States GMPs are referred to as "cGMPs"[21] or "current Good Manufacturing Practices" GMP is a term that is recognised worldwide for the control and management of manufacturing and quality control testing of pharmaceutical products.

Since the sampling of products will statistically only ensure that the samples themselves (and perhaps the areas adjacent to where the samples were taken) are suitable for use, and end-point testing relies on sampling, GMP takes the holistic approach of regulating the manufacturing and laboratory testing environment itself. An extremely important part of GMPs is documenting every aspect of the process, activities, and of operations. If the documentation is not correct and in order, showing how the product was made and tested, that allows for traceability, and recall from the market in the event of future problems, then the product does not meet the required specification and is considered contaminated (in the U.S. considered adulterated). Additionally it is a GMP requirement that all manufacturing and testing equipment and utilities have been qualified as suitable for use; and that all operational methodologies and procedures (such as manufacturing, cleaning, and analytical testing) utilized in the

[21] Wikipedia (http://en.wikipedia.org/wiki/Good_Manufacturing_Practice), 2007

drug process have been validated to demonstrate that they can perform the activities they purport to, according to predetermined specifications.

In GMP regulations, the focus is on environment factors and the quality of raw materials. It gives directions on how to avoid food safety risks and how these risks can be controlled. GMP is closely related to HACCP. Without GMP, complying with HACCP is not possible.

2.6 Standards for food-processing

2.6.1 CAC

The Codex Alimentarius Commission (CAC) is a cooperation between Food and Agriculture Organization (FAO) and World Health Organisation (WHO) Food Standards Programme. It is responsible for formulating the standards, codes of practice, guidelines and recommendations that constitute the Codex Alimentarius. Its members consist of government members of the United Nations organization who subscribe to become its members.
The Codex Alimentarius is an important global reference point for consumers, food producers and processors, national food control agencies and all those involved in the international food trade. This is why it serves as an ideal point of reference for the dried fruit and vegetable sector in Tanzania to set their standards in food processing.

In the by the CAC described recommended international code of hygienic practice for dried fruits (CAC/RCP 3-1969), are described. These recommendations are very elaborate and deal with subjects as: raw material requirements, plant facilities and operating requirements and end product specification. All these sections will be briefly discussed in this paragraph, but for the entire recommendation code, please refer to appendix 5.

Raw material Requirements

This section deals with the recommended standards for raw material handling, which in this case is the drying harvesting and transportation of fresh fruits.
The area where the raw material is growing and produced, should have sanitary disposal of human and animal wastes in such a manner as not to constitute a public health or hygienic hazard and extreme care should be taken to protect the fruit from contamination with these wastes. The used irrigation water, to grow the crops, should be clean. No animals, rotten or decomposing fruit should be present in the area to prevent plant pest or diseases.
Harvesting and food production has to be sanitary, the equipment and product containers should be easily cleanable to avoid contamination of the fruit and vegetables. The raw material has to be examined by competent persons and unfit material should be disposed of in an appropriate manner. During handling and storage the fruit may not be contaminated by animals, insects, vermin, birds, chemical or microbiological contaminants or other objectionable substances. Suitable storage should be found or the fruit should be processed immediately.
The place where fruits and vegetables are dried is referred to as the drying yard, this drying yard should be located at sufficient distance from cattle feed lots, settling pods and/or other waste collection areas. The yard should be constructed with a cleanable surface, should be fenced, and kept clean free from weed and other debris. The fresh fruit should preferably be cut in closed sheds with screened windows, and spread on trays for drying.
Both the fresh fruit and vegetables as well as the dried fruit and vegetables, should be stored in areas where it is protected from rodents, insects or birds. There should be an adequate supply of clean potable water for hand-washing, equipment cleaning, and raw product washing. Standards for the described clean potable water shall not be less than those contained in the "International Standards for Drinking Water", WHO, 1971.
Drying trays, cutting equipment, and storage bins should be kept clean and free from fruit residue and foreign substances that may cause contamination of the fruit and vegetables.
Transportation facilities should be adequate and be so constructed that they will permit thorough cleaning and maintenance.
The produce should be handled in such a way that it prevents contamination. When needed the product can be cooled with refrigerators, or ice (when contacting the fruit and vegetables see: CAC/RCP 3-1969, Section IV - A (2c) in appendix 5) can be used.

Plant Facilities and operating requirements

The plant should be constructed and laid out in such a way that it creates enough working space for the expected purpose. It should be cleanable, and kept free of unwanted external influences that can contaminate the fruit and vegetables.

The storage of the raw materials should be separated from the production and packaging area to prevent contamination. Sufficient cold water and, where necessary an adequate supply of warm water should be available, the water should be of potable quality, complying with the previous mentioned WHO standard. Available non potable water, used for example for fire control, may never contact the potable water supply. Plumbing and waste water disposal should be designed to handle peak loads.

The premises should be well lit and ventilated. Toilets should be provided and should have self closing doors. There should be adequate, convenient, clean and well equipped hand washing facilities in sight of the processing floor.

In the equipment and utensils all food contact surfaces should be smooth; free from pits, crevices and loose scale; nontoxic; unaffected by food products; and capable of withstanding repeated exposure to normal cleaning; and non-absorbent. Equipment and utensils should permit extensive cleaning, and the ones used for inedible or contaminating materials should be identified as such and not used for edible materials. The equipment for drying should be so constructed that cannot be harmfully affected by the drying medium.

The hygienic operation requirements require sanitary maintenance of plant, facilities and premises, vermin control and the exclusion of domestic animals. Health problems should be addressed to the management, and appropriate action should be taken. Toxic substance should be separately stored to prevent possible contamination of the produce. A high degree of personnel hygiene is required, this includes suitable clothing (including headdress and gloves), and hand washing. No foreign substances (including body liquids) may contact the produce to prevent contamination.

The operating practices and production requirements deal with the following subjects: raw material handling, inspection and sorting, washing or other preparation, preparation and processing, packaging materials of finished product, preservation of finished product and storage and transport of finished products. Only good quality raw materials should be accepted, and stored in a controlled surrounding that prevents contamination. The raw materials should be washed, with suitably treated water, and foreign substances should be removed. The packaging materials should be stored in a clean and sanitary matter. The packaging itself should be done under conditions that preclude the introduction of contamination into the product. The finished product must be preserved with a method that destroys all possible factors that can cause health hazards. The moist content of the product has to be at a level that deterioration by decay, mould, enzymatic changes, or other causes, is limited when held in foreseeable conditions. The finished products should be stored and transported under such conditions as will prevent the contamination with or development of pathogenic or toxicogenic microorganisms and protect against rodent and insect infestation and deterioration of the product or of the container.

The sanitation Control Program declares a preference of one individual that is responsible for the cleanliness of the plant, and can lead a trained cleaning staff which is part of the organization, and cleans the plant equipment and utensils at regular intervals.

Every plant should have access to a laboratory to test product quality, in Tanzania this could be the TFDA.

End product specifications

The end product has to comply with certain criteria described in section V of the CAC/RCP 3-1969. The products should be regularly tested using appropriate methods of sampling and analysis.

2.6.2 Food processing facilities requirements EU

Within the EU a machine designs used for food-processing are often based on the norm EN 1672-2. This norm contains recommendations regarding hygienic requirements. In this norm only general risks are discussed[22].
The machine for food-processing can basically be placed in three different areas, namely[23]:

- Food preparation area,
- Spill area,
- The non-food preparation area.

The food preparation area is the area where surfaces can contact the food-produce. This includes the surfaces that can touch the produce during the expected handling operations, where after it is redirected into the production process.
The spill area is the area that exists of surfaces where the food-produce can spat or leak on during the expected handling operations, which are not redirected into the production process.
The non-food production areas are all other areas that were not addressed in the previous mentioned areas.
It is of the utmost importance that cross contamination, is not possible. When the food-produce is manually redirected from the spill area into the production process, then this area is also referred to as a food preparation area.

Materials

The surfaces of the materials and coatings have to be sustainable and cleanable. When required, it must be possible to be disinfected. The materials are not allowed to crack, burst, splinter or fragment in any other manner. It is not allowed that unwanted materials can penetrate during the expected use.
Besides these general requirements, the materials have to be, during the expected procedure:

- Corrosion resistant;
- non-toxic;
- non-absorbent.

In addition the materials:

- Are not allowed to transfer any unwanted smell, colour or contamination to the food-produce;
- are not allowed to have a negative influence on the food-produce;
- are not allowed to assist in the contamination of the food-produce.

The design of the food preparation area

The surfaces have to be cleanable. When required, it must be possible to disinfect them. In real life this means that the surfaces have to be smooth, continuous or sealed. No food-parts are allowed to stay behind in small cracks, where it is difficult to remove them. These requirements also account for removable parts.
Joints have to be hygienically sealed. Preferably no joining mechanisms, like bolts and nuts a.o., are present within the food preparation area. When this is technically inevitable, they will have to be cleanable, and when required it must be possible to disinfect them.
Unused spaces have to be avoided. This prevents that in these spaces raw material, detergents and so forth, can stay behind and are not completely removed.
If possible bearings have to be placed outside the food preparation area. When this is not possible they have to be greased with a lubricant that is permitted to be applied with food. In addition they have to comply with all requirements of clean ability and disinfection.
Panels, lids and doors have to be designed in such a way that negative influences are avoided, for example the penetration or accumulation of contamination. Furthermore they have to be cleanable and when required be disinfected.
The supply of gas, water, electricity, pipes, connections and accompanying equipment that are a integral part of the machine(s) have to comply with the same requirements.

The design of the spill area

When the machine is located in the spill area it has to be constructed according to the same principles as in the food preparation area. When the food-produce is not redirected to the food preparation area

[22] Unfortunately the entire document represents a value of Euro 77, and is not in our possession, but the most important issues will be addressed.
[23] As stated on Euronorm.net 2006

less strict technical design criteria are required, evidently under the condition that this has no negative consequences on the food-produce.

The design of the non-food preparation area

The requirements for this area are obviously less strict, in comparison to the other areas. Issues that have to be addressed are:

- Exposed surfaces, which are used in the non-food preparation area, have to be constructed of corrosion resistant material or from a material that is treated against corrosion (coating or paint). These surfaces have to be cleanable, and when required, be disinfected. In addition they are not allowed to contaminate, or otherwise negatively influence the food-produce in any way.
- The equipment has to be designed and constructed in such a way that it cannot contain any moisture, that it can not offer entrance or shelter to vermin and no contamination can accumulate.
- The design must allow inspection, small and major maintenance, cleaning and disinfection.
- A frame constructed of piped has to be fully sealed or efficiently sealed.

Manual

In the manual for food-processing machine the intended use of the machine has to be described and the limitations of the machine should be mentioned. For hazards that proved to be unavoidable, the user of the machine has to be informed about the necessary directives.

Operation manual

The operation manual has to comply with the following requirements:

- Information regarding the machine start-up;
- Needed space for use and, where necessary, the needed precautions for contamination by open air, dust or liquids caused by leakage.
- Information regarding cleaning: recommended detergents and disinfectants have to be mentioned, as well as guidelines for cleaning, disinfecting, flush and inspection of cleanness.
- Information regarding maintenance: a schematic overview has to be given with all needed measures that have to be executed in a certain period to maintain the required hygiene level for the machine.

Labelling

On the machine at least the following information has to be given:

- Name and address of the manufacturer;
- Obligatory labels (CE-label a.o.);
- Year of manufacture;
- Indication of type;
- And, when available, serial number.

Check-up

The check-up for complying with the hygienic requirements has to be executed by material inspections, visual inspections or measurements.

2.7 Implications of exporting to foreign markets for Tanzania

From the above can be concluded that there is potential for Tanzania as an exporter of dried fruit and vegetables to markets such as the EU and the US. The trend in these markets is an increased demand for dried fruit and vegetables. Tanzania can benefit from this large demand by selling to food processing industries in these regions which will use the dried fruits and vegetables as an ingredient for their own products.

The dried fruits and vegetables sector in Tanzania should also be able to benefit from their status as a developing economy in terms of tariffs and quotas concerning export to the EU.

The increasing demand for dried fruits and vegetable products is partly caused by the increased demand for healthy food. However, there are also big concerns for the safe production of food. This results in a lot of requirements which will have a big influence on how fruits and vegetables are handled throughout the production chain. This calls for the implementation of preventative control systems for complete production chain of dried produce for Tanzania. These systems are mostly, if not completely, non-existent in Tanzania at the moment. By implementing preventative control systems such as HACCP and GMP the entire production process can be monitored and in case of production errors, key actions can be taken to prevent repetition of the problems.

These systems will also help the dried fruits and vegetables sector in Tanzania to be able to comply with the EU en WHO market requirements for dried fruits and vegetables. However, the people who will want to work in this sector have to be educated in numerous areas such as traceability, packaging, labeling.

Concerning the issues with standards for food processing, as have been discussed in paragraph 2.6, it can be concluded that these standards are not in practice in the dried fruits and vegetable sector in Tanzania. The fruits and vegetables that are dried in Tanzania are dried by individual farmers who do not have the facilities or the money to install the facilities which would enable them to comply with the food processing requirements. Problems like this can be solved by using a different kind of organization for the dried fruits and vegetables sector. This will be discussed in chapter 5.

3. Technologies for drying

The second step in the chain linked model is the analytic design. This is composed by currently used principles, designs and various arrangements of existing components and modification of current designs within THIO. The main characteristics of the technologies will be discussed in the light of the requirements which are set by the analysis of the potential market. These modifications on the currently available technologies will be aimed at the requirements stated in the potential market.

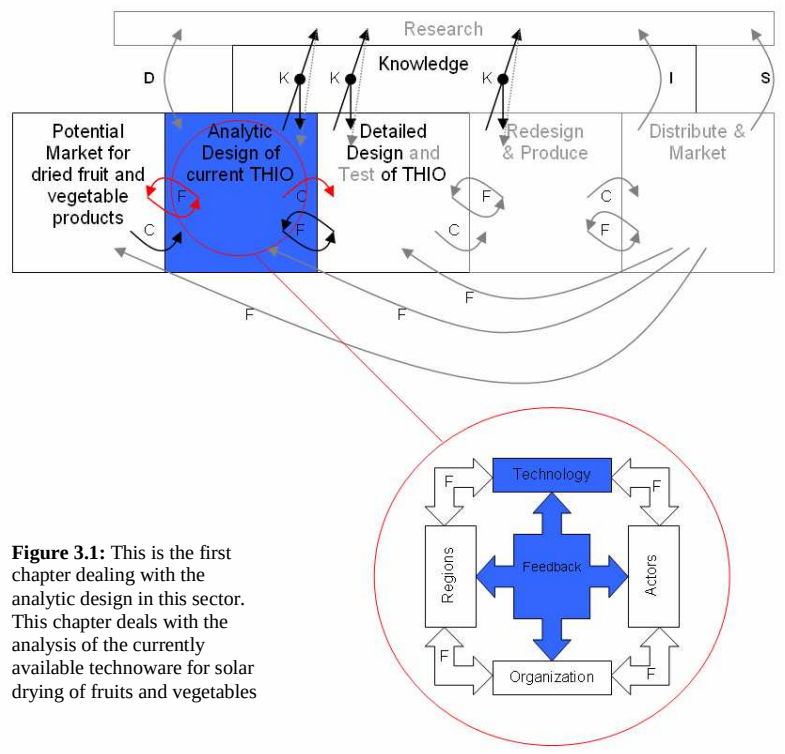


Figure 3.1: This is the first chapter dealing with the analytic design in this sector. This chapter deals with the analysis of the currently available technoware for solar drying of fruits and vegetables

On should also note that the choice of a particular technology will influence what the role of the actors will become, which organisation structure is most suitable and in which location in Tanzania the solar dryers will be placed. For the graphic representation of these interactions, see the bottom-right part of the figure above.

The feedback loop (the red marked F-arrows in the figure above) from this part of the research in accordance with the chain-linked model, will consist of analysing whether or not a particular technology will be able to meet the requirements that have been identified by analysing the potential market.

The outcome of the analyses of the technologies will be the first input (the red marked C-arrow in the figure above) for the detailed design phase of the model. This will be discussed in chapter 7 of this thesis.

3.1 Open-air Drying

Open-air drying is the most common method and involves simply laying the products in the sun on mats, roofs or drying floors. This simple and basic approach of sun drying has the advantage that it is very cheap, ideal for products where little or no value is added and the fruits can usually be dried close to home. Unfortunately this technique has its limitations, the produce is open to contamination by dust, the process is totally dependent on good weather, the very slow drying rates of the process create the danger of mould growth and the process may not be able to dry to a sufficient low level of moisture to prevent mould growth.
Nevertheless sun-drying remains an economically viable method for preserving foods for the rural poor. Especially for fruits where value is added by drying the fresh product and so may also justify an investment in improved drying technologies.

3.2 Solar Dryers

Solar dryers are simple machines that can eliminate the negative effects of open-air solar-drying, and can more efficiently make use of the suns heat. This results in higher drying temperatures which positively effects the drying times and creates the ability to dry to lower final moisture content. The insulated housing of the machines protects the produce from contamination by dust and from rain showers.
A suitable solar dryer for the rural poor should be low cost and relatively simple to install and to maintain.
Several techniques were developed for solar-drying of foods. The most commonly used and appropriate technologies will be discussed here, as well as how they could be used in Tanzania and/or how they could

3.2.1 Box-Dryer

The dryer that requires the smallest investment is the box type (see figure 3.1). This dryer consists of a drying chamber with a transparent cover, this cover must filter the harmful UV radiation, which reduces the loss of colour and vitamins, out of the sunlight, and can basically be made out of glass but because of the fragile nature of this material, Visqueen, a UV resistant polythene sheet, is preferably used. The chamber has appropriately placed openings to facilitate airflow.
The products that are to be dried are spread in a thin layer on wire mesh trays and placed inside the chamber, and are heated by the incident solar radiation.
Because of the budget characteristics of this dryer type it is seen as the most suitable solution for the poor small scale farmer. The machine can be produced by locals with carpeting skills mainly from locally available materials. Although this dryer does not require specialized manpower, the dryer should be operated properly to reach a good quality of the dried produce. The conditions in the drying chamber cannot be controlled in any way and are exposed to the incident weather-conditions. So drying times, temperatures and moist content may vary.

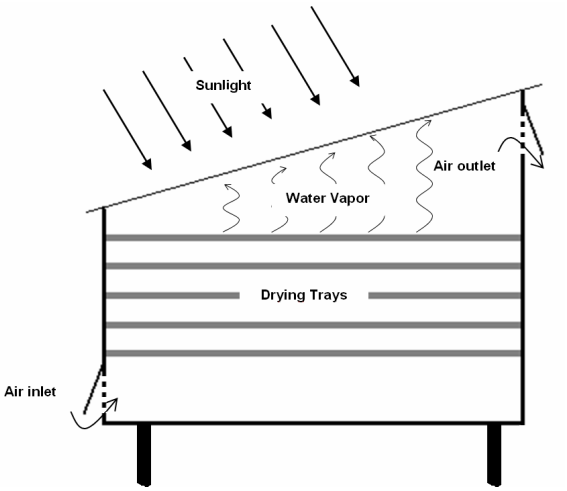
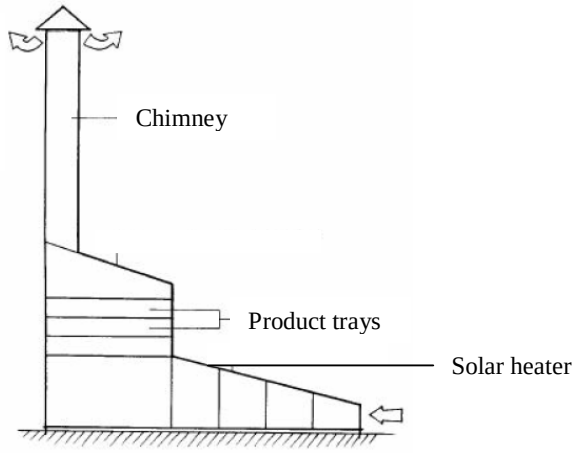


Figure 3.1: Working principle of a box-dryer

3.2.2 Indirect Solar-Dryer

A more complicated and more expensive method of solar drying is indirect solar-drying. The products are not exposed to direct sunlight, but hot air from a separate solar heater passes through the drying chambers containing the products.
An indirect solar dryer can differ in levels of complexity, resulting in different quality output of the produce. In a small scale dryer airflow can be generated to natural convection (figure 5 and 6) or with an air powered fan on top of the chimney.

Figure 3.2: A small scale indirect solar dryer, with airflow by natural convection
Source: ITDG, technical brief, small scale drying technologies.



More complicated solar dryers employ forced air-circulation by using fans or blowers. The camber can be equipped with steering system to control the drying temperature, which varies according to the type of crops. A more controlled environment will lead to a more continuous quality of the dried product. The relatively simple indirect dryers can easily be equipped with these features.
This principle can be elaborated to a heavy duty dryer, with a larger batch-size, as shown in figure 3.3 and 3.4. Again the air is heated through sun collectors, but now they have to be much bigger and are usually placed on the roof. The air circulation fan can be AC or DC powered. Rural areas often do not have access to power and if there is power it is not reliable, power-cuts are very common in Tanzania. The advantage of DC power for rural areas is that it can be generated by solar panels.

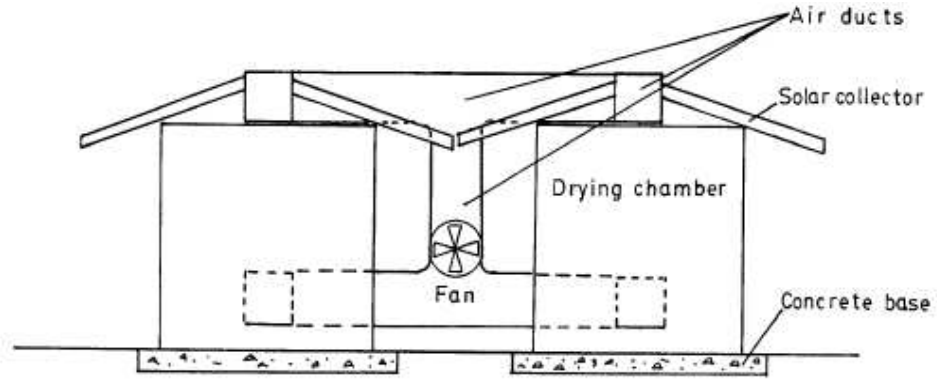


Figure 3.3: Heavy duty indirect solar dryer with AC or DC powered fan.
Source: AREED

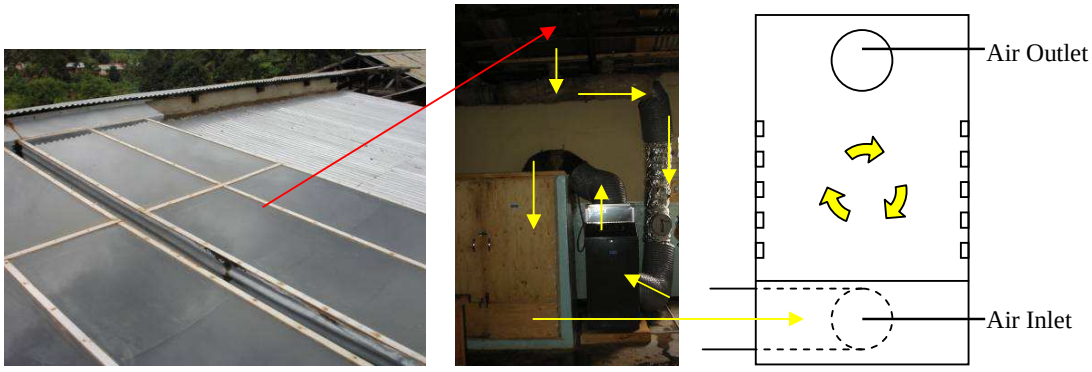


Figure 3.4: Indirect solar dryer, UNIDO food-processing-plant in Muheza, Tanzania.
A. Solar Collectors on the roof, to heat the air.
B. The hot air is transported by a duct system,
C. The hot air is transported into the base of the drying chamber, the hot air flows through the trays in the chamber towards the outlet and is discharged in the environment.

3.2.3 Tunnel dryer

A typical solar tunnel dryer (figure 3.5) consists of a solar collector, drying tunnel and axial flow fans that can drive the moist out of the dryer. The air is heated in the first part of the tunnel dryer, which acts as the solar collector, and is accountable for approximately 45%[24] of the total area of the tunnel dryer, this area is exclusively used for air heating so no produce can be placed here. The last part of the tunnel-dryer is the drying room. The fresh produce, that is to be dried here, is placed as a single layer inside the drying tunnel. Air entering the solar collector is heated and forced on the products placed in the drying tunnel, using the axial fans at the air inlet of the solar collector. These axial fans can be DC powered, and can therefore be connected to solar panels to generate the required energy. For example in a tunnel-dryer, developed at Hohenheim University, five 14W axial flow fans were installed, with an air capacity of 130 m^3/hour each, the required power is generated by three solar PV panels[25] (figure 3.6).

Figure 3.5: Working principle of the tunnel dryer.

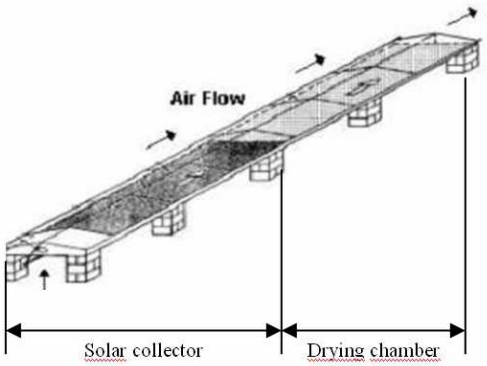


Figure 3.6: AIT solar tunnel-dryer for chilli, based on Hohenheim design

[24] Based on the dimensions of the Hohenheim tunnel solar dryer.
[25] G.A. Mastekbayeva, M. Augustus Leon and S. Kamur, Performance evaluation of a solar tunnel dryer for chilli drying, Asian Institute of technology, 1998, p 2

3.2.4 Combined Solutions

In the quest for the most suitable solar-dryer for the rural areas, combined solutions emerged, fusing properties of the standard drying methods. One interesting example is the UDSM Box dryer with forced air circulation (figure 3.7). This dryer is based on the design of a box solar dryer from a Tanzanian NGO named AMKA, the redesigned dryer has a larger batch capacity (40kg versus 25 kg) and reduces the drying time with a day (2-3 days versus 3-5 days). The most important modification on the AMKA dryer, are the two DC fans on top of the dryer, powered by a solar panel. The function of the fans will be to increase air turbulence and circulation in the dryer. The working of the fans will be depending on the solar intensity.

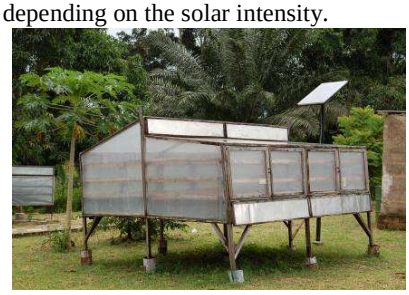


Figure 3.7: UDSM Solar Dryer with forced air circulation

Figure 3.8: TIRDO mixed dryer

Another example is the mixed solar-dryer that is developed by TIRDO (figure 3.8), this dryer combines the properties of a direct and an indirect solar dryer. Basically the dryer is the same as a usual box dryer with this exception that it has an extra solar collector mounted at the front, through this solar collector extra heat can be inserted into the dryer, generating shorter drying times. An advantage of this dryer over a fully indirect dryer is that it keeps the low cost properties of a direct solar dryer, because it is constructed of the same low cost materials.

In Uganda there is a project with drying of fruits, where farmers use a simple box dryer like the one discussed previously combined with a freeze drying unit which is more centrally located to dry the products further to achieve an appropriate quality. For further detail on the organisation of this project in Uganda, please refer to chapter 5 of this thesis.

3.3 Heat-collector placement

The heat collector has to heat up the air that is used to dry the fruits and vegetables. Most heat from the sun is collected when the sun hits the solar collector at an angle of 90 degrees[26]. The collector has to be placed at such an angle that this desired angle is attained. On the equator this is 0^0 to generate the desired angle at midday. The collector should be aimed at the sun this means that, at the south of the equator the collector should be aimed north and north of the equator aimed south (figure 3.9).

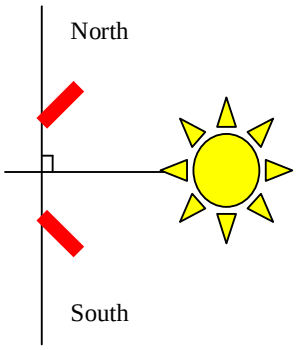


Figure 3.9: positioning of the collector (red), in comparison with the equator

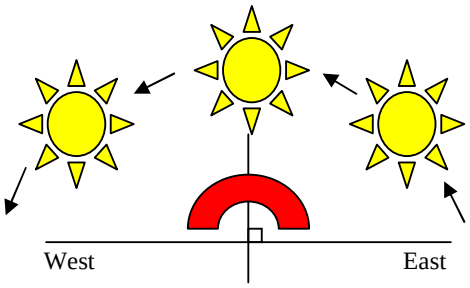


Figure 3.10: A more efficient collector (red) shape, regarding the path of the sun.

[26] As stated by mr. Osman, professor at TDTC, on the 17th of October 2006.

Currently most heat-collectors are rectangular shaped only generating the desired 90 degree angle at midday. A proposal made by mr. Osman of the TDTC, to generate more efficiency, is to shape the heat collector in a way that the sun always makes a 90 degree angle with the collector (as demonstrated in figure 3.10).

3.4 Analyzing the available Technologies

3.4.1 Open-air drying

Open-air drying remains the cheapest method of food drying, no investment maintenance or power is required and it is capable of large batch sizes. But the product is exposed to various contamination risks, such as dust, animals, ants, rain, etcetera, resulting in a poor quality of the dried product, and requiring labour to survey the crops. Products that are dried in the open air are not fit for consumption when one regards international standards, like the CAC.

3.4.2 Box dryers

Box dryers can handle medium size batches and are relatively cheap (although more expensive than open-air drying). Drying times are longer than with other dryers, strongly dependent by the sun intensity. Because of the direct heating by the sunlight conditions within the dryer are not identical, the top layer will dry much faster then the lower layers and through the high sun intensity on the top layer there is a risk of "burning" the fruit, which turns it brown. Because of these uncontrolled conditions in the drying chamber product output may vary in moist content, a too high moisture content can result in rotting, with a too low moisture content the product is unfit for direct consumption. All in all one can conclude that the quality of product output will not be consistent.

Figure 3.11: A box dryer located in an overgrown area in Tanzania

Figure 3.12: Trays used in common box dryers in Tanzania are not suitable according to CAC standards

Because of the characteristics of this dryer (cheap, medium batch size, long drying times), they are commonly used in projects to introduce fruit-drying to rural farmers. Experience (refer to interviews with fruit drying women group in Morogoro in appendix 1) from farmers involved in these projects (usually one dryer operated by an entrepreneur that buys fruit from local farmers) shows that food processing conditions are not in line with international standards (CAC), knowledge and training leaves much to be desired, and the value added of the drying is negligible because of the small batch sizes. Because of this small batch size and a lack of infrastructure, dried produce is often assembled over a certain period so that the quantity is large enough to make transport to Dar Es Salam (packaging) viable, resulting in rotten dried produce (high moisture level) before packaging.

The UDSM box dryer is equipped with a solar driven fan which is meant to generate airflow and so create controlled chamber conditions. The UDSM box dryer is meant to handle large batches, although after testing the dryer was not capable of drying the desired quantity (it was meant to process 100 kg instead of 40 kg), so the realized batch size is much smaller. Because the basic design of a box dryer is kept most disadvantages also stayed, "burning" is still a problem, and even though the fan was installed to make drying conditions in the chamber more consistent, they are still not, resulting in an inconsistent output. Because of the addition of a solar panel and a fan the costs rise considerably in comparison to an ordinary solar dryer also the level of complexity of the machine has raised undoing the low-tech advantage of the ordinary box dryer. The increase in costs and complexity makes it inappropriate as a

suitable technology for individual fruit and vegetable drying, when considering the capabilities for individual farmers.

The technical data of the UDSM box dryer is as follows:

Batch size:	40 kg of raw material (i.e. peeled, sliced and stoned)
Drying time:	2-3 days
Power requirement:	55 W
Drive of fan:	solar panel
Price:	approximately $350

3.4.3 Indirect solar dryers

Small scale indirect solar dryers

Indirect dryers can have controlled chamber conditions and the produce is not directly exposed to sunlight, creating a constant product quality. Indirect dryers are able to generate more heat, which shortens the drying time. In addition indirect dryers are less sensitive to weather conditions because other heat sources can easily be added. There are basically two types of indirect dryers, the stand-alone (small) solar dryer, and the heavy duty indirect dryer that is accommodated within a building.

Figure 3.13: A small scale cabinet dryer produced by TIRDO in Tanzania. The dryer uses airflow by natural convection

Figure 3.14: The trays that are used in the design by TIRDO are not suitable according to CAC standards

The stand-alone indirect solar dryer is relatively expensive and can only process small batch sizes furthermore the heat collector is placed low and topped with glass making it sensitive for damaging and therefore unpopular with rural farmers.

The technical data of the small scale cabinet dryer by TIRDO is as follows:

Batch size:	40 kg of raw material (i.e. peeled, sliced and stoned)
Drying time:	3 to 4 hours
Price:	approximately $1.000

Heavy duty indirect solar dryer

The heavy duty indirect solar dryer, can handle very large batch sizes which can be dried under very controlled conditions. Not only can the drying chambers be controlled but because everything is packed into one building the produce will never contact the open air until it is packed and ready for transport, reducing the risk of any contamination. Because of there size and more complicated technology these dryers are expensive. The heat collectors of this dryer are also topped with glass but due to the high placement of these collectors, chances of damaging are lower.

The technical data of the Hohenheim heavy duty dryer is as follows:

Batch size:	ranging from 40 – 510 kg of raw material (i.e. peeled, sliced and stoned)
Max capacity per day:	ranging from 80 up to 1020 kg of raw material
Dimensions(LxWxH):	from 1,4 x 0,75 x 0,9 to 1,4 x 2,6 x 2,3
Drying area:	from 4 m^2 to 50,8 m^2
Heating power:	from 4 kW to 65 kW
Installation time:	1 day
Price:	approximately $32.750 including packaging

Figure 3.15: A Cabinet dryer as produced in Germany by Innotech Ingenieursgesellschaft mbH

3.4.4 Tunnel dryers

Tunnel dryers can handle medium size batches and have controlled chamber conditions (although it is not as controlled as with the indirect dryers). When sun intensity is too high the drying chamber can be covered and when the sun intensity is too low another heat source can be added, the fans controlling the airflow in the tunnel adjust themselves to the sun intensity. Tunnel dryers are more expensive than a box dryer but cheaper than an indirect dryer. Drying times are relatively short although longer than the indirect dryers.

Figure 3.16: Electrical fans as used by

Figure 3.17: Application of foil for light sensitive products

The technical data of the Hohenheim tunnel dryer is as follows:

Batch size:	150 – 250 kg of raw material (i.e. peeled, sliced and stoned)
Length and width:	18 x 2 meters
Solar collection area:	16 m^2
Drying area:	20 m^2
Air flow rate:	400 -1 200 m^3/h
Air temperature:	30 - 80 °C
Power requirement:	20 - 40 W
Drive of fans:	solar panel
Thermal energy gain (solar radiation):	up to 60 kWh/day
Installation time:	1 day
Price:	approximately $6.500 including packaging

3.4.5 Other drying technologies

The mentioned drying methods are commonly used and much data is available about them for example concerning construction. Although some other more experimental methods were found.
For example the TIRDO mixed dryer and the UDSM box dryer. The TIRDO mixed dryer combines the characteristics of an indirect and a direct solar dryer, batch sizes are medium and the price is comparable with that of a normal box dryer. Conditions can be controlled, although minimal (the direct part of the dryer can be covered creating an indirect solar dryer). Because the dryer is basically set up as a normal box dryer with an extra heat collector, the “burning” of produce and inconsistency of output are still disadvantages. The extra heat collector generates extra heat into the dryer shortening the total drying time.

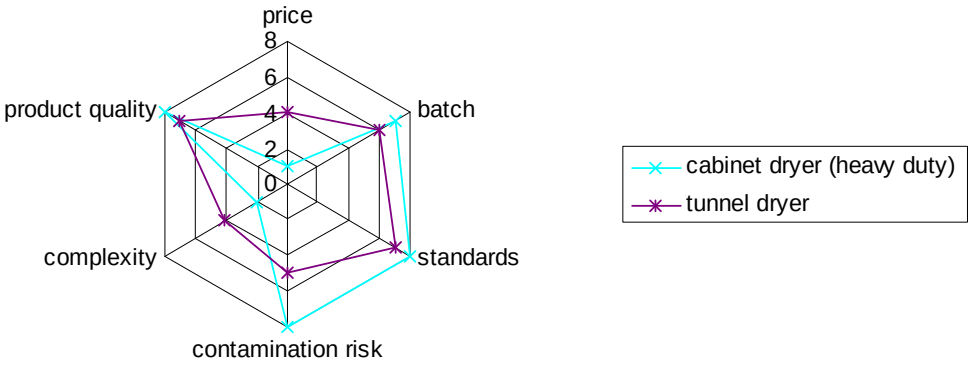
3.5 The most suitable technology for Tanzania

In table 3.1 the different drying methods are compared regarding the most important characteristics. These characteristics are given grades varying from 1 (bad) to 8 (good), in the last column the grades are added.

	price	batch	standards	contamination risk	complexity	product quality	Total
open air drying	8	8	1	1	8	1	27
box dryer	7	3	2	2	7	2	23
cabinet dryer (stand alone)	5	1	5	7	6	6	30
cabinet dryer (heavy duty)	1	7	8	8	2	8	**34**
tunnel dryer	4	6	7	5	4	7	**33**
mixed dryer	6	2	4	3	5	4	24
box dryer + freeze drying	2	5	6	6	1	5	25
UDSM dryer	3	4	3	4	3	3	20

Table 3.1: comparison of drying methods

According to this table the cabinet dryer (heavy duty) and the tunnel dryer are, using the set characteristics, the best drying techniques. Open air drying appears to be a good option as well, receiving 27 points resulting in a 4th place. However one should keep in mind that the characteristics where it obtains the lowest possible score (1), are crucial for the production of a sellable export product.
Another issue one should bear in mind is that the tunnel dryer is more of an all-round scorer in the comparison. This can be seen in the figure below. The heavy duty cabinet dryer has a few low scores, whereas the tunnel dryer only has a low score for price.



4. Organization of the Solar Drying Sector

Currently the rural fruit and vegetable sector is unorganized in Tanzania. Because of the relative small size of the producing farms, its scattered structure, and the lack of large commercial buyers, there have been hardly any efforts to organize this sector.
An organization structure has to be found that is suitable for implementation in Tanzania's rural vegetable and fruit sector and fits the technologies that proved to be appropriate according to chapter 3. Several organization structures will be discussed followed by an analysis to determine the most suitable structure.

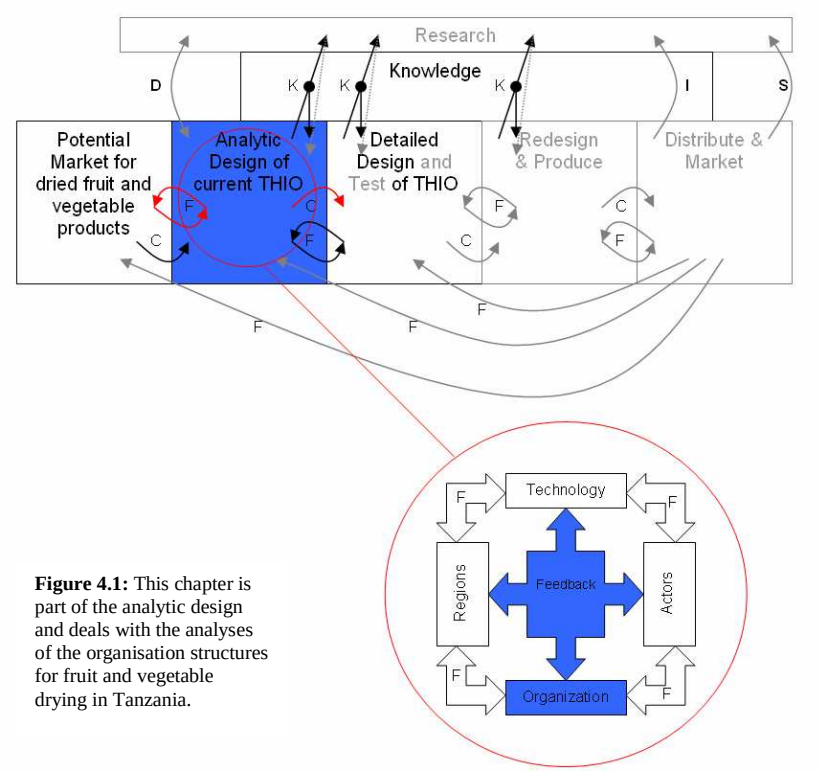


Figure 4.1: This chapter is part of the analytic design and deals with the analyses of the organisation structures for fruit and vegetable drying in Tanzania.

This part of the thesis deals with the different available organisation structures and is part of the analytic design. At the end of this chapter a most suitable organisation structure will be identified in conjunction with the most suitable technologies and will use the requirements for the export market from chapter 2 (red marked F-arrows). The information from these analyses will be used as input (red C-arrow in the figure above) for the detailed design, which will be discussed in chapter 7.

4.1 Cooperative Structure

The title of this paragraph may ring some alarm bells because of negative experiences with cooperative structures received with Ujamaa, in the 1970's during the Nyerere period. The here discussed structure is different because:

- The project is not dependent on government support, this in contradiction to the structures in Ujamaa that were *"over reliant on government finance"*[27],
- Membership of the cooperatives is voluntarily,
- The farmers own the production plant,
- Profit making is a goal.

The NRI claims that the establishment of producer groups can be a suitable solution when the *"horticultural producers are small and scattered over a large area"* and the problem of scale can be

[27] **"Tanzania**." Encyclopædia Britannica. 2007. Encyclopædia Britannica Online. 21 May 2007 <http://www.britannica.com/eb/article-37555>.

overcome with this solution[28]. This is currently the case (and the problem), of the fruit and vegetable sector in Tanzania. Therefore group formation sounds as a suitable solution for the project. The considerations made by the NRI to successfully format producer groups will be reflected on the project case.

4.1.1 Producer groups

To create a sustainable reliable and dedicated relation with the rural farmers it is thought that farmers should have to have a certain ownership in the project. This can be done by creating cooperations with a group of selected rural farmers, so that they can run and own the dryer themselves. For this the farmers will have to be organized into groups, so that they can generate enough input for the dryer. Besides input security group formation generates more advantages in terms of a.o. credit, communication and social control.
The National Resources Institute (NRI) has experiences in creating of producer groups among rural farmers. They mention the following advantages[29]:

- economies of scale in provision of services, supply of inputs and collection of crop;
- easier two-way communication of information,
- more effective provision of training,
- easier negotiations on price,
- joint collateral for loan security,
- peer group pressure for loan repayments,
- easier monitoring of performance and quality control.

4.1.2 Group formation

The CBA's mentioned in this report (see chapter 7) show that 520 to 940 tons of fruits and vegetables are needed per selected region, which is approximately 0.5% of the total produced amount. The mentioned needed amounts can be produced by two to three larger rural villages, taking the visited villages during the interviews as a point of reference. The so called producer groups can therefore be formed within these firm communities, creating a strong social control on the project. Adjacent to this control issue these "village groups" are a pre-existing organization that share common values and objectives creating a more stable organization than one where the members have no previous history of working together, a consideration from NRI when formatting groups[30]. Other important criteria mentioned by the NRI regarding group formation are less evidently present in the communities but can be implemented like the participation of females in the groups[31]. However the set-up of village groups is not a necessity to form a producer group, important is that all members of the prospective group are fully involved in the decision of setting up the group[32]. When this can be reached in an existing community, group formation can be achieved more easily, therefore this is a plausible proposal.

4.1.3 Leadership and management

Strong hierarchy in leadership is often present in rural communities in Tanzania, there is a group of senior village inhabitants that represent the village. This is valuable for the quest for a suitable group leader, who needs strong leadership[33]. Another pro for "village groups" is the essential constitution with role clarifications[34], this constitution is to a large extent present in small social communities as rural villages, but have to be put in writing. A group leader should be chosen in a transparent and democratic method[35], but a village leader has the natural status, and can therefore be an excellent candidate.
The democratic and transparent process is not only required for group leadership but also for group management therefore all decision making should be transparent and democratic as well to avoid dictatorial tendencies[36], in addition a high literacy rate of the group will lower the risk of mismanagement[37]. Voting power for this democratic system should not be equal for each group

[28] NRI www.nri.org/NRET/SPCDR/Chapter2/linkages-2-7.htm
[29] Ibid
[30] NRI www.nri.org/NRET/SPCDR/Chapter2/linkages-2-7-2.htm
[31] Ibid
[32] Ibid
[33] NRI www.nri.org/NRET/SPCDR/Chapter2/linkages-2-7-3.htm
[34] Ibid
[35] NRI www.nri.org/NRET/SPCDR/Chapter2/linkages-2-7.htm
[36] NRI www.nri.org/NRET/SPCDR/Chapter2/linkages-2-7-3.htm
[37] Ibid

member, but should be subordinated to capital share in the cooperation[38]. In other words: a farmer that supplies 20% of the raw produce should have more voting power within the cooperation than a farmer that supplies 2%.
The administration of supplied quantity by the farmers will be part of the management tasks of the "village group" leader, this way it remains clear which farmer delivered what batch of fruit. Besides tractability options this is needed to pay every farmer according to delivered quantity. This way the central fruit processing plants will not have to deal with the individual farmers but deal only with the villages, paying them the amount delivered per village. Creating big quantities of raw material, instead of relatively small quantities delivered by individual rural farmers, relieving management constrains for the plant. In figure 4.2 the structure of the cooperation is illustrated, when the dried produce leaves the processing plant it also leaves the cooperative structure, the nationally collected produce, of all cooperative structures, will then be exported.

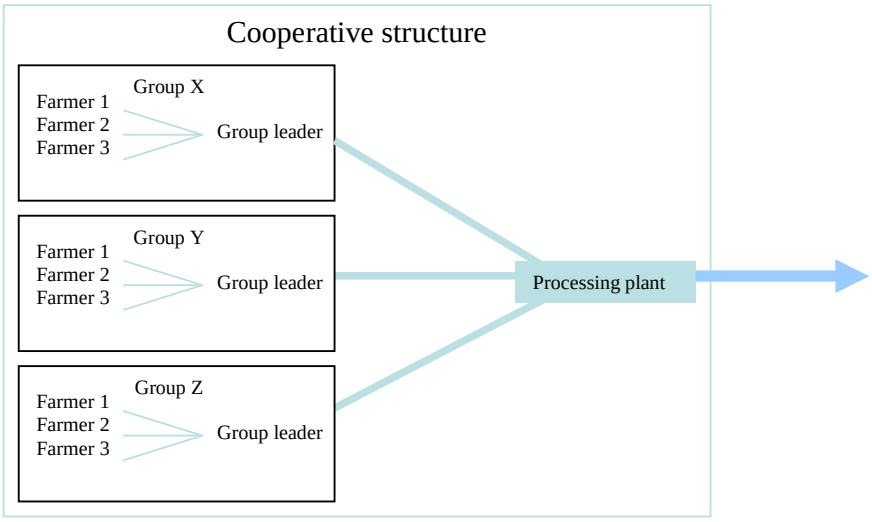


Figure 4.2: Cooperative structure producer groups

The dryer is owned by the cooperation but operates individually, it has its own staff. Membership meetings will be held frequently to emphasize the transparent and democratic character of the group, these will deal with financial issues and decision making.

[38] B. Nierop, Chief Commercial Officer NMB, 2006

4.1.4 Finance

Finance is an important issue within producer groups, and is the main break-up cause of such groups[39], therefore finance should be handled in a professional and transparent manner. Good financial management and record keeping can contribute a great deal to group stability.
Banks in developing countries are often not willing to provide credit to individual rural farmers but are more agreeable in supplying credit to groups of farmers, however only when they meet specific obligations[40]. Banks focus on creditworthiness of their clients when deciding to provide credit, this is obviously a major issue to the often poor rural farmers. Most rural fruit and vegetable farmers have negligible own capital and often have no secure, trustworthy and creditworthy clients. These secure, trustworthy and creditworthy clients do exist in Tanzania, for example in the coffee tobacco and sugarcane branches. Rural farmers that produce these crops are supplied with credit because risk is averted by security of collection and payment of the produce. The procedure of giving credit to farmers with secure, trustworthy and creditworthy clients is known as the warehouse-receipt system and is widely used by credit institutions in developing countries, and is clarified by figure 4.3.

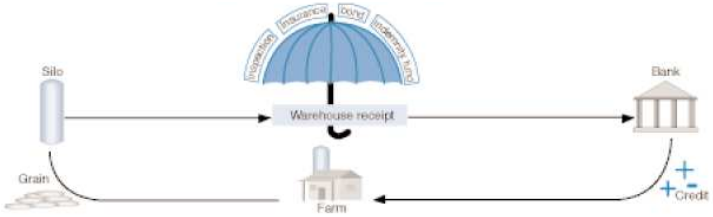


Figure 4.3: Schematic representation of the warehouse-receipt system. *source: IMF*

The described client characteristics needed for this system are often only met by multi-million dollar international industries, like the tobacco coffee and sugar branches. This unfortunately is not the case in the Tanzanian rural fruit and vegetable branch causing barriers for credit acquirement. The drying project is capable of producing a steady quantity and quality of produce, making the sector more appealing for the export market. Because of this relevant export market in developed economies, the project will be capable of finding its required clients, and with that the required credit. The NMB has shown interest in supplying credit in the project[41].

In addition banks are more willing to provide credit to producer groups because of the strong social control within these groups, resulting in pressure to pay back the loan, and higher traceability compared to individual credit[42].
The group should be set up with full participation of the members and group membership must be seen as a privilege[43], the NRI therefore recommend that the group members pay a fee for prospective advantages. Besides a psychological effect the fee can be used to increase capital power of the cooperation. This fee can be created by for example a 1% tax on crop output[44].
To create dedication, the potential profit of the project should be divided among the participating farmers according to delivered quantity. This implies that the dryer will be run as a non-profit organization. All income of the project deducted by costs of maintenance, staffing costs, etc. will flow back to the rural farmers.
The created cash flow into the project will de divided in the opposite direction of the produce flow. This means that the created income by exports will flow back to the different cooperation structures deducted with the running costs of the trading company concerned with export. These trading companies pay for the received produce from the drying plants, they on their part will pay the “village group” leaders who will pay the individual farmers.

[39] NRI www.nri.org/NRET/SPCDR/Chapter2/linkages-2-7.htm
[40] B. Nierop, Chief Commercial Officer NMB, 2006
[41] Ibid
[42] L. Muze, Ag. General Manager of Kwanza Collection co. ltd, 2006
[43] NRI www.nri.org/NRET/SPCDR/Chapter2/linkages-2-7.htm
[44] B. Nierop, Chief Commercial Officer NMB, 2006

4.2 Ugandan Concept

The fruit drying sector in Uganda seems to be successful and therefore serves as an ideal benchmark for the fruit drying sector in Tanzania. Therefore virtually all organizations active in solar drying in Tanzania pursue this set example. How is the sector in Uganda organized, can it prove suitable for the solar drying project in Tanzania and why do all current organization seem to fail hopelessly in implementing the Ugandan concept in Tanzania?

The main contributor to the success in Uganda, is the main exporter of dried fruits in that country, a Ugandan company called Fruits of the Nile Limited (FoN). This company has build up a network of more then 60 solar dryer operators (1999)[45]. The dried products (mainly pineapple and banana) are exported to Tropical Wholefruits Limited, a UK sister company.

FoN's supply network exist of a variety of structures that supply the company, like for example; cooperatives, individual smallholder farmers (running a single dryer), and entrepreneurs (running multiple dryers)[46]. The used dryers are simple basic design box-dryers[47], which are incapable of producing products with a constant quality[48]. The processors sort and grade the produce, low-quality produce that unfit for export is sold on the domestic market[49].

FoN provides training, information on access to credit and organizes the construction of solar dryers. Tropical Wholefoods repacks the product into 100g bags for distribution to retailers in the UK including Oxfam Trading Limited[50].

In 1999 the combined output of dried fruits in Tanzania was 60.000 kg/year produced by 150 simple box-dryers, capable of drying 2.5–3kg batches (dried pineapple) drying such a batch takes 2 days[51].

A market overview of the dried fruit sector in Uganda states that the drying technologies used in Uganda are in terms of quality rated as low[52]. In the same report it is stated that the mostly used technology are simple box-dryers. This corresponds with the experiences received in Tanzania, where the low quality of the output served as one of the constraints, for proper marketing of the produce. FoN claims that at processing level HACCP and GMP are adopted[53], which is quite unlikely if the production is executed in a similar approach as in Tanzania. Mr Osman (TDTC, UDSM) argues that the entire collected quantity is freeze dried at the companies premises before export, this can be done according to HACCP and GMP. Peculiar is that no report seems to explicitly mention this freeze dryer, just one report briefly mentions a placement of the produce in a deep freezer at -20^0C for 48 hours to make microorganisms dormant[54].
It is quite plausible to assume that FoN uses these freeze dryers, because with individual on-site production with simple box-dryers one is unable to meet the strict European standards, and therefore unable to export to the UK.

The used freeze dryer and the lack of a national market for dried fruits ("*people are not used to eat dried fruits*"[55]) can explain why attempts to implement the "Ugandan concept" in Tanzania. Because Tanzania does not use a freeze dryer, produce is not exportable. The domestic demand is insufficient,

[45] MSc in the Faculty of Economics (Development Studies) (1999) *Fair Trade, Good Business: An exploration of the relationship between the participation of the poor and efficient economic structures using dried fruit production in Uganda as a case study*, London School of Economics, p7
[46] Ibid
[47] Arfaoui Y.(year of publishing unknown) *Improving the welfare and increasing the income generation by the commercialization of sustainable energy technology: Commercialisation of Solar dryer for Agricultural Products*, UNEP & AREED, Annex 1
[48] Agona J. A, Nabawanuka J., Kalunda P. (2002) *A market overview of the dried fruit sector in Uganda: A Foodnet grants award project*, National Post Harvest Programme/KARI, p4
[49] Ibid
[50] MSc in the Faculty of Economics (Development Studies) (1999) *Fair Trade, Good Business: An exploration of the relationship between the participation of the poor and efficient economic structures using dried fruit production in Uganda as a case study*, London School of Economics, p14
[51] Ibid p14
[52] Agona J. A, Nabawanuka J., Kalunda P. (2002) *A market overview of the dried fruit sector in Uganda: A Foodnet grants award project, National Post Harvest Programme/KARI*, p6
[53] Ibid, p11
[54] Ibid p11
[55] Arfaoui Y.(year of publishing unknown) Improving the welfare and increasing the income generation by the commercialization of sustainable energy technology: Commercialisation of Solar dryer for Agricultural Products, UNEP & AREED, Annex 1

so produce can virtually not be sold there. Recapitulated one is producing a product that is very difficult to sell.

4.3 Large scale plantations

Large scale plantations sound as an obvious solution, because infrastructure, quality and quantity problems are overcome. When placed in the right surrounding it could generate employment for rural farmers, possibly lifting them of subsistence level.
A big plantation can produce more efficiently and irrigation systems and transport infrastructure can be set up more easily.

From the prospective of product quality and constancy this seems the best option training can be aimed very accurate and product auditing and tracing can be done very effectively.
However one should keep in mind the initial aim of the project, which is lifting rural farmers from subsistence level. Small scale enterprises are generally more effective than large scale enterprises in distributing benefits to the poor[56].
Because the project is aimed at poor rural farmers they are the ones that will have to participate in the project. But are rural farmers going to participate in setting up a large plantation? If this is presumed, they will have to give up their current method of farming on their own small piece of land, one may question oneself if a farmer is going to give up his land, which secures him from income, to invest in a project.
Investments in drying facilities will be approximately the same, because more or less the same amount of produce will have to be dried, however extra investments are now a necessity because land will have to be purchased as well.

Another aim mentioned as a goal in the project is that the project should be sustainable, meaning that the project will be self supporting and members will be involved and devoted to the project. An often mentioned issue to create this is generating ownership among the project members. In a large scale plantation it can prove to be difficult to create ownership of the project among its members because the project member is likely to become an employee of the large plantation.
In the other discussed organization set-ups, a sort of reward system was build in, when a smallholder is producing more crops for drying one will receive more payment or a larger share of the profit. This reward system is difficult to implement in a plantation set-up.

The Tanzanian Ministry of Agriculture and Food Security argues that large farms are usually sited in the highly productive areas of the country. These will be the areas for profitable plantations as well, but these are not always the areas where the rural poor are located[57], so only a small proportion of the poverty will be solved. This in contrast to the other discussed organization set-ups which are more or less flexible, in fact they can be implemented virtually everywhere in the country, although some areas will be more suitable then others.

4.4 Analyzing the possible organization set-ups

The NRI gives the most clear organization set-up considerations for a sector that has small producers that are scattered over a wide area and have a scale problem (individual farmers do not produce enough to become commercially viable). A cooperation set-up is argued to be the most suitable solution.
In the chapter “technologies for drying” one can see that the most suitable technologies for drying are the heavy duty cabinet dryer and the tunnel-dryer, these are too expensive for individual use. This means that the set-up as described in paragraph 4.1, where a group of farmers own one drying facility is a potential option.
Considering the quality and continuity of the dried produce it will be difficult to implement the “Ugandan concept”, despite of the fact that it is implemented successfully in Uganda, it is felt that better product quality and continuity can be achieved with not a big central processing plant but with several small processing plants. Employees of the drying facilities can be trained and drying will be there core business in contrast to farmers for which drying is a side activity to farming. The input received by the central freeze dryer will most probably be of inconstant quality. Of course this can be

[56] MSc in the Faculty of Economics (Development Studies) (1999) Fair Trade, Good Business: An exploration of the relationship between the participation of the poor and efficient economic structures using dried fruit production in Uganda as a case study, London School of Economics, p9
[57] “National Sample Census of Agriculture 2002/2003 Small holder agriculture, Volume 2 Crop Sector-National Report”: NBS, 2006, p 117

rectified by the freeze dryer but this will only kill microorganisms making it fit for consumption it will not be able to restore a constant structure of the end produce, creating a produce that can only be processed in end products. Dried fruits with a nice structure can be sold as an end product itself, generating a bigger market. Moreover sun dried produce is said to have a sweeter taste then produce that is dried with other methods[58].
The large scale plantation set-up, is, however probably commercially viable, difficult to implement considering the original research aims concerning poverty alleviation of rural farmers and sustainability created by ownership.

4.5 Most suitable organization set-up

The analysis shows that the cooperative structure as is presented by the NRI has no obvious disadvantages, except maybe the fact that it may remember some people to Ujamaa, which is unfounded when one looks into the composition of the set-up.
Based on the NRI considerations the entire organization set-up for this particular project could be proposed.

At first there are the producer groups, they exist of farmers that deliver to a, democratically chosen, group leader. He is responsible for the administration in his own group, so every delivered batch is attached to a farmer. Several of these producer groups are linked to a drying facility, which is owned by all the members of the several producer groups. The drying facility administrates every group, so that each batch can be retraced to a certain group. Management is organized as described in the producer groups chapter; voting power within the group is dependent on delivered quantity, groups are formatted and set up with a democratic and transparent character, members of the cooperatives pay a small fee to gain full participation of the members and a feeling of privilege, it also increases the capital power of the group.

The dryer is owned by the group members but ran by trained staff. The drying facility has a non-profit character, indicating that the potential profits are divided among the group members relative to delivered quantity. The group members are responsible for their own drying facility, so from the gained income drying staff, maintenance and possible investments have to be paid. Finance is managed transparently and important financial issues, like new investments, are democratically determined in meetings with all participating members.

[58] Agona J. A, Nabawanuka J., Kalunda P. (2002) *A market overview of the dried fruit sector in Uganda: A Foodnet grants award project, National Post Harvest Programme/KARI,* p12

When the dried produce leaves the drying facility it leaves the producer group cooperative. Subsequently it goes to a trade-cooperation, set up in a location with a good export infrastructure (harbour, airport), say Dar es Salaam. This cooperation will arrange export to potential costumers. The cooperation administrates the batches per drying facility, so that each batch can be retraced to a certain drying facility. The cooperation pays per delivered batch to the drying facilities, who on their part, divide it among the group leaders, who divide it among the group members.
Because every batch is administrated delivered batches can be retraced to a specific farmer and the used drying facility, this way quality can be checked, maintained and addressed in addition inferior batches can be ejected very effectively.
Schematic the organization looks like figure 4.4:

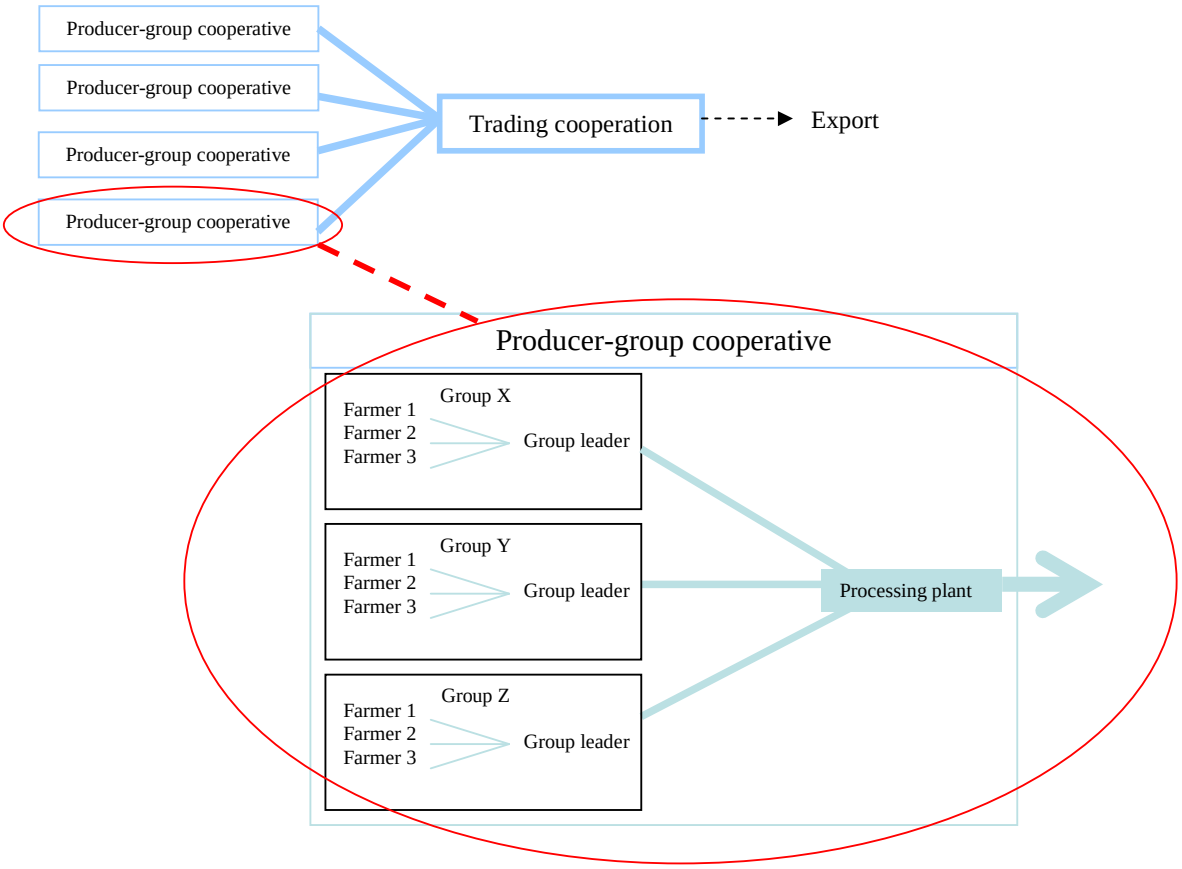


Figure 4.4: Schematic presentation of the organization as a whole and the producer groups.

5. Relevant actors in Tanzania

In this project various actors are of great importance. Several actors in Tanzania are more or less involved in the project they provide training, information supply and credit. What these actors do and why they are important and what key considerations have to be considered, will be discussed in this chapter.

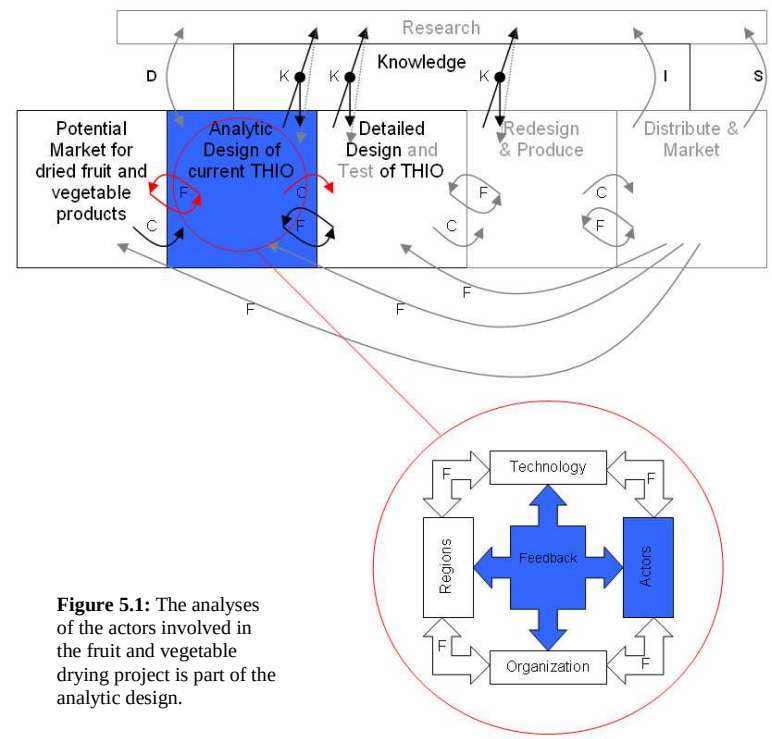


Figure 5.1: The analyses of the actors involved in the fruit and vegetable drying project is part of the analytic design.

In this chapter the roles of the actors which are involved in the project are identified and they will be analysed to determine in what way they can contribute to the successful implementation of solar drying technology in accordance with the requirements of the potential market (see the red F-arrows in the figure above). The information from the analyses of the actors will be used in the detailed design phase of the research (see the red C-arrow).

5.1 Actor activities

5.1.1 Training & Information

Product quality and production quantity are influenced by services given to rural farmers. If technical (and other) services are sufficient, the yield and quality of crops is likely to be high: when services are poor or non-existent, their yield and quality is more likely to be low. Since product quality cannot be improved after production, it is necessary to stimulate and train smallholders to produce the best quality within their means before harvest.

By providing rural farmers with timely technical agronomic and managerial advice based on research, training and extension methods, and by assuming responsibility for rigid enforcement of standards and records of all procedures, exporters can effectively integrate farmers into supermarket supply chains. In this way, trust is established on both sides, which gives European importers and supermarkets the confidence to buy from smallholders. It is important that the rural farmers are strongly involved with the financing and development of new technologies, the greater the involvement of smallholders in developing and paying for new technology, the greater the likelihood of its effectiveness[59].

[59] NRI.org, Small producers in export horticulture, A guide to best practice, providing services to smallholders, research training and extension – How can they best be provided, 2007

NRI gives the following considerations when training small-scale farmers[60]:
- Training should be conducted to inform on specific skills, which have been identified as needed and valid.
- Carry out training in an environment that is familiar to farmers so that they can see the relevance of the training to their own farms, for example on-farm demonstrations
- Restrict the duration of training sessions so that key farm decision-makers (both men and women) can attend
- Link technical training to financial training on cost-benefit analysis, budgeting and business management, so that innovations taught are financially as well as technically viable.

Various organizations deal with the training of users of the solar drying equipment. There are national and international organizations that more or less intervene on this topic. Training in general is aimed at food hygiene, food processing, and food safety.
Training is usually given to the recipient of the machine and experience shows that these training skills are passed on within the community and to future generations. However this information often changes during this passing[61].
The organizations that provide training have different approaches: creating training manuals, training TOT's (Trainers Of Trainers) and/or training at community level. An often mentioned point is the lack of organization of the fruit farmers which makes community aimed training difficult.
The quality of training can fluctuate. Some organizations give training according to their own insight while other organizations base their training on international training manuals like NRI. These international training manuals were mostly modified according to own insight, some in doubtful ways. SIDO for example claims that some hygienic issues mentioned in the NRI manual are not imperative for the situation in Tanzania. It claims that shielding products from the open air is not required because of the lack of air pollution in Tanzania's rural areas[62]. Presuming this remark is true, still a note can be added: the end product is not only exposed to air pollution but also to organisms that can influence the quality of the end product.
Tanzanian organizations do have substantial experience in the training of farmers, but are usually aimed at large organized farmer groups which are easy to reach, for example the cassava farmers. Because of the large number of cassava farmers in most communities and a structured network this group is easily reached by, for example government organizations. They are regularly informed about new developments in the market and new agricultural improvements. Because of the organization of these farmers successful food processing companies, cassava milling companies, came into being.
A substantial problem for efficient training of the rural fruit farmers is the lack of organization and the decentralized character of the sector.
In general training is supported by manuals, this is acceptable because 84%[63] (1995) of the Tanzanian people is literate. Experienced trainers (Osman (TDTC) and UNIDO a.o.) state that training should be theoretical as well as practical. Trainers should be heavily involved in the process, and it is recommended that trainers should be present when the first few batches of dried fruits are produced.
Most of the current trainings are theoretical and are given in one day, when the training is over the farmers can start producing. There is no further support, and there is no evaluation later on in the process.

The Ministry of Agriculture works with so called extension officers, these are representatives of the ministry that inform rural communities about current policies, regulations, and market- and product-development regarding their businesses.
Because of the decentralization and unorganized characteristics of the rural fruit sector, the extension officers often do not address the rural fruit farmers. Nevertheless, this could be a good medium to provide (update) training, and information, and conduct evaluations, and auditing of the fruit drying process.

NRI also emphasizes the necessity of extension and comes up with the following considerations[64]:
- Encourage small-scale farmers to identify their own problems and to develop their own solutions

[60] NRI.org, Small producers in export horticulture, A guide to best practice, providing services to smallholders, training considerations, 2007
[61] Concluded from interviews with rural farmers.
[62] As stated by Linus C. Gedi Agro-Food Specialist at SIDO in his interview, 13/10/2007
[63] Education for all The 2000 Assesment, Ministry of education and agriculture, 1999, Table 37
[64] NRI.org, Small producers in export horticulture, A guide to best practice, providing services to smallholders, extension, considerations, 2007

- Use indigenous technical knowledge amassed in any rural community as the basis to devise new technologies wherever possible
- Test and validate new technologies on farms before expecting them to be widely adopted
- Use various extension techniques, e.g. smallholder-to-smallholder exchange, demonstrations, study tours, problem-solving exercises, market-news services, etc.

The agricultural sector as a whole gets most of her academic support from the Sokoine University of Agriculture in Morogoro. This university is currently involved in a solar drying project. In this project box solar dryers were given to rural farmers in the Morogoro region, the used materials to build the dryer were paid for by the project, so the farmers only had to pay the assemble costs. Also the UDSM was involved in this particular project with her so called incubator program, meant to generate SME start ups in the private sector. In this particular program a small shop was set up in the Morogoro city to sell dried products, produced by an organized group of fruit dryers.
Experiences of project members showed that the project only has a marginal success. Gained income from participants, which are farmers, using the dryer is not significantly higher than that of average rural farmers[65]. Some participants chose to become food processing entrepreneurs, buying fresh produce from farmers transforming it into dried fruit, their incomes proved to be very low and insufficient[66]. The only participant that gains sufficient income out of the project is the project leader, he owns several dryers and is responsible for the collection of produce of all the participants, transport, packaging and sales in the shop[67].

Input from research can be of great assistance to rural farmers, the NRI gives the following considerations for research[68];
- Plan and select priorities with farmers for the design and implementation of the research
- Experiment in farmers' fields to formulate improved technologies under farmers' conditions, e.g. testing new crop varieties on farmers' fields
- Assess the results with farmers using farmer observation, agronomic evaluation, statistical and economic analysis
- Demonstrate improved technologies to farmers through training and extension.

5.1.2 Granting of Credits

Credit is of great importance to rural farmers. When they have sufficient credit it is possible for them to buy services and inputs that allow them to produce products suitable for export.
To overcome the risk of failure to pay, either due to an inability or refusal to repay loans, requires careful screening and selection of potential borrowers, monitoring the use of the loan, and establishing procedures to minimize the risk of no repayment. To create pay back security some companies provide credit to farmers in return for an assurance to market their crops through the same company. Loans are recovered by deducting the cost of the loan from the price paid to the farmer for the crops grown[69].
Credit recovery can also be based on secured sales to a major buyer, the method that credit suppliers that use a secure buyer, either the company itself or products with a big market, is the so called warehouse receipt, loans are given based on underlying commodities[70]. This method is especially suited for large and organized sectors. The warehouse receipt will be further discussed in chapter 4, paragraph 4.1.4. In general, the fewer alternative users/buyers of the crop, the better the chance of success in loan recovery, though if the right measures are taken, success is possible even with multiple buyers[71].
Monitoring the credit given to farmers is important and therefore it is essential to establish, and control an effective credit-monitoring system that can be audited. Close monitoring of farmers (for example; to minimize failure to pay) and their suppliers (for example; to minimize late payment) is required to ensure that the maximum benefit is derived from the credit. More generally, "good communications help to promote good company/farmer relations and a sense of trust, which has the positive effect of reducing payment failure" [72].

[65] Based on interview with fruit dryer user Morogoro
[66] Based on interview with fruit drying women group Morogoro
[67] Based on interview with Mr. Fafumbe, leader of the fruit drying group Morogoro.
[68] NRI.org, Small producers in export horticulture, A guide to best practice, providing services to smallholders, Research considerations, 2007
[69] NRI.org (2007), *providing services to smallholders, credit,* Small producers in export horticulture A guide to best practice
[70] R. Lacroix and P. Varangis (1996), *Using the warehouse receipts in developing economies,* Farmers and development
[71] NRI.org (2007), *providing services to smallholders, credit,* Small producers in export horticulture A guide to best practice
[72] Ibid

There are different sources of getting access to credit, NRI defines the following options[73]:

- Contracting exporter: Exporters or buyers of smallholders' crops may provide credit in kind in the form of inputs in return for crops grown under contract. Often this service is supplemented with general advice on crop management and specific technical guidance on the use of purchased inputs. In some cases, a contract serves to assure a private lender of the smallholder's creditworthiness, thus facilitating access to private credit.
- Savings and credit schemes: Smallholders deposit up to 25% of the value of the loan in a saving account, and the remainder is provided on credit
- Group schemes: Specialized micro-finance institutions may support groups of smallholders to set up 'group liability' schemes. Responsibility is taken collectively to cover each member's liability to repay.
- Agricultural suppliers: Exporters or buyers supply inputs on credit to appointed suppliers in the growing area, who then take responsibility to supply the inputs to smallholders.

Suitable farmers, with the required resources and know how to transform the credit into productive use, must be committed to the project for which they have taken a loan, to ensure repayment of the loans. To find these farmers proper screening is essential, in order to screen out farmers who may prove to be unreliable or lazy.

To create more assurance for pay back of credit the following can be considered when allocating a loan to a specific person[74]:

- Lending to individuals within a farmer group can be effective if penalties for non-repayment by an individual affect the entire group. Groups therefore have an interest in ensuring that new members are creditworthy, and in excluding those who are not.
- Sharing of information on individual farmer creditworthiness between exporters, agribusinesses and financial institutions acts as a powerful prevention to not repaying.
- Setting criteria to control personal behaviour and commitment by, for instance, requiring farmers to show that in the past they have attained a minimum yield, or to demonstrate their willingness to provide guarantee, say a percentage of the loan deposited in a savings account, as security against the loan.
- Targeting borrowers with a greater incentive to be included within a scheme, for example, poorer farmers with good crop management skills, who would otherwise face considerable difficulty in accessing services.
- Where feasible, targeting more women farmers, who are often more reliable in repaying loans but may have greater difficulty in obtaining credit from government schemes. Provision of alternative sources of credit should be considered so they can benefit from productive opportunities in the export horticulture sector.

Repayment can still prove to be a problem even after significant screening of candidates, therefore it is important to consider the following points, to create a situation where repayment is more likely[75]:

- Individual incentives, the more complete the range of services offered by the agribusiness, the more individual farmers stand to lose if they fail to repay, because then they are excluded from these services
- Group incentives, groups with a high social control, generates pressure often resulting in high repayment rates
- Lending in kind, providing credit in the form of seeds, pesticides, fertilizers, etc. reduces the possibility of diverting credit to alternative uses. Also, credit is released in parts through the production cycle, with inputs distributed only as and when required.
- Co-operation between buyers, this is not common but, potentially, provides mutual benefits, either through agreement not to purchase from farmers contracted by other buyers, or through joint operation of the scheme.
- Lack of alternative uses for output, If the output has any value other than to the processor or trader who provides the credit, then there is a risk that not all of the produce will be available for purchase by the credit provider. This is particularly relevant to food crops. It is impossible to prevent household consumption, and households will resort to this if they are dissatisfied with the

[73] Ibid, sources of credit
[74] Ibid, screening considerations
[75] Ibid, Repayment considerations

price offered for the produce, or if they are food insecure, or if they believe they can escape penalty. Fruit has this problem, so it is essential for the project that given prices are compatible.

- Strict treatment of nonpayer, Legislation can be developed and enforced which, in theory, protects both parties in the contract. In the absence of legally enforceable contracts, companies have sometimes taken enforcement into their own hands.

5.1.3 Actors involved in the dried fruits and vegetables sector

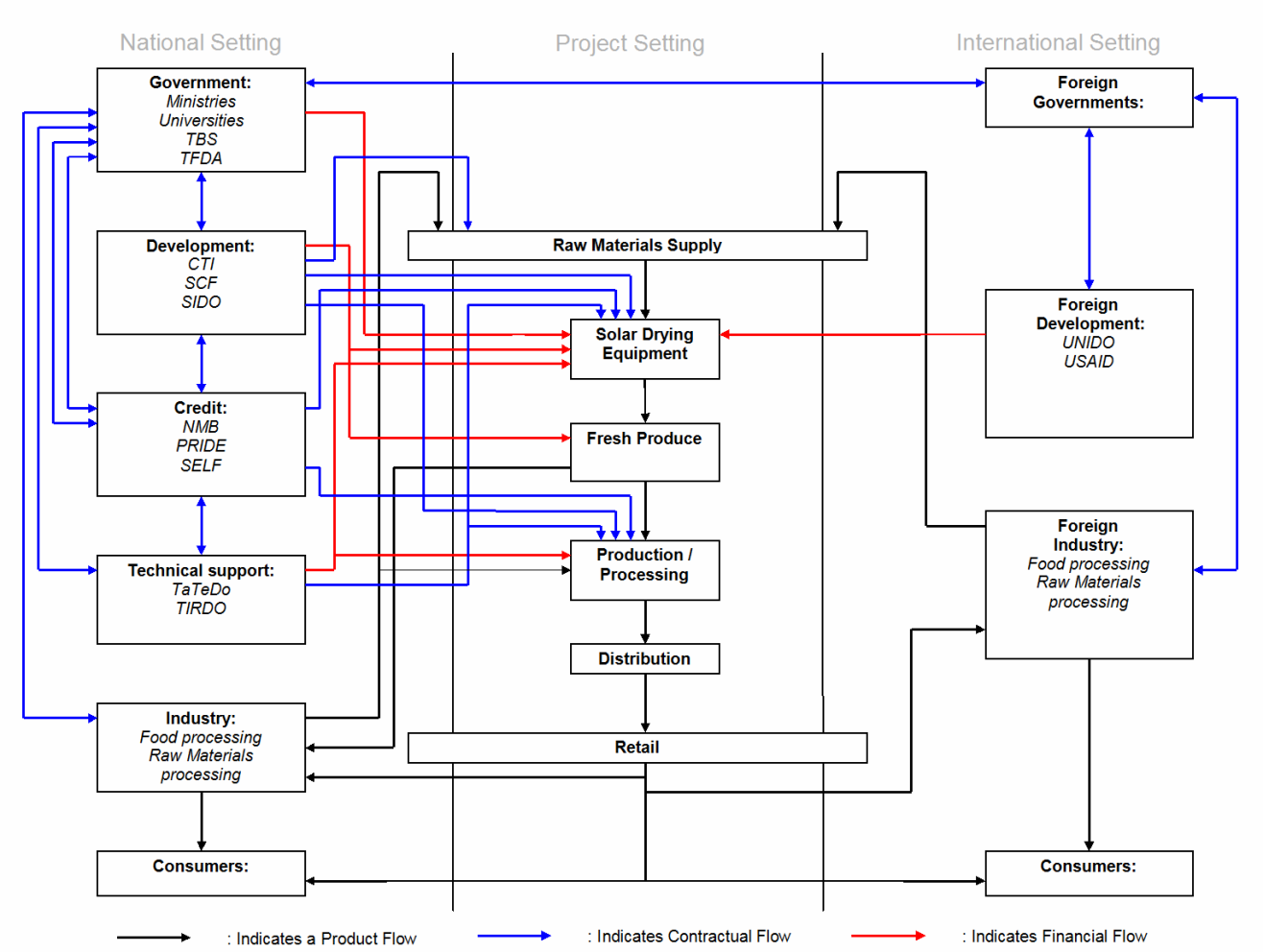


Figure 5.2: The actor-network chart which resulted from the analysis of the actors. The chart shows which and how an actor is involved with other actors, domestically and/or internationally and how it influences the project setting. Further explanation of this actor network chart is given below.

Tanzanian Government
The Tanzanian government is involved in the dissemination of the technology. Regarding the link between Tanzania, its responsibility lies in the regulatory services for dried fruit and vegetable products between Tanzania and the international world.
The government consists of various ministries of which the ministries of Agriculture and Industries & Trade are most important for the dried fruit and vegetable sector. The ministry of Agriculture provides services such as training in food processing and crop cultivation. The ministry of Industries & Trade is responsible for regulating the imports and exports which are important to the dried fruit and vegetable sector.
Universities involved in the solar drying project are set up by the government and they are in charge of providing education in entrepreneurship, business administration, food cultivation, design of machinery etc. Currently the UDSM and Sokoine University in Morogoro are actively involved in the project.
The government also helped to set up different development organisations within Tanzania to help its rural population, to alleviate poverty and to promote entrepreneurship. The government assisted in the establishment of these organisations through funding and policies.

Development Organisations
The various development organisations are there to assist the national and international government in their aim to develop specific areas of Tanzania's socio-economic structure. These organisations provide educational, financial and administration services to their target group. These institutions are non-profit organisations

Credit Organisations
Credit organisations are part of Tanzania's financial system and as such provide financial services to businesses in the dried fruit and vegetable sector. Regardless of their core business, they have the right to evaluate credit applications by businesses according to their own business goal in achieving maximum profit.

Technical Support Organisations
These organisations are involved in designing and diffusion of solar drying technology and often cooperate with various government organisations and development organisations in executing government policies en development plans.

Tanzanian Industry Sector
Tanzania's industry is one of the major clients for the fruit and vegetable sector. It should be able to process the semi finished products which the dried fruit and vegetable sector produces. It also serves as an input for the construction of solar dryers by means of producing building materials such as plastics and wood.

Foreign Government
The foreign government provides the link between Tanzanian organisations and organisations within the particular foreign country. The link involves trade agreements, foreign development policies etc.

Foreign Development Organisation
The foreign development organisations have the same responsibilities as the local development organisations. These organisations, however, have more general development strategies, which are more generally applicable to development countries, as opposed to local organisations which aim their strategy at the specific problem that Tanzania faces.

Foreign Industry
The foreign industry could serve as a source of output for the dried fruit and vegetables from Tanzania, but they could also be a source of input for Tanzania in terms of raw materials for machine building.

The end-users
An important actor which has a crucial role in the successfulness of the project is the end-user. If this particular actor is not satisfied with the implemented solution the project is doomed to fail simply because of the lack of devotion and involvement of the person who has to put the proposed theory into practice. Therefore it is considered as crucial to take into account demands, preferences and wishes of this particular actor.

5.2 Relevant actors active in Tanzania

5.2.1 The end-user

Considering the proposed organization set-up, rural farmers will be the owners of the drying facilities, making it important to consider their demands in the detailed design of the project. The users of the machinery will be employees most likely recruited from nearby areas.
Generally the rural farmers have no experience with fruit drying, but they all acknowledge the problem of crop spoilage because of a lack of market. Therefore the broad opinion on a proposed fruit drying project to create sales of otherwise spoilt crops was very positive.
Harvested produce is generally sold to middlemen that take the produce to the markets in the cities, a small quantity is sometimes sold by the farmer self, in the local market or on the side of a busy road. Middlemen often abuse the rural farmers because they know that farmers are dependent on them for income, resulting in very low prices. When farmers fear that a large quantity of their crops will be spoilt prices sink even lower. In some cases crops are given away to prevent spoilage.
Almost all interviewed rural farmers argue that their current income is insufficient to make ends meet, but if possible they are willing to invest in a project that could possibly create more income. Most of them do not have experiences with big investments, but if they knew how they are not unwilling to acquire a loan. Remarkable is that the people that have experiences with credit often had credit offers with doubtful conditions, very small loans with very high interest rate and very short pay back periods, often obtained from unofficial organizations. But still people argued that they were not unwilling to acquire a loan for investment.
Usually farmers are not familiar with the opportunities that are offered by the government or other institutions, they have no knowledge of projects that could be of interest for them.
Most rural farmers and inhabitants of rural village are able to read and write and do simple math making them qualified to receive training.
Their attitude towards change is generally positive, some even made changes to adapt to market demands, changing to other crops or their conduct of business.
Cooperation with anybody else but other rural farmers is approached cautiously and with a certain degree of mistrust. But cooperating with other rural farmers is quite usual, and there is a high degree of trust between them.
In respect to the used machinery used for drying they state that it has to be demolition-proof, often local kids will deliberately destroy for example glass by throwing rocks on it. That is one of the reasons that most organizations involved in building box-dryers use visqueen plastic instead of glass, or the glass is protected by steel bars.
This information became apparent during the interviews with the rural farmers.

5.2.2 TaTEDO

TaTEDO is a national NGO non-profit energy and traditional environment organisation, and is a coalition of individuals, professionals, artisans, farmers, CBO's (community based organizations) and micro enterprises involved in the development and promotion of renewable energy systems for enhancing sustainable environment and socio-economic development of communities. TaTEDO has developed a box-solar dryer (figure 5.3) and is planning activities in the following areas[76]:

Figure 5.3: TaTEDO's box-solar dryer

- Training in dryer operation including food-processing, business management and market-development;
- Promotion, demonstration and dissemination of solar drying technology to potential producers;
- Supporting of commercial solar drying enterprises by provision of information on solar drying technology, trouble shooting and assistance in market development activities.
- Carrying out studies regarding solar drying technology and market opportunities.

[76] Brochure TaTEDO, 2006

5.2.3 SIDO

SIDO is an organisation that supports small industry development, "SIDO works with so called micro's, people who have small income without proper education. They offer, among others, skills training in food processing and entrepreneurship. So the trainees can start their own business, and can grow along the way"[77].
SIDO has an incubator programs that is aimed at beginning entrepreneurs that have "innovative and creative business or industrial[78]" ideas, they can assist in helping them to develop to a level of commercial business undertakings. At the centre work premises, technical advice, access to information through ICT facility, financial support through loans can be provided, along with other Business Development Services on demand. There are numerous organizations in Tanzania that deal with entrepreneurship development, technical assistance and micro credit but SIDO distinguishes itself, as the only organization which offers these facilities in one "package".
The provided financial support exists of micro-credit that is offered by the Tanzania Gatsby trust for food-processing (UN, TAFU), the micro credits are financed by government funds (NEDF). The criteria for this loan are: 22-26% interest and a payback period of 6 months to 2 years (depending on the required time for the investment to generate income).
SIDO also has a program aimed especially at women-groups (WED), jointly organized with UNIDO, dealing with food-processing. This group is trained, among others in food-drying. They train food hygiene (HACCP standard), food processing, and food safety. They use simple dryers, with wooden frames wire mash trays and visqueen plastic, SIDO has these materials in stock. The courses are based on the NRI manual, this UK manual is adapted for Tanzania by SIDO according to their own views, and the training is practical as well as theoretical.
The fruits, produced by these groups, were tested by the TFDA and met the required standards, it is however unclear which standards were met because Tanzania has currently no standards for dried fruits. The used dryers are available from Tsh 200.000,- for the smallest dryer with a batch size of 20 kg. The WHO standards for location, drying yard construction etc. described in the recommended international code of hygienic practice for dried fruits (CAC/RCP 3-1969) are not met, because no interest is paid in this subject and experience shows that the dryers are randomly placed, sometimes even in reach of cattle. But according to L.C. Gedi, Agro-Food Specialist at SIDO; this cannot be a constraint, because of the different circumstances in the rural areas. Note that the WHO standards are minimum food standards established for countries that currently have no standards in certain areas like dried food production in Tanzania.

5.2.4 TIRDO

TIRDO's is an institution that carries out technological research and capability building so as to facilitate maximum exploitation of locally available natural resources for industrial development and to become an International Centre of Excellence in conducting R & D activities in the sector of Industry and Environment. It also conducts research in solar dryers and then seeks entrepreneurs to start producing the machines.
TIRDO has indirect (figure 5.3), direct (figure 5.4) and mixed (figure 5.5) solar-dryers. Prices are Tsh 1,3 million for an indirect solar dryer with a batch-size of 40 kg and a drying time of 3-4 hours., a direct dryer costs Tsh 800.000,-[79]. Provided to registered farmers with a clear objective, they will receive a 30 to 50% funding.

Figure 5.4: TIRDO indirect Solar Dryer

Figure 5.5: TIRDO direct Solar Dryer

Figure 5.6: TIRDO mixed Solar Dryer

[77] As stated by L.C. Gedi, Agro-Food Specialist at SIDO, on the 13th of October 2006
[78] Website SIDO/incubator program, 2006, http://www.sido.go.tz/
[79] As stated by A. Moshi, Senior Research and development officer at SIDO, on the 23rd of October 2006

TIRDO provides training in the drying process, packaging and labelling. With the current labels it is not possible to trace the produce back to its origin. They also train TOT's (Trainers Of Trainers) for the manufacturing of the machinery. People with the ambition to become entrepreneurs in the manufacturing of the machinery, can use the well equipped workshop at TIRDO.
Potential farmer-groups are selected by the extension officers, then appropriateness is tested by TIRDO by means of executing a survey.

5.2.5 AMKA

AMKA, the Swahili word for awareness or awaken, is a Tanzanian NGO that provides Business Development Services (BDS) and export markets facilitation to Small and Medium Enterprises (SME's) in Tanzania.
AMKA does no longer exist but is still discussed because its project had a lot of potential.
AMKA was sponsored by DFID, APT and USAID. The project stopped because one sponsor (APT, a UK NGO) pulled out of the project, because of "internal problems[80]". AMKA was involved with the construction of box solar-dryers (figure 5.7) and linking its products to the (national) market. They provide training in the areas of drying, maintenance, selling and business administration and involve local carpenters in the building process so that they are able to construct a solar dryer themselves.

Figure 5.7: AMKA box solar-dryer

AMKA was the organization that introduced the technology for the solar dryer in Tanzania in 1999. After visiting a trade fair in the UK, where dried fruits were displayed, they got in contact with an organization called Tropical Wholefoods supported by the NRI, which has a similar very successful project in Uganda (Fruits of the Nile). The idea was to start a similar project in Tanzania. The project was mainly aimed at individual rural farmers.
The dryers were sold for Tsh 350.000,- , for a big one, and Tsh 150.000,- , for a small one, and were given to rural farmers as an interest free loan, and the pay back period was adjusted to the time it takes to make money out of the machine. The machine or the produce did not comply with any standards as this would raise costs, and AMKA was aiming at serving the local market other than at exports. Exports were to be started during the second part of the project, after capabilities in fruit drying would have been built up.

5.2.6 CAMARTEC

CAMARTEC is an organisation under the Ministry of Industries and Trade. Its aim is to improve rural life through development, adaptation and implementation of appropriate technologies in the field of agricultural mechanisation, water supply, building construction and sanitation, rural transport and energy.
CAMARTEC carries out applied research to facilitate the designing, adaptation and development of machinery and equipment suitable for use in the agricultural sector and for rural development. It also aims at developing and manufacturing approved prototypes and components of farm implements, and evaluating their suitability for local use. It also performs tests on all types of machinery and equipments intended for use for agricultural and rural development in the country. It also offers consultancy services on designing, testing and other technical aspects of agricultural mechanization.

5.2.7 UDSM

Incubator Program

In collaboration with the Tanzania Ministry of Industry and Trade the University of Dar es Salaam, has set up an incubator program to help the start-up of business/technology SMEs with potential. A business incubator is "a service centre that provides entrepreneurs with the expertise, networks and tools they need to make their ventures successful, and thus catalyses the process of starting and or growing enterprises". A technology incubator is "a facility that promotes enterprise development through the enhancement of technology available to and used by enterprises". There are four different incubator models available, varying from a full service incubator to a virtual incubator.

[80] As stated by L. Muze, Ag. General Manager of Kwanza Collection co. ltd, on the 30th of October 2006

COET/MECHE
The faculty of mechanical and chemical engineering is currently active in the development of a solar-drying project that can assist in poverty elevation of the rural poor, under supervision of Dr. K.N. Njau.

TDTC
The Technology Development Transfer Centre, is, among other things, involved in the development of and research on Solar-dryers, working closely together with several institutions dealing with solar drying. Mr. Osman is the main expert in the field of solar drying and has experiences with several projects dealing with this issue.

5.2.8 Sokoine University

Sokoine University is established in Morogoro, and is aimed at the agricultural sector. Among other things the university gives academic assistance to farmers and sets up projects. In the field of solar drying they have a particular project in the Uluguru Mountains, where they have provided groups with box dryers, given to them as a loan. They still assist these groups with information (occasionally), and have given them training in food-processing (once, when the dryers were delivered).

5.2.9 NRI

The National Resources Institute (NRI) is part of the British Government's overseas aid program, and is recognized as a centre of expertise on the natural resources of developing countries. Among their field of expertise are farming systems and crop utilization, they among other things provide training in food-processing and advice when working with rural farmers. The NRI can serve as a source of experience to avoid pitfalls and can be set as a standard for, for example, training manuals. Some projects utilized this expertise, although often it was adjusted at own insight.

5.2.10 Ministry of Agriculture

The Ministry of Agriculture already builds dryers (in cooperation with TIRDO[81]) for community use and poverty alleviation. However, they are experiencing difficulties with organizing the users of these solar dryers. The solar dryers are placed in a central location where rural farmers are free to use them. The ownership of the solar dryers remains with the government, by means of TIRDO. According to the Ministry of Agriculture[82], the maximum price of a solar dryer, which can be afforded by rural farmers is TSH 250.000,-.

The Ministry of Agriculture is responsible for the traceability of food products produced in Tanzania (see also the paragraph of the TFDA in this chapter) and it acknowledges that traceability of dried fruit and vegetable products is crucial for Tanzanian products to be exported. However, this is a big issue because of the current fragmented organization structure of the farmers and the Ministry has not yet succeeded in restructuring the organization of smallholder fruit growers.

The Ministry of Agriculture is responsible for the education of the smallholder fruit growers. The Ministry gives training to rural farmers and ToT's and produces training manuals for rural farmers in food processing, packaging, etc. Currently, the Ministry is facing difficulties in efficiency because the rural farmers are decentralized and only 34% of the households receive crop extension advice[83].

In an interview with the Director Post Harvest Management Services of the Ministry of Agriculture, it was claimed that specific policies regarding rural farmers have not yet been formulated. However, for the very poor people in Tanzania, there are policies in place which enables these people to purchase processing materials without payment of taxes.

The Ministry of Agriculture supports the idea of solar drying with larger centralized solar dryers. This is to have better control of quality and quantity and to circumvent the problem of the rural farmers being unable to pay for the individual dryers themselves. Similar projects are executed in Ghana, Uganda and in Muheza, Tanzania. According to the Ministry, in Ghana a project with dehydration machines for fruit and vegetables is running. These machines are Canadian made and are very expensive, but these machines can dry very large batches of fruit of a constant and good quality.

[81] As stated by A. Moshi, Senior research and development Officer at TIRDO, on the 23rd October 2006
[82] As stated by K. Mtambo, Asst director Post harvest management services Ministry of Agriculture, on the 18th of October 2006
[83] United Republic of Tanzania, *National Sample Census of Agriculture 2002/2003*, 2006

Another project with a larger, centralized fruit and vegetable dryer, takes place in Muheza, a small village in the north of Tanzania near Tanga. The Ministry claims the management of this project lies with TIRDO. Research showed that the project in Uganda is executed in cooperation with the Danish Government and the project in Muheza is managed by UNIDO.

5.2.11 Small & Medium Enterprise Competitiveness Facility (SCF)

SCF supports product quality improvement, and market and trade development, for market oriented SME's in Tanzania through a funding facility. Eligible applications may receive matching grants to cover costs of certain activities.
SCF is supported by the Danish government and operates under the Ministry of Industry and Marketing. The organization deals with international trade, multilateral and bilateral trade agreements, and tries to add value to products by post harvesting methods.
SCF does not directly invest in machinery but primarily supports products quality improvement and the ability of businesses to meet international standards. Examples of their activities are, among others:

- Technology transfer;
- Productdevelopment / diversification;
- Meeting international standards;
- Quality assurance;
- Packaging;
- Market research;
- Trade fair participation;
- MIS (Management Information Systems) development;
- Match making;
- Value chain management;
- Network creation;
- Applied research.

To apply for a grant a brief concept paper has to be sent to the SCF office, it will then be decided whether or not one qualifies for a grant. Criteria for this grant are, among others, that an entrepreneur has at least 2 years experience in his field, and can show prove of a potential market.
SCF can provide a grant, with a value of $5000 to $ 30.000, representing 50% of the total project costs. The other 50% has to be raised by the entrepreneur, other NGO funding for this 50% is not accepted, other financial support is accepted. Because when a project is feasible, other parties should be interested as well, when this is not the case the project might not be that feasible as presented to SCF. When SCF decides to invest in a project they will investigate consumer desires in the potential export market to create the best fit for the product in the potential market.
SCF also offer funds for training and manuals, it prefers investing in TOT's, instead of in individual rural farmers, to simplify the organization structure.

5.2.12 UNIDO

UNIDO describes itself as a specialized agency of the UN that works towards improving the quality of the life of the world's poor by helping countries achieve sustainable industrial development. UNIDO views industrial development as a means of creating employment and income in order to overcome poverty. It helps developing countries produce goods they can trade on the global market, and helps provide the tools (training, technology and investment) to make them competitive.
UNIDO simply used to provide SIDO with funds and they would then execute projects for sustainable industrial development.

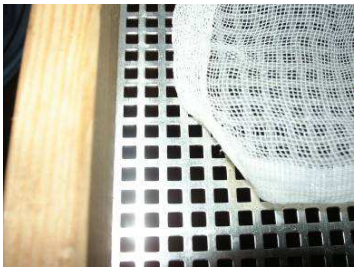


Figure 5.8: stainless-steel tray with removable wire-mash

UNIDO, now itself, has experiences in solar drying in Tanzania, they implemented a centralized food-processing plant in Muheza with a big indirect solar dryer with forced air-circulation, in cooperation with the University of Sokoïne and SIDO. This dryer represents a value of 25 million Tsh, and was fully sponsored by UNIDO including training (one day with little or no practice) and installation. Training in machine maintenance was not provided, so in case of a break down an external expert has to be called. UNIDO also named a manager for the plant with experience in food-processing.
This dryer, placed in an already existing building, has a batch-size of 100 kg of fresh fruits and a drying time that varies from 8

hours (vegetables) to 15 hours (oranges). Chamber temperature is regulated with the help of a thermostat. The dryer has 77 stainless-steel trays with non-fixed wire-mesh (figure 5.8). The required heat-collectors are placed on the roof together with solar panels that can generate power for the fans.
The fresh fruit is washed in a separate washroom and cut on plastic cutting-board with stainless-steel knives, after cutting the produce is washed again and placed on the trays and shoved into the dryer.

Figure 5.9: Universal label, with no tracing capability.

Figure 5.10: special clothing worn during the drying process

When the produce is dried it is weighed packed and sealed. After packaging, the products are labelled with a universal label (one label for all products) with no possibility for tracing (figure 5.9), although this is currently in progress.
The employees are equipped with special clothing (apron, hat and shoes) (figure 5.10), that are washed after every process.
The required fresh fruits, which are packed in woven baskets, are collected from the local rural farmers at the plant itself with a truck (the plant is owned by a group and not by a cooperation of farmers). The dried fruits are sold locally, no produce is exported and no international standards are met.

5.2.13 USAID

USAID is an independent federal American Government agency that receives overall foreign policy guidance from the Secretary of State that supports, among other things agricultural development in developing countries. Its aid is, among others aimed at sustainable agriculture, food security and product marketing, terminology that fits the solar-drying project. USAID sponsors project that they judge applicable. USAID already has experiences in solar drying, in Kenya, where they sponsored a project for a big indirect solar dryer (figure 5.11) costing 300.000 KSh, approximately $ 4.100, with a capacity of 10.000kg fruit/day[84]. USAID was also involved in the AMKA program, as well as solar-drying projects in Eurasia.

Figure 5.11: Indirect solar-dryer in Kenya sponsored by USAID

5.2.14 NMB

The National Microfinance Bank was currently privatized and bought by a Dutch bank, the Rabobank, and three Tanzanian partners; Eximbank, investments-company NICO and the Tanzanian Chamber of Commerce, Industry & Agriculture. The Rabobank is a non-profit bank that originated from a co-operation among farmers that could serve as insurance when one of the farmers had to make an unexpected big investment. Farmers and agriculture are still of great importance to the Rabobank and therefore the NMB can be of assistance for the solar-drying project.
The NMB provides financial services to those areas and persons who would not otherwise have access to financial services. It provides savings accounts for small savers, money transfer services for individuals and corporations, payroll services, micro lending to individuals and small businesses, and foreign currency exchange services.
Very small loans are distributed from the NMB to individuals by NGOs like PRIDE, because they can work more efficient than a large bank like NMB.

[84] As stated by a vegetable solar-drying women-group in Iringa on the 11th of September 2006.

NMB itself rather provides somewhat bigger loans to farmers that are organized in cooperatives, because they are easier to control. The NMB utilizes the warehouse receipt system (the system that one can only get a loan when a cooperative has a trustworthy solvent buyer, which guarantees a certain acquisition, which will guarantee a certain income for the farmers). The NMB can assist in creating solid cooperative structures among farmers, and has already done so with tobacco, coffee and sugarcane farmers. As mentioned before, the rural fruit and vegetable sector is currently not suitable for this system because one needs a big and solid industry that processes these crops, this is lacking in the rural fruit and vegetable sector that sells their crops individually to small unreliable middlemen.
When creating cooperatives key a factor for success is[85]; voting power. A smaller farmer should have less power than a big farmer (more capital in the cooperation means more power). A cooperative should run "lean and mean", meaning that it should be non (or almost non) profit, and always considering the best solution for the farmers, the money that flows into the cooperative should flow to the farmers, only deducted by the amount of money needed to run the cooperative. In order to create some capital reserve for the cooperative all participating farmers should pay a certain amount of money, and let this capital grow by for example a 1% tax on crop output, in this way the financial base of the cooperative will grow steadily. (this structure is comparable to the Dutch Boerenleenbank (Farmers Lending Bank, now called the Rabobank) system, which started out as a cooperation between farmers, and is now one of the largest banks of The Netherlands, and a big shareholder in the NMB)
According to Bas Nierop of the NMB, the concept of individual dryers for farmers is "doomed to fail", and therefore the NMB would not provide credit to the initial project plan of the UDSM. Only when farmers are organized in a group (cooperative) and have big reliable buyers of their crops, credit for this project can be provided.

5.2.15 SELF

SELF is a government organization that deals with a microfinance lending project that gives out loans to micro-finance institutions (MFIs), i.e NGOs, SACCOS and Community Banks for on lending the same to rural and urban portion of under served entrepreneurs. It also checks these institutions. Its criterion is poverty reduction. SELF was not able to provide any data about loan criteria.

5.2.16 PRIDE

PRIDE is a micro finance institution involved in the provision of credit to small and micro entrepreneurs in Tanzania. It aims itself at self-selecting groups, existing of five people, which want to start a business worth less than US$ 1,400.00[86], located within the range of branch offices. PRIDE can offer loans varying from Tsh 50.000 to Tsh 5.000.000. Interest rate is charged above market rates and the loan terms range between 25 to 100 weeks depending on loan size.

5.2.17 Tanzania Food and Drugs Authority

Tanzania Food and Drugs Authority, is an organisation which regulates and monitors the quality, safety and effectiveness of food, drugs, herbal drugs, cosmetics and medical devices. The TFDA is under the control of the Ministry of Health and became operational on July 1st 2003.

The TFDA has the following duties with regard to the drying of fruit and vegetables and dried fruit and vegetable products in Tanzania[87]:

- **Product Evaluation and Registration:**
  The products will have to be evaluated and registered by TFDA before being approved for distribution and marketing in the country. The objective of the evaluation and registration is to ensure that only safe, quality and efficacious products are approved for use.
- **Premises Registration and Licensing**
  The Directorate of Inspection and Surveillance of the TFDA ensures that all dealings in food are done after obtaining relevant licenses and permits.
- **Inspection and surveillance**
  The Directorate of Inspection and Surveillance of the TFDA inspects manufacturers, wholesalers and retailers and ensures that standard requirements for food are complied with.
- **Import and export control**
  The TFDA controls import and export of food to ensure their safety and quality.

[85] As stated by B. Nierop, Chief Commercial Officer at NMB, on the 10th of October 2006
[86] As stated on the PRIDE website, 2006, http://www.pride-tz.org
[87] Tanzania Food and Drugs Authority, 2006: www.tfda.or.tz

- **Post marketing product risk analysis**
  The TFDA continually monitors safety of food on the Tanzanian market.
- **Laboratory analysis for quality, safety and effectiveness**
  Laboratory analyses are carried out to ascertain the quality and safety of food produced in Tanzania.
- **Product Promotion Control**
  Promotion of food in the country is regulated by the TFDA.
- **Public education**
  Public Education section is responsible with marketing the TFDA and its activities through educating and informing stakeholders on all issues related to institution's functions such as control of the quality, safety and rational use of food

5.2.18 Tanzania Bureau of Standards

Tanzania Bureau of Standards is under the responsibility of the Ministry of Industries and Trade. Specifically, TBS's responsibility is to undertake measures for quality control of products of all descriptions and promote standardization in industry and commerce.
With regard to the fruit en vegetable drying project, the main operations of TBS in order of priority are as follows[88]:

- To formulate Tanzania's standards in all sectors of the country's economy. Agriculture and engineering have been identified as priorities for the formulation of national standards.
- To implement the promulgated standards through a third party Standards Mark Certification Scheme.
- To improve the quality of industrial products both for export and local consumption through various certification schemes like pre-export / pre-import inspection and testing, the tested product certification scheme and quality system registration.
- To promote standardization and quality assurance services in industry and commerce through training of personnel in company standardization, quality assurance, quality improvement and laboratory techniques.
- To undertake the testing of product samples drawn by TBS inspectors in the course of implementing standards (certification samples) or as requested by manufacturers (type-testing samples).
- To undertake calibration of industrial and commercial measuring equipment and instruments in the areas of mass, length, volume, energy, temperature etc.

5.2.19 Government

The Tanzanian government has several regulations and policies that are of influence to the project, they will be addressed in this paragraph.

The Rural Development Strategy

The aim of the Rural Development Strategy is to improve socio-economic performance in the rural areas in Tanzania. Development of the rural areas in Tanzania would imply a major boost for a country like Tanzania, as Tanzania consists for the largest part of rural area. More then 80% of the population lives in these areas[89].

Regarding the dried fruit and vegetable sector in Tanzania, the following actions, as formulated in the strategy, are the most important:

Investing in Agricultural Research and Technology to Increase Productivity, Raise Farm Incomes and Protect the Environment
Science, technology and innovation are crucial to raising the productivity of agriculture in Tanzania and Africa in general as well as protection of the environment. Investments in agricultural research generate high payoffs. Funding for research and technological development is currently inadequate and needs to be increased, through supports from both public and private sectors supports.

In the past management of agricultural research has been centrally controlled. In order to improve effectiveness the Tanzanian government has tried to decentralize resources; involve farmers, livestock

[88] Tanzania Bureau of Standards, 2006: www.tbs-tz.org
[89] www.nationsencyclopedia.com/economies/Africa/Tanzania.html, 2007

keepers and agribusiness in formulating research priorities, develop a competitive system for outsourcing research activities, improve coordination among research institutions; and systematically monitor and evaluate research results. More effort is directed at the research agenda on the needs of women farmers and on private sector investments, not only on agricultural extension and/or research but also on agricultural technology.

Mainstreaming New Institutional Arrangements in Extension

The Tanzanian government is developing the agricultural extension system based on the principles of:

- Decentralizing resources and responsibilities for extension to Local Government and communities. This will give farmers and livestock producers a much bigger role in designing, funding, governing, executing and evaluating extension programmes.
- Outsourcing extension service to non-governmental organizations, private groups or others, with the aim of improving efficiency and accountability of extension agents.
- Sharing costs of extension service among national and local Governments, farmers' associations, non-governmental organizations, donor, pastoralists and farmers, with the aim of making financing of extension services more sustainable and less dependent on donor and central Government.

Improving Marketing

Currently, many producers and service providers in Tanzania are facing different problems in accessing markets for their products or services due to various factors such as:

1. Poor infrastructural services such as; roads and, communication services especially in rural areas.
2. Unfair competition of local products against imported cheap and dumped products.
3. Lack of capital and skills including failure to meet quality standards to penetrate foreign markets.
4. Absence of organized markets for small producers including miners, horticultural, agricultural, livestock and fishing products.
5. Poor processing and packaging technology for the above.
6. Absence of efficient and effective marketing boards that adequately represent the interest of producers.

Tanzania still relies on traditional export which contributes to over 50% of export earnings. However the export market is faced with problems of price fluctuations in the world market and general deterioration in the Terms of Trade in the agricultural sector. An export strategy has been adopted with the aim of diversifying and increasing the volume of exports while ensuring quality and value added through processing. The marketing of both agricultural and livestock commodities and inputs have been liberalized. Private companies participate alongside with cooperatives unions.

By 1993, a significant decline in union activities was becoming evident, initially, in areas where food crops were an important part of the union's business, but gradually also in export crop growing areas. The shrinking union activities were a result of the new wave of inescapable agricultural marketing reforms, which was prompted by inefficiency of the cooperatives and particularly the burden these institutions created to the innocent farmers as well as the banking institution.

The Tanzanian government has taken the following measures to improve the market access and performance, nationally, regionally and internationally, by:

- Improving the collection and dissemination of market information so as to reach farmers, pastoralists and traders timely.
- Removing of artificial restrictions to trade such as movement control as well as multiple and excessive levies.
- Rehabilitating or establishing of physical marketing facilities and proper storage for farmers, livestock producers and traders to exchange and increase competitiveness
- Researching appropriate on and off – farm storage technologies to increase returns to both farmers and traders.
- Improving processing technologies both on and off-farm to increase value added and overall food availability.

Investment policy

The Tanzanian government provides incentives for investment in the agricultural sector of Tanzania. With regard to the fruit and vegetable sector, there is room for large scale production of a range of tropical as well as temperate fruits and vegetables. The following are possible areas for investment[90]:

- Processing and canning factories in regions with high potential for production of fruits and vegetables.
- Open fruit and vegetables plantations for domestic and export markets. Potential areas for horticultural crops are Arusha, Kilimanjaro, Tanga, Morogoro, Dar es Salaam, Dodoma, Iringa, Mbeya, Mwanza and Kagera.

The incentives for investment in this sector comprises of:

- Zero-rated duty on capital goods, all farm inputs including fertilizer, pesticides and herbicides.
- Favourable investment allowances and deductions on agricultural machinery and implements.
- Postponement of VAT payment on project capital goods.
- Imports duty drawback on raw materials for inputs for exports.
- Zero-rated VAT on agricultural exports and for domestically produced agricultural inputs.
- Indefinite carry-over of business losses against future profit for income tax.
- Reasonable corporate and withholding tax rates on dividends

5.3 Analysis of the Actors

In Tanzania numerous organizations, (not all of them were even addressed in this study) deal with entrepreneurship development, food-processing and other value adding agricultural processes. Many of these organizations are entwined and are dealing with more or less the same subject, which results in a very indistinct and unnecessary difficult network of actors. Micro-credit is provided by financial institutions as well as by institutions that provide machinery and training. Various, government supported organizations are practically doing the same work, namely creating box-solar dryers and provide training for this. There are also NGOs that are providing the same services supported by big international development organizations. This chaos of tasks and responsibilities is especially pointed out by figure 5.2 at the beginning of this chapter. It shows a tangle of arrows to and from the equipment and processing part in the project to various institutions in the government, credit and development organisations.
Because of this there is no clear “innovation system”, in which different actors interact to transform an idea into a process, product or service on the market. According to this system theory innovations are a result of good relationship between relevant actors in research, finance, support services etc. This is clearly a problem within Tanzania because several organizations are active in multiple, although the same disciplines.
When every organization would aim itself at a specific part in the process, for example hardware (machine building), software (training), and credit, the process could become much clearer and that will generate more efficiency. This would benefit the information deficient target-group, the rural farmer, for who it is imaginably difficult to know where to go for certain aid, because even with access to modern information media, like internet, this is hard to pinpoint. A clearer structure and interaction of actors could also benefit to meet set objectives and ease “government budget aiming”. Another big advantage is that organizations can learn from each other, benefiting their knowledge and experiences.

Research and field work has shown that the different government bodies are strong in identifying problems, related to the dried fruit and vegetable sector. The ministries of the government have acknowledged the potential of this sector and have set out numerous policies in addressing different problem areas. The universities are aware of the potential and have conducted research in this field of knowledge to design technology which could stimulate the development of this sector.

Nonetheless, where the government is strong in pinpointing problem areas, it is weak in solving the problems. At the moment the different policies are yet to yield the expected benefits in this sector and the government has contributed to the establishment of numerous development organisations, of which a lot seem to have the same or overlapping objectives and responsibilities.

With respect to standardisation, the government has established an institution which is necessary for the dried fruit and vegetable sector to deliver products that will meet the strict regulations of the export

[90] Ministery of Agriculture and Food Security, *A Summary of Investment Opportunities available in the Tanzania’s Agricultural Sector*, 2004

markets. On the other side, the standards for dried fruits and vegetables are yet to be established in Tanzania and although the TFDA and TBS have the power to monitor the quality of dried food products, they have never used this power in practice[91].

Striking is that practically all organizations that are involved in the development of solar dryers and provision of training pursue the Ugandan Fruits of the Nile concept, small (box)dryers for individual on-site use. These dryers generate a low quality and inconstant produce that is unfit for export. In the Ugandan project this was intercepted by freeze drying the complete supplied quantity, making it fit for export.
The difference however with Tanzania is that in the project in Uganda was organized by Tropical Wholefruits an organization that itself processes the druid produce, so in the Ugandan project an exporter was already available this in contradiction with the Tanzanian situation. Another issue is that none of the projects in Tanzania used a freeze dryer, creating a produce that is unfit for export and too expensive to sell on the local market. Inquiry with AMKA showed that the idea behind this was capability building before investing in an (expensive) freeze dryer. Another crucial point is that Tropical Wholefruits set up a collection system, to collect the sun dried produce for further processing, in Tanzania farmers themselves or small cooperatives try to sell the produce, this results in quantities that are simply too small for successful export.
Nevertheless, no project with this set up has proven to be successful in Tanzania, although some projects have been running for almost ten years. So in a way one can say that most organizations pursue a top-down implementation model, desperately trying to implement “the Ugandan” concept.

[91] As stated by: TBS on the 11th of October 2006

5.4 Future roles for the actors in the project

5.4.1 Training

Based on the proposed organization set-up, farmers can be trained as an organized group, rescinding the decentralization problem of the rural fruit farmers discussed in the organization set-up chapter the training and information paragraph.
Because farmers are not directly involved with the food processing itself no training on that matter is required, they will need training in crop related issues. These more agricultural issues can be handled by the extension officers of the ministry of agriculture, which is their current task as well. Only now, because of a more organized structure, the relatively small and scattered fruit farmers can be reached more easily.
Group leaders have to be trained in a more theoretical way; they must be able to run a good administration regarding the traceability of the produce and have to be trained in good financial management since they are responsible for the income distribution in the group.
The employees of the drying facility have to be trained in food-processing, so the end product is capable of reaching international standards, like the CAC. To accomplish this international training methods have to be utilized, for example the NRI training. Training institutions in Tanzania, like the training given by SIDO, currently base their training on these international training methods, but are changed questionably. Therefore training will not have to be based on international accepted training methods but have to be international accepted training methods.
There are various organizations active in the field of training, SIDO, TaTEDO, TIRDO and the ministry of agriculture, and each of them has their own method. It is advisable that the current situation has to be clarified, by indicating one organization with a specific task. Tasks that have to be fulfilled are financial and administrative training and food-processing training.
Most mentioned organizations are active in technology development as well, so one organization can be appointed to provide technical assistance to the drying facilities.
It is of great importance that bonds stay close between the trainers and the trainees so regular updates and repetitions are desirable. Besides this it is of great importance ass well that the trainers assist in the start up of the processes preventing and repairing initial or unforeseen flaws in the process.

5.4.2 Production

The required machinery is readily purchasable in Europe, for example at a company named Innotech. This company has experience in solar drying in developing economies, and produces tunneldryers and cabinet dryers.
However local production will create employment and serve the present technical know how available within the country. Several organization, UDSM, SIDO, TIRDO, have so called incubator programs that can be utilized by financially minute entrepreneurs, to build this machinery. These entrepreneurs have to be assisted by organizations that posses the required know how, to build a suitable drying facility.
At UDSM there is a large amount of this required know how present, and they have been involved in this particular project, therefore the UDSM can serve as a good partner for the production of drying facilities. Graduated students have the technical expertise to build a drying facility, academic support and know how is nearby and the UDSM is equipped with an incubator program, creating an ideal production facility.

5.4.3 Finance

When the recommended organization set-up is executed, credit provision can be simplified, because conditions as in the warehouse receipt program can be created. The NMB, a major credit supplier in Tanzania, stated that if one can organize a sector in such a way that it is orderly and clear, it could ease credit provision. Confronted with the drying project, B. Nierop, Chief Commercial Officer of the NMB, stated that the NMB would only be interested in providing credit if a cooperative structure will be created[92].
An institution as SELF should be contacting rural farmers itself passing on budgets granted to the Tanzanian government by foreign governments and institutions. Currently this is a vague and practically unknown organization by the target group, the rural populations.

[92] As stated by B. Nierop, Chief Commercial Officer at NMB, on the 10th of October 2006

6. Crops and Locations for Solar Drying

When one wants to implement a project successfully the project will obviously have to be placed in relevant areas. For this particular project it is important to pinpoint locations that have the following characteristics:

- availability of the relevant crops within short distance of the drying facility,
- good transport infrastructure,
- availability of potable water and electricity is desirable.

Locations will be indicated for drying facilities in the most promising areas and the most suitable location for a trading cooperation, responsible for exports, will be indicated as well.
To attend to these mentioned characteristics it is essential to know what crops are suitable for drying and where these crops are available within Tanzania.

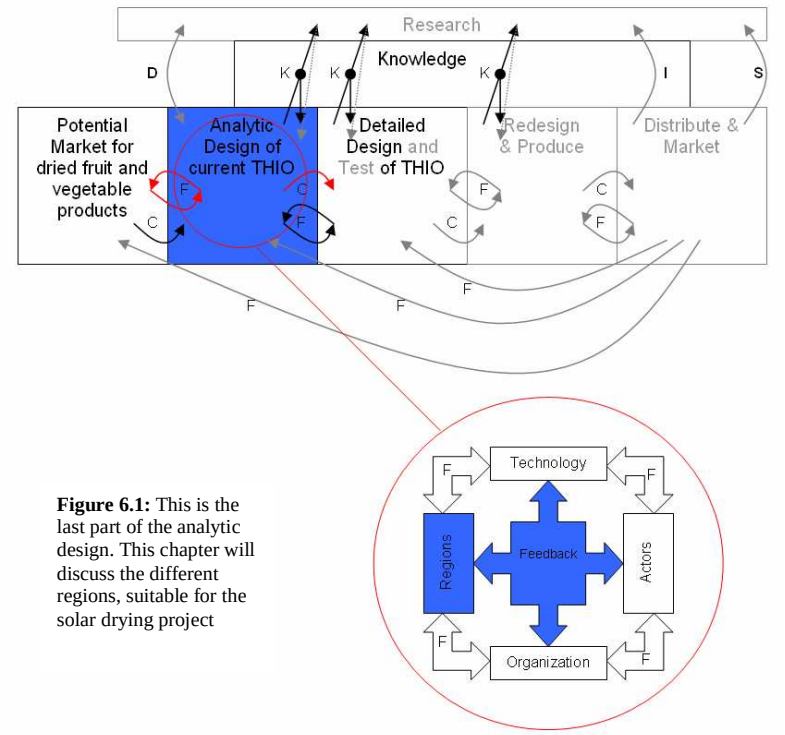


Figure 6.1: This is the last part of the analytic design. This chapter will discuss the different regions, suitable for the solar drying project

The information about the regions is the last input (the red marked C-arrow) for the detailed design which will be discussed in the next chapter.

6.1 Suitable crop types

Often mentioned in reports and therefore probable examples of popular dried fruit products, that grow in Tanzania are;

- Pineapple,
- Banana,
- Apricot,
- Apple,
- Tomato,
- Mango.

In field research other examples alongside these were found;

- Coconut,
- Orange.

Fruits are not the only products that are dried in Tanzania, also vegetables are dried, and common examples are:

- Cassava,
- Cassava leaves,
- Philiphili peppers,
- Peppers.

The most important crops for smallholders are discussed in the national sample census of agriculture 2002/2003 small holder agriculture. The crops that are mentioned in this report are produced in big quantities and are therefore important to the smallholder sector as a whole. The products described in this census and are dryable will be discussed.

6.1.1 Cassava

Starch and flour

Cassava is an important and much grown crop, 25% of the total crop growing households are growing cassava[93], it is a root and tuber crop and can, among other things, be eaten as a starch or flour. In the process of creating this starch or flour the water added in the process during purification is removed by drying[94].

Often the drying is executed in an uncontrolled environment, open air drying, resulting in low quality cassava flour. Another used drying method for cassava starch, is drying with the help of tunnel dryers. There are several other methods of cassava drying, but these often use a generated heat resource, not the sun.

Leaves

The leaves of the cassava plant are also dried and eaten as a vegetable. The drying of cassava leaves is often executed in a simple box dryer, and used for own consumption.

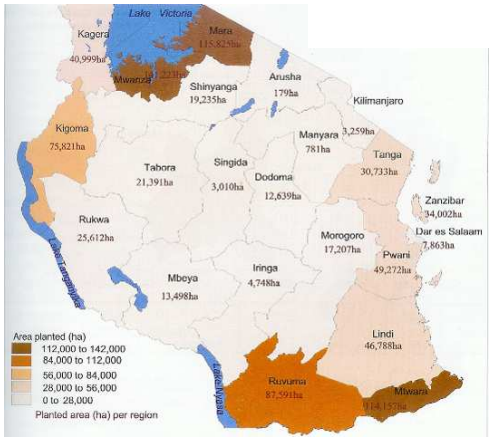


Figure 6.2: Cassava Planted by Region
Source: national sample census of agriculture

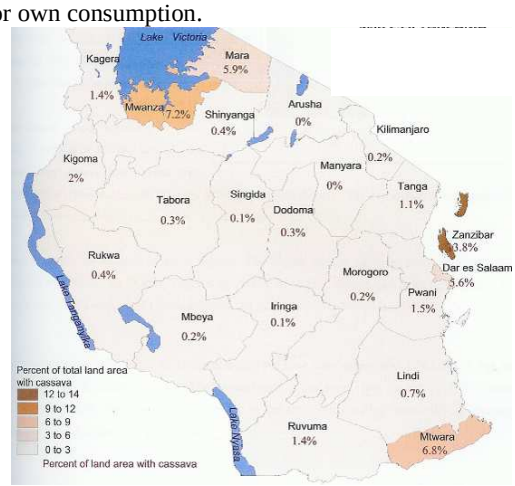


Figure 6.3: Cassava Planted by Region as a percentage of total land area
Source: national sample census of agriculture

[93] National sample census of agriculture 2002/2003, p32
[94] http://www.fao.org/docrep/X5032E/x5032E02.htm#2.%20Cassava%20flour%20and%20starch

6.1.2 Tomatoes

Tomatoes represent 2 percent of the total crop growing households in the long rainy season and 1 percent in the short rainy season[95]. Most regions have a low percentage of land used for tomatoes production.

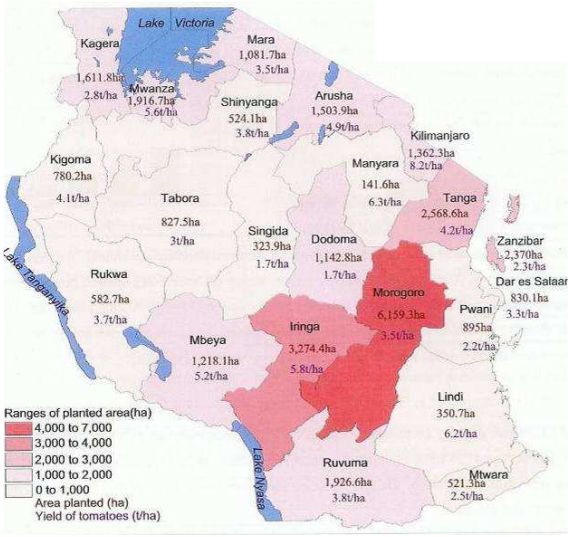


Figure 6.4: Planted area and yield of tomato (t/ha) by region

6.1.3 Bananas

Bananas are grown by 12 percent of the total crop growing households, and are the second most important permanent crop grown by smallholders in Tanzania. The total production of bananas in 2002/2003 was 2,205,673 tonnes[96].

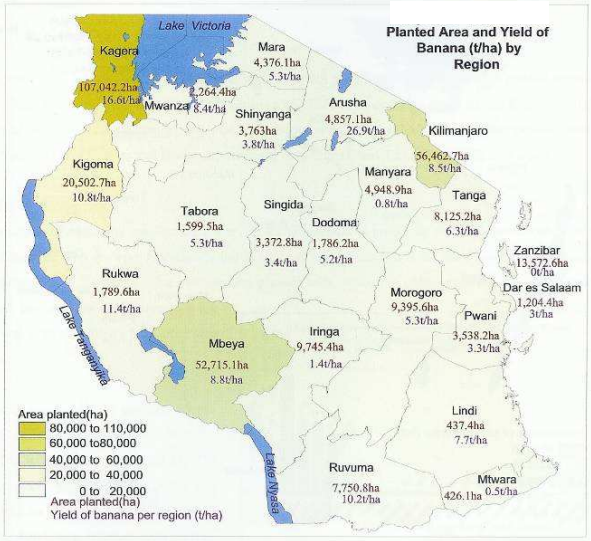


Figure 6.5: Planted area and yield of banana (t/ha) by region

[95] National sample census of agriculture 2002/2003, p43
[96] National sample census of agriculture 2002/2003, p56

6.1.4 Mangoes

Total production of mangoes by smallholders in 2002/2003 was 336,028 tonnes representing 4.4 percent of total crop growing households. Mangoes are the 5th most important crop for smallholders in Tanzania[97].

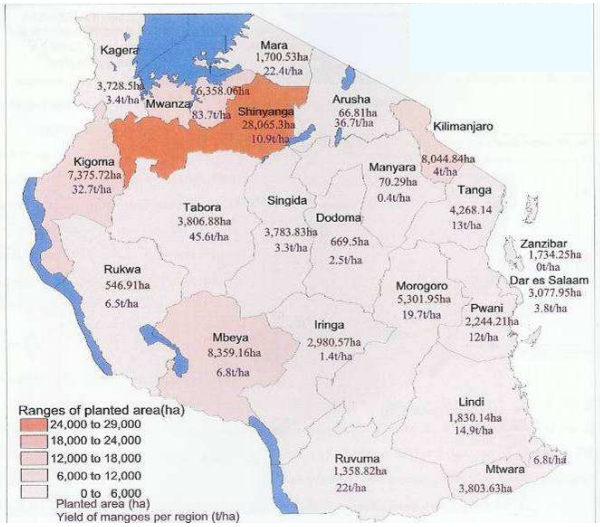


Figure 6.6: Planted area and yield of mangoes (t/ha) by region

6.1.5 Coconuts

In 2002/2003 the smallholders on the mainland produced 102,458 tonnes of coconut. Of the total planted area of coconut s on the mainland only 7% are large scale farms[98].

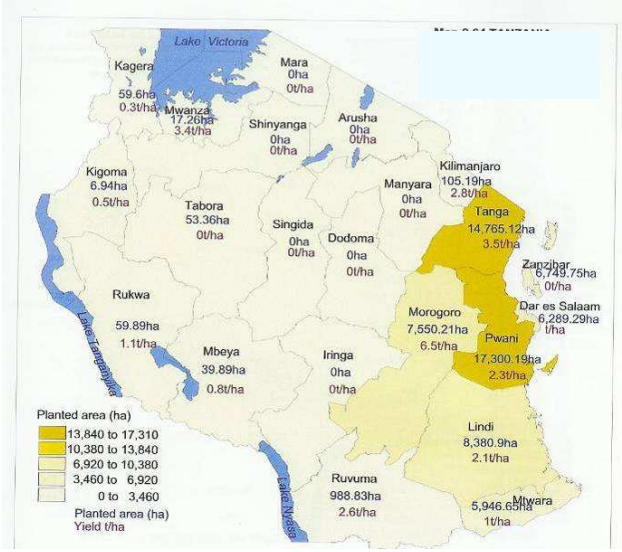


Figure 6.7: Planted area and yield of coconuts (t/ha) by region

[97] National sample census of agriculture 2002/2003, p60
[98] National sample census of agriculture 2002/2003, p66

6.1.6 Oranges

Orange production is largely concentrated in the north east coast of Tanzania. In 2002/2003 194,978 tonnes of oranges were produced by smallholders[99].

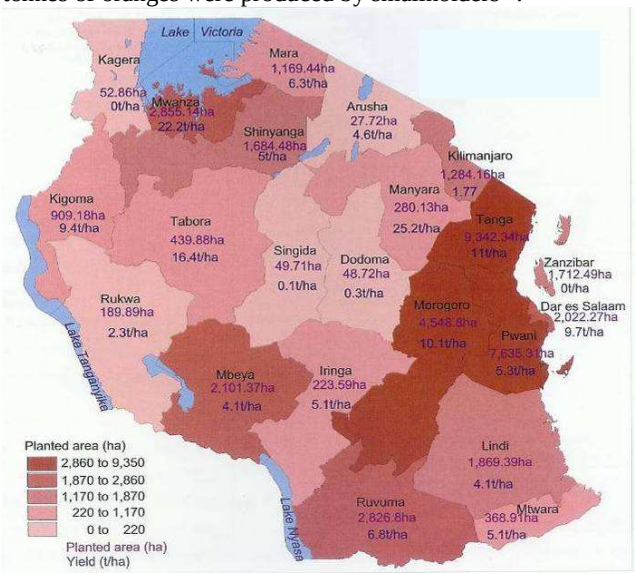


Figure 6.8: Planted area and yield of coconuts (t/ha) by region

[99] National sample census of agriculture 2002/2003, p66

6.2 Regions

In general the most important regions for the production of fruits and vegetables are Morogoro and Iringa[100], but that does not mean that these are the most important areas when one considers crops that are suitable for drying.
Considering the, previous mentioned, larger crops that can be used for drying the following regions are of importance, in order of proportion in area planted:

Cassava (annual crop)	Tomatoes (annual crop)	Bananas (permanent crop)
1. Mwanza	1. Morogoro	1. Kagera
2. Mara	2. Iringa	2. Kilimanjaro
3. Mtwara	3. Tanga	3. Mbeya
4. Ruvuma	4. Zanzibar	4. Kigoma
5. Kigoma		

Mangoes (permanent crop)	Coconuts (permanent crop)	Orange (permanent crop)
1. Shinyanga	1. Pwani	1. Tanga
2. Mbeya	2. Tanga	2. Pwani
3. Kilimanjaro	3. Lindi	3. Morogoro
4. Mwanza	4. Morogoro	4. Mwanza
5. Morogoro	5. Zanzibar	5. Ruvuma
6. Tanga	6. Dar es Salaam	
	7. Mtwara	

When regarding the most important crops, in planted quantity, that are suitable for drying, for smallholders, the key regions are:

1. Morogoro (4 = times mentioned)
2. Tanga (4)
3. Mwanza (3)
4. Mtwara (2)
5. Ruvuma (2)
6. Kigoma (2)
7. Zanzibar (2)
8. Kilimanjaro (2)
9. Mbeya (2)

10. Pwani (2)
11. Shinyanga (1)
12. Dar es Salaam (1)

[100] National sample census of agriculture 2002/2003, p xiv

6.2.1 Morogoro

Cassava quantity harvested/year : 1,794 tonnes
Tomato quantity harvested/year : 21,747 tonnes
Banana quantity harvested/year : 47,415 tonnes
Mango quantity harvested/year : 49,490 tonnes
Coconut quantity harvested/year : 17,963 tonnes
Orange quantity harvested/year : 30,883 tonnes

Climate

The average annual rainfall is 600mm in lowlands and 1,200 in highlands. Temperatures range similarly from 30^0C in lowlands and 18^0C in highlands[101].

Crop Location[102]

Zone	Area covered	Crops	Livestock raised
Highlands 600m	Nguru,Mahenge,Rubeho,Udzungwa and the Ubena mountains	Maize,Vegetables,Fruits, Coffee, Cocoa, Citrus	Poultry, Pigs, Goats,Sheep
Plateau 300-600m	Major part of Kilosa District and part of the middle of Morogoro South	Maize, sorghum, sweet potatoes,cotton, sunflower, simsim,citrus, paddy, cassava and banana	Cattle, sheep, chicken
Lowland and River valleys	Kilombero Wami, Mkindo, Ngerengere, Mgeta, Luwegu and Luhomberovalleys	Paddy, maize, sugarcane, bananas, cocoyams, cassava and sweet potatoes.	Mainly poultry

Table 6.1: The locations of the various crops.

Infrastructure

Figure 6.9: The road and rail network in Morogoro region.

Road

There are 3,742 km of roads in Morogoro, of which 559 km are defined as trunk roads[103], trunk roads are strategic or major roads that usually connect one or more cities, ports, airports etc, which is the recommended route for long-distance and freight traffic[104].

Rail

The central railway line and the Tazara railway line passes through the Morogoro region. The central railway line goes through Morogoro town, and connects Dar es Salaam with Kigoma. The Tazara railway line runs through the rual south of Morogoro and connects Dar es Salaam with Zambia[105]

[101] The planning commission Dar es Salaam and Regional commisioner's office Morogoro, *Morogoro region socio-economic profile,* 1997, p 27
[102] Ibid, 27
[103] Ibid, 98
[104] Wikipedea 2007
[105] The planning commission Dar es Salaam and Regional commisioner's office Morogoro, *Morogoro region socio-economic profile,* 1997, p102

Electricity

Percentage with electricity supply per district:

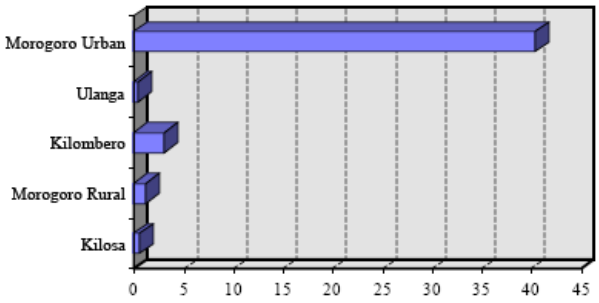


Figure 6.10: percentage with electricity per district

Water availability

District	Total Population	Population seved within 400m.	Percent served
Morogoro Rural	489,200	197,000	40.3
Kilosa	407,000	190,000	49.7
Kilombero	227,000	149,000	65.5
Ulanga	151,000	84,000	56.0
Total	1,274,200	620,000	49.0

Table 6.2: safe water supply in rural areas

In the urban areas of Morogoro, 65% of the population is served with clean water[106]

Education

Although basic education leaves much to be desired, for example classes are often overcrowded, there is an entry for basic education in almost every village[107]. This results in a big percentage of the population that is literate. Even in small villages 70% of the population is literate, the percentage that is illiterate often represents the older unschooled community[108].
The official literacy rate in 1995 in Morogoro was 85.8%[109].

6.2.2 Tanga

Cassava quantity harvested/year : 2,509 tonnes
Tomato quantity harvested/year : 10,852 tonnes
Banana quantity harvested/year : 34,126 tonnes
Mango quantity harvested/year : 35,641 tonnes
Coconut quantity harvested/year : 26,329 tonnes
Orange quantity harvested/year : 65,210 tonnes

Climate

The climate in Tanga is warm and wet, especially at the coast where there is a high atmospheric humidity, often reaching 100% maximum and 65 – 70% minimum. The average annual rainfall is 750 mm, varying from 1,100 to 1,400 mm at the coast and than decreasing land inwards, excluding the Usambara Mountains, where depending on slope and height rainfall may exceed 2000 mm per year. The average temperature in Tanga is 30°C – 32°C[110].

[106] Ibid, 172
[107] Ibid, 109
[108] Concluded from questionnaires with different visited village representatives.
[109] Unesco, The EFA 2000 Assessment: Country Reports, Tanzania mainland.
[110] The planning commission Dar es Salaam and Regional commisioner's office Tanga, *Tanga region socio-economic profile*, 1997, p22

Crop Location[111]

Zones	Average rainfall	Dominant Crops
Coastal belt (0-15m above sea level). Covers Pangani district, Tanga and part of Muheza district	800-1400mm	Citrus fruits, Sisal, Coconuts, Cashewnuts, Maize, Cassava, Rice and Sea Weeds.
Wet Plains (300-600m. above sea level) Covers mostly Muheza and Korogwe districts	800-1000mm.	Sisal, Coconuts, Cashewnuts, Cotton, Maize, rice, beans, Cassava and Citrus fruits
Dry Plains (200-600m. above sea level) Handeni, part of Korogwe, Muheza and Pangani.	500-800mm	Timber, Honey, Sisal, Cotton, Tobacco, Maize, Cassava and beans.
Mountain belt (1000 - 2000m above sea Level) Covers areas in Lushoto, (Usambara mts) Muheza (Amani mts) and Handeni (Nguu mts) districts.	800-2000mm.	Tea, Coffee, Cardamon, maize, potatoes, bananas, beans, vegetables and temperature fruits.

Table 6.3: Crop locations in Tanga region

Infrastructure

Road

TYPE OF ROAD	SURFACE			TOTAL (Kms)
	Tarmac (kms)	Gravel (kms)	Earch (kms)	
Trunk Roads	304	-	48	352
Regional Roads	-	1028.8	-	1028.8
District Roads	-	48	1039.7	1087.7
Feedes Roads	-	14.7	294.3	309
Total	304	1091.5	1382	2777.5

Table 6.4: Type of road and road surface in Tanga region

Rail

The region has the second largest railway density of all regions in Tanzania, and is equipped with 279 km of rail. The so called Tanga line links Tanga with Moshi and Arusha following the foot of the Usambara Mountains, the railway is also has a connection with Dar es Salaam. The railway line is used for cargo purposes only[112].

In figure 6.11 the most important roads in the Tanga regions are indicated with purple and the railway lines are indicated with a black, vertically crossed, line.

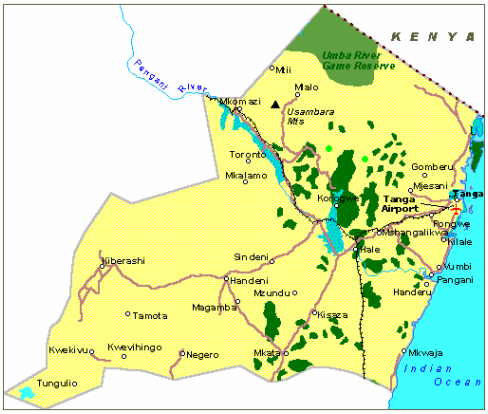


Figure 6.11: Infrastructure in Tanga region (source: Coastal)

[111] Ibid, 25
[112] Ibid, 92

Harbour
Tanga has a natural harbour which is the second largest harbour of Tanzania (after Dar es Salaam). Although it handles less cargo than Dar es salaam the capacity of the Tanga harbour is bigger[113].

Airport
The region is equipped with a small airport, Tanga airport, located in Tanga town and is the 5th most important airport of the Tanzanian mainland.

Electricity
The region is relatively well served with electricity compared to other regions in Tanzania. Outside the urban areas many small to medium villages are also served with electricity[114].

Water availability

District	Population (1995 Estimates)	Population Supplied with Water	(%)	Number of Villages in the District	Villages Supplied with Water
Tanga	222,825	183,137	82	23	17
Muheza	256,811	139,381	54	140	100
Pangani	41,450	21,057	51	23	20
Korogwe	246,310	119,733	49	132	53
Handeni	299,376	184,303	61	102	76
Lushoto	416,040	152,576	37	137	39
Total	1,482,812	800,187	54	557	305

Table 6.5: Water services distribution per district in 1995

TYPE OF WATER SOURCES	NUMBER OF WATER SOURCES
Gravitational Water Supply	63
Pipe Water	23
Deep Wells	19
Shallow Wells	475
Dams	11

Table 6.6: Type and number of water sources in Tanga region in 1995

Education
The situation in basic education can be described as typical[115], and is discussed in the education paragraph of the Morogoro region.
The official figure for literacy in Tanga in 1995, given by UNESCO was; 90.4%[116].

[113]Ibid, 94
[114]Ibid, 93
[115]Ibid, 97
[116]Unesco, The EFA 2000 Assessment: Country Reports, Tanzania mainland

6.2.3 Mwanza

Cassava quantity harvested/year : 1,794 tonnes
Tomato quantity harvested/year : 10,714 tonnes
Banana quantity harvested/year : 12,351 tonnes
Mango quantity harvested/year : 56,094 tonnes
Coconut quantity harvested/year : 263 tonnes
Orange quantity harvested/year : 22,737 tonnes

Climate

Mwanza has two rain periods, a short one in October to December and a long one from March to May. The average annual rainfall is 930 mm varying from 1,800mm in the western parts of Ukerewe island to 750mm in the southern parts of the region. There is a dry spell from January to March, this period is used for the planting of crops[117].

Crop Location[118]

Zone	Rainfall	Crop
Zone I, Butundwe, Bugando, Kasamwa, Geita, Busanda, Kahunda and Buchosa.	> 900mm	Cotton, cassava, beans and bananas (playing a major part in the north-west area of the zone).
Zone II, Mwanza district Missungwi (formerly in Kwimba district).	> 900mm (20% probability of < 850mm)	cotton, cassava and maize
Zone III, "Sukuma Heartland", Magu district.	700-850 mm	cotton and cassava
Zone IV, Geita district Sengerema district; Missungwi district, Kwimba district, Magu district.	800-900 mm.	cotton, sorghum, rice and cassava.
Zone V, Ng'wamashimba and Nyamilama.	750-900 mm	maize and chickpeas with cotton and cassava as secondary crops.
Zone VI, Ilangala, Ukara, Mumulambo and Mumbuga.	1200 mm	Cotton, cassava, coffee, paddy, sweet potatoes and fruits.

Table 6.7: Crop location per zone in Mwanza region

Infrastructure

Road

In total 139.5 km of the total road network (6,349 km) in Mwanza is covered with tarmac, representing some roads in Mwanza town and the Mwanza to Musoma trunk road[119]. The Mwanza to Shinyanga trunk road was under reconstruction in 1997, and is now finished[120], the road is now also covered with tarmac. The remaining trunk roads are unpaved covered with gravel or earth.

Rail

Mwanza region is served by the central line railway system that connects Mwanza with Tabora, Kigoma and Dar es Salaam[121].

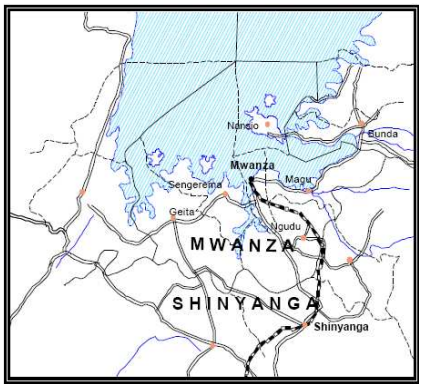


Figure 6.12: infrasructure Mwanza region (source: Socio-Economic profile Mwanza region)

[117] The planning commission Dar es Salaam and Regional commisioner's office Mwanza, *Mwanzaa region socio-economic profile,* 1997, p22
[118] Ibid, 23-27
[119] Ibid, 103
[120] http://www.mkonsult.net/roads.html
[121] The planning commission Dar es Salaam and Regional commisioner's office Mwanza, *Mwanza region socio-economic profile,* 1997, 109

Harbour
Mwanza town is served with a lake port that is connected to other lake ports of Kenya and Uganda surrounding Lake Victoria[122].

Airport
Mwanza has one major airport that is capable of landing a Boeing 737 aircraft[123].

Electricity

District	Total Households	Households supplied with Electricity	Households not supplied with Electricity	Percent with Electricity
Mwanza	42,722	14,983	27,739	35
Magu	48,016	288	47,728	0.6
Kwimba	63,876	514	63,362	0.8
Ukerewe	25,129	-	25,129	0
Sengerema	46,417	-	46,417	0
Geita	66,802	-	66,802	0
Total	292,962	15,785	277,177	5.4

Table 6.8: households per district in Mwanza region supplied with electricity

Water availability

District	Population Estimates 1995	Population Served with Clean Water			% Population served with clean water
		Rural	Urban	Total	
Magu	358,200	185,527	14,119	197,646	55
Kwimba	292,343	123,082	10,732	133,814	46
Misungwi	237,397	99,351	9,080	108,431	46
Geita	585,545	189,932	10,620	200,552	34
Sengerema	361,238	122,949	16,675	139,624	39
Ukerewe	204,179	77,234	8,883	86,117	42
Mwanza	268,734	28,171	116,765	144,936	54
Total	2,307,636	824,246	186,874	1,011,120	44

Table 6.9: People served with clean water, in Mwanza region per district

Education
Like in the rest of Tanzania there is a great deficiency in primary education class rooms[124]. However there is access to primary schooling even in small villages[125]. The literacy figure for the Mwanza region is 82.7%[126].

[122] Ibid, 106
[123] Ibid, 110
[124] Ibid, 127-128
[125] Concluded from questionnaires with different visited village representatives
[126] Unesco, The EFA 2000 Assessment: Country Reports, Tanzania mainland

6.2.4 Kagera

Kagera is not a region with a great variety of produce but is an important region because it produces 1,239,219 tonnes/year of bananas, which corresponds with 56%[127] of the banana output of Tanzania.

Climate

Kegera region has an annual average rainfall of 500 – 2000 mm, the region hast two rain periods from March to May and from October to November. With higher rainfall along he shores of Lake Victoria and lower more inland, varying with altitude. The average temperature in the region is 20^0C – 28^0C[128].

Crop Location[129]

Zone	Rainfall	Crop
Zone 1: Lake Shore and Islands; altitude: 1,300 to 1,400m; covers: Bukoba Urban, most of Muleba and Bukoba Rural district, and the eastern parts of Biharamulo district.	1,400 - 2,000 mm	bananas, beans, coffee, tea
Zone 2: Plateau Area; altitude: >1400m; covers: parts of Bukoba Rural, Muleba and Ngara's Bugufi highlands, and almost the whole of Karagwe district.	1,000 - 1,400 mm	bananas, maize, beans, coffee, cassava
Zone 3: Lowlands: location <1,300m away from Lake Victoria; covers: small parts of Muleba and Bukoba Rural, most parts of Biharamulo and Bushubi in Ngara district below the Rubuvu river.	500 – 1,000 mm	maize, beans, cassava, cotton

Table 6.10: crop location per zone, Kagera region.

Infrastructure

Road

Kagera has 605.5 km of trunk roads a total of 212.2 km has a tarmac surface[130]. A large proportion of the trunk roads are unpaved. The paved roads are probably situated in the urban areas[131].

Rail

Kagera region is not served with a rail network.

Harbour

Because of the unreliability of the land routes to and from Kagera region, marine transport is a good alternative. The only other alternative is air transport, but this is expensive. The major port outlets are Bukoba, Kemondo Bay (for coffee cargoes) and Nyamirembe[132].

Airport

Kagera region has the services of an airport, Bukoba airport that is capable of handling light aircraft. On the average the airport handles only 5,435 passengers and 3.2 tons a year[133].

Fig 6.13: map with infrastructure in Kagera region
(source: darhotwire)

[127] National sample census of agriculture 2002/2003, p 209
[128] The planning commission Dar es Salaam and Regional commisioner's office Kagera, *Kagera region socio-economic profile*, 1998, 20
[129] Ibid, 22-23
[130] Ibid, 81
[131] www.roadsfundtz.org/web/images/map.jpg
[132] Ibid, 86
[133] Ibid, 88

Electricity

District	Population	Population Covered	% Population Covered
Bukoba Urban	46,056	12,294	26.7
Bukoba Rural	337,793	781	0.2
Muleba	272,560	1,512	0.6
Biharamulo	208,908	661	0.3
Ngara	159,526	696	0.4
Karagwe	283,976	1,203	0.4
Total	1,308,819	17,147	1.3

Table 6.11: population in Kagera region provided with electricity, per district

Water availability

District	Total population	Population Covered	% population covered
Bukoba Urban	-	-	-
Bukoba Rural	387,721	106,400	27.4
Muleba	312,912	119,846	38.3
Biharamulo	236,915	121,610	51.3
Ngara	193,513	78,800	40.7
Karagwe	383,589	105,600	27.5
Total	1,514,650	532,256	35.1

Table 6.12: rural population in Kagera region provided with clean and safe water

Urban Centre	Total Urban Population	Urban Population Covered	% urban population covered
Bukoba	56,926	40,000	70.3
Muleba	16,800	10,300	61.3
Biharamulo	14,800	7,500	50.7
Karagwe	22,900	8,900	38.9
Ngara	25,100	9,000	35.9
Total	136,526	75,700	55.4

Table 6.13: urban population in Kagera region provided with clean and safe water

Urban Centre	Demand million litres/day	Actual supply million litres/day	(-) Deficit/Surplus(+) Million litres/day	Percent surplus (+) deficit (-)
Bukoba	6.0	3.2	-2.8	-47
Ngara	1.4	0.3	-1.1	-79
Biharamulo	0.9	0.6	-0.3	-34
Karagwe	1.7	0.7	-1.0	-59
Muleba	1.1	0.7	-0.4	-36
Total	11.1	5.5	-5.6	-50

Table 6.14: urban water demand and supply Kagera region

Education

As stated in this paragraph in the other discussed regions, Kagera is a region with great shortage in primary school facilities[134]. However it is possible for a key sum of the population to be literate, the literacy rate of this region is 82.1%[135].

The regions with the most potential for the allocation of the producer-group cooperatives were determined in the regions chapter, and are, successively:

- Morogoro
- Tanga
- Mwanza
- Kagera

These regions as a whole are too big and not every location within this region is just as suitable, therefore the best locations within these regions have to be identified. This suitability is mainly dependent on crop locations and infrastructure.

6.3 Locations within the regions

After analyzing the suitable regions thoroughly it is important to pinpoint the exact suitable locations within these regions using the infrastructure data discussed in the former paragraph.

Obvious one has to place a central processing plant in a location that is equipped with a proper transport infrastructure, but because of processing needs it will be desirable if potable water and electricity are available as well on the location. Furthermore it is important that rural farmers that grow the desired crops, members of the cooperatives, are within reach of the facility, because else the problem of distant end markets is not solved.

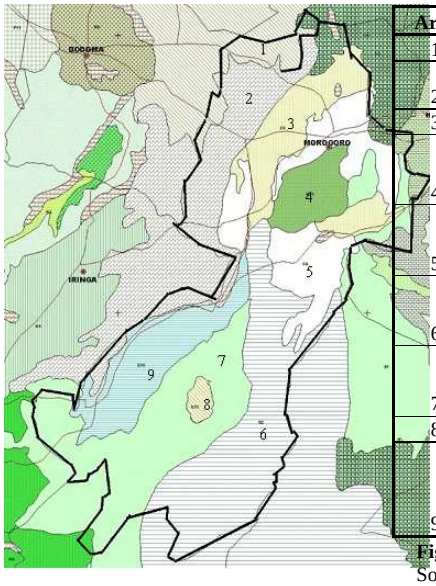
6.3.1 Morogoro

Because there is insufficient information about the exact crop locations in the Morogoro region, there are only rough estimates on what crops are grown on different altitudes, crop location is determined based on crop suitability, figure 6.14.

In the south of the region good infrastructure is absent to a large extent, so it will be difficult to set up a drying facility there considering transport, electricity and water. Infrastructure is at its best in the north of the region especially around Morogoro town, access to rail, highway to Dar es Salaam, sufficient electricity and water supply.

Zone 4 (see figure 6.14) just south of Morogoro town, is capable of supplying all relevant crops for drying.

A drying facility in the Morogoro region could therefore best be positioned around Morogoro town.



Area	Crop suitability
1	Sorghum, hyacinth bean
2	Maize, Sorghum, i/potato, finger millet, common bean, pigeon bean, hyacinth bean, banana, passion fruit, castor, simsim, sunflower, sisal
3	Rice, cotton, maize, sorghum, cow pea, pigeon pea, sisal
4	Tea, coffee, mango, maize, sorghum, rice, banana, wheat, cassava, i/potao, s/potato, beans, p/pea, passion fruit, pineapple, macadamia, castor, simsim, sunlower, vegetables, fruits
5	Maize, sorghum, wheat, cassava, s/potato, c/pea, p/pea, lablab, castor, ground nut, simsim, soya bean, sunflower, tabacco, cotton, f/millet, sisal, jatropha
6	Cashew, coconut, mango, cassava, maize, sorghum, rice, simsim, passion fruit, f/millet, c/pea, p/pea, s/potato, citrus, sisal, jatropha, castor, ground nut, s/bean, sunflower, tabacco, cotton
7	Maize, peas, beans, sorghum, rice, wheat, cassava, i/potato, s/potato, f/millet, p/pea, lablab, banana, citrus, mango, passion fruit, pine apple, macadamia, castor, simsim, sunflower
8	Coffee, tea, maize, beans, vegetables, sorgum, finger millet, wheat
9	Rice, cashew, coconut, mango, cassava, simsim, passion fruit, maize, sorghum, p/pea, s/potato, c/pea, f/millet, g/nut, tabacco, cotton, sisal, jatropha, sunflower, castor

Figure 6.14: crop suitability, Morogoro region
Source: www.agriculture.go.tz

[134] Ibid, 164
[135] Unesco, The EFA 2000 Assessment: Country Reports, Tanzania mainland

6.3.2 Tanga

The most fruitful areas in the Tanga region are the areas around Lushoto and Muheza. They are both well connected with transport infrastructure, close to a trunk road connecting them with Tanga and Dar es Salaam and the railroad, running from Tanga to Moshi and Arusha.
Electricity supply is generally good in this region, even outside the urban areas. Water supply is not optimal, Lushoto with a coverage of 37% and Muheza with 54%.
Because the distance between the locations is relatively small, one could chose for one centralized drying facility, in between these locations. A good location would than be the road junction of the "Moshi-Tanga" road and the "Dar es Salaam" road.

6.3.3 Mwanza

The most important crops suitable for drying in respect to produced quantity in Mwanza are mango and orange. These fruits grow in the most rain fed sections of the region (1200 mm annual rainfall), these are Ilangala, Ukara, Mumulambo and Mumbuga.
Ilangala is a city at Ukerewe Island, located in Lake Victoria, approximately 40 km of the coast of Mwanza city[136]. Ukara is an island as well and is located approximately 10 km of the coast of Ilangala[137]. Mumulambo and Mumbuga are so small that they are untraceable, but it can be presumed that these are located in or near Lake Victoria, because these are the areas with the highest amount of rainfall.
Because the majority of the suitable produce is produced at islands, boats are necessary for transport, although Mwanza city is not the closest to these regions (40-50 km sailing), but is equipped with a good harbor, relatively good infrastructure, and is reasonably supplied with water. These characteristics make Mwanza city to a good location for a drying facility. However the produce has to be shipped in time to maintain freshness and the transport costs will be significantly higher than produce that is produced on the mainland.

6.3.4 Kagera

Bananas are the only interesting crop for large scale drying in Kagera, this region alone is responsible for 56% of all produced bananas in Tanzania. They mainly grow on the lake shore area, the islands and the plateau area. This area covers most of the Karagwe district most of Bukoba rural and urban the eastern part of Biharamulo and some small higher placed locations in Ngara. Transport infrastructure is present but is little developed, there is an unpaved trunk road running from Bukoba to the south and to Uganda. Almost none of the region is covered with grid electricity, 26.7% in Bukoba urban and < 0.6% in the rest of the region. Water availability is highest in Bukoba urban as well (70.3% of the population covered). Because of this relatively good infrastructure level Bukoba can serve as a good location for a drying facility.

[136] MSN Encarta World Atlas
[137] Ibid

6.4 Trading cooperation

As discussed in the organization set up paragraph the trading company has to be located in a place where infrastructure is optimal, not only to receive the dried produce but to export them as well.
It is likely that the produce will be exported either by plane or by ship, so the location has to be equipped with a good harbor and a good airport. Tanzania has two big sea harbors in Dar Es Salaam and in Tanga, and two international airports in Dar Es Salaam and in Arusha. Regarding previous points Dar Es Salaam has a well equipped export infrastructure. The infrastructure for receiving the produce is excellent as well, Dar Es Salaam has an elaborate paved road network linking the city with virtually the entire country.

In figure 6.15 the road infrastructure of Tanzania is represented and the proposed drying locations and trading location are indicated.

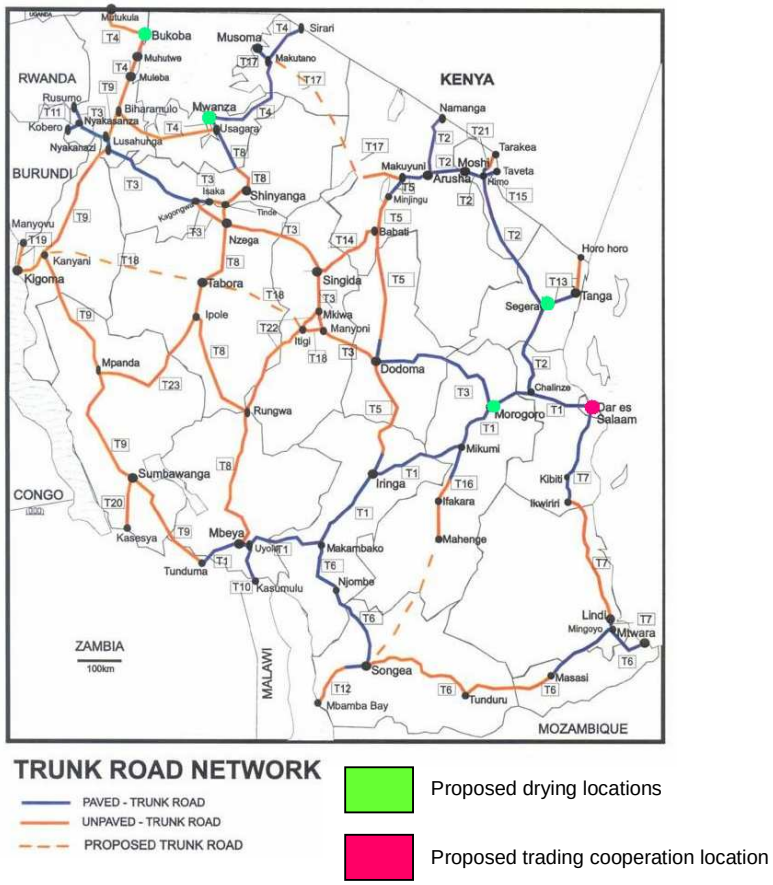


Figure 6.15: trunk road network and proposed locations
Source: www.roadsfundtz.org

7. Detailed design proposal

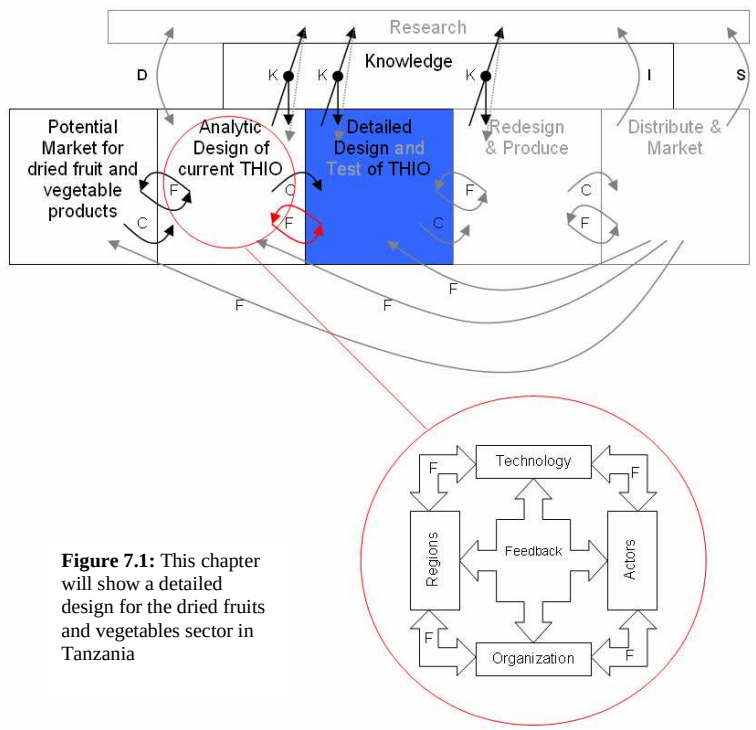


Figure 7.1: This chapter will show a detailed design for the dried fruits and vegetables sector in Tanzania

Based on everything that was discussed in the analytic design phase of the research model a proposal for detailed design can be derived (this is represented by the red marked F-arrow in the figure). In the analyses of the different elements (technology, actors, organization and regions) discussed in the analytic design, the most suitable solution were presented for every individual element regarding all other elements as well. When all these proposed solutions are added a detailed design of the project comes into being. To summarise: the detailed design will contain:

Technology
- Tunnel dryer
- Heavy duty cabinet dryer

Organization
- Cooperative structure with centralized food processing plants in several regions owned by the supplying cooperatives.

Locations
- Food processing plants: Morogoro town, Sogera (Tanga region), Mwanza town, Bukoba (Kagera region).
- Trading cooperation: Dar es Salaam.

Each technology combined with the organisation structure and region was analysed to determine financial viability of such a project (this analysis is carried out at the end of this chapter with a CBA. If a particular solution for solar drying of fruits and vegetables proved unfeasible during the CBA, a new solution would have to be determined with the information from the analytic designs. Hence the feedback loop from the detailed design to and from analytic design in the research model.

7.1 Cost Benefit Analyses Calculations

For the implementation of the two most suitable technologies for solar drying in Tanzania in the indicated areas, cost and benefit calculations have been made. The starting points for the calculations were the 4 most promising regions in terms of fruits and vegetables availability and infrastructure.

7.1.1 Data Input for Calculations

The costs of the tunnel dryer in the CBA are based on prices, which have been provided by Innotech Ingenieursgesellschaft mbH (see appendix 4) in Germany. The tunnel dryers are built by this company for €5.800, excluding VAT. Coverted to US Dollars this is approximately $7.500. For this amount of money, it should be possible to build a similar dryer in Tanzania itself. For the calculation of the costs, an amount of $8.000 is used to have a profit margin.
The price of a solar cabinet dryer, which has been used in the calculations, has also been based on prices provided by Innotech. Innotech builds these dryers for $32.750. It should be possible to build these dryers in Tanzania for approximately the same price.

Data from a funding report by the UDSM for the solar drying project, shows prices for the construction of the food preparation buildings, tools, utilities, clothes, etc. The amounts used in this report served as a point of reference to determine these costs in case of a new solar tunnel drying project. The determination of these numbers takes into account a larger inflow of raw material, more storage space, more cutting utensils, etc.

The price of dried fruit and vegetables is based on fair trade, farm gate prices, determined by the Fair Trade Labeling Organisations in 2005. The prices are used as a starting point for selling dried fruit and vegetables to other countries. These prices are rather conservative and thus give extra contingency in the CBA calculations as selling prices.

The turnover of the project per year is calculated by taking a 0.5% of the total available fruit and vegetables in a specific region. An amount of 0,5% is taken because not all available dried fruit and vegetable is available for drying due to various reasons like: reachability of the drying site for certain farm villages, the selling of fresh fruit and vegetables, loss of harvest, etc. Furthermore, the project strives to be sustainable and able to sell large amounts to dried fruit and vegetables importing countries, without letting the project become too vast and uncontrollable. When the project is successful, there will be room for extending the project to other areas.
For the calculations in the Kagera region, an amount of 0,05% is taken. This percentage corresponds to approximately 130.000 kg of fresh product. If an amount of 0,5% would have been taken into account, the investment in this region would be far higher than in other regions and this will make it more difficult to apply for a loan for this project. Still this 0,05% will produce enough dried product to be able to make trading agreements with foreign companies to export to.

After using the 0,5% (0,05% for the Kagera region) of the total available fruit and vegetables, the weight of the fruit and vegetables which will be loaded into the dryer after washing, peeling and stoning, is determined by taking 50% of the initial weight.
After drying, the weight of the fruit and vegetables will decrease further with another 60%. This percentage is based on the moisture content of the various fruit and vegetables and taking into account that the product will be dried (or is supposed to be dried) to a moisture content of 15% - 20%. The moisture content of the various fruits and vegetables[138] are found on www.thefruitpages.com.

The amount of dryers needed in a project has been calculated by establishing the capacity of 1 dryer per year. In the interviews with the rural farmers in Tanzania showed that there are 2 harvesting periods a year in Tanzania. These periods each last approximately 2 months and it is during this time that the drying of the fruit and vegetables should take place. This is why 20 weeks of drying time a year is used in the calculations.
According to the technical data provided by Innotech, a tunnel dryer has a capacity of drying a batch in 2 days. Using a 6 day workweek during the harvesting periods and a batchsize of 1 tunnel dryer of approximately 200 kg, this results in a annual capacity of 1 tunnel dryer of 12.000 kg.

[138] Found on the nutrition page of *"The Fruitpages": http://www.thefruitpages.com/contents.shtml*

The annual capacity of a cabinet dryer was based on the technical data provided by Innotech. The cabinet dryer from Innotech serving as a reference is model HT15. This type of dryer has a capacity of 320 kg per day. When the dryer is operated 6 days per week during 20 weeks, this will result in 38.400 kg per year for this type of dryer.

The maintenance costs are determined at $5 per drying cycle. This is probably quite high because the costs of maintenance consist of replacing visqueen plastic every 2 years and cleaning products.

The transport costs are calculated, using data about transport costs[139] per kg per km in 2000 in Tanzania and corrected this data by using an inflation rate of 7% every year. The other data used for the calculation of the transport costs for a particular fruit and vegetable drying project obtained from a distance chart for Tanzania[140].

7.1.2 The CBA explained

The first table in the CBA calculations is that of the non-financial cash flows. "*Non-financial cash flows (officially called 'cash flows from non-financial operations') are all cash flows that arise from investing in the project*[141]*.*" It therefore consists of all the expenditures in solar dryers, tools, construction, maintenance, etc and also the turnover from selling products.

Next is a table consisting of all the financial cash flows. "*Financial cash flows (officially called 'cash flows from financial operations') are all cash flows that arise from financing the project*[142]*"*. This table shows all cash flows like the loan for investing, interest payments and loan repayments.

The calculation of the Net Present Value (abbreviated: NPV) is to calculate the excess or shortfall of cash flows. This measure is one of the key values in determining the profitability and thus the financial decision to execute the project or not. If the NPV is larger than 0, than the project is expected to yield more than the prevailing market interest rate Therefore the project might be approved for implementation in principle. However, this decision is still subject to the results of the liquidity analysis and the risk assessment; these also need to yield acceptable results. If the NPV is equal to 0 than the project is estimated to yield the same as the market interest rate and if the NPV is less than 0, it will yield less than the market interest rate and the project should not be executed[143].

Another way of determining the profitability of the drying projects is done by calculating the Internal Rate of Return (abbreviated: IRR)[144]. When the IRR value is higher than the interest rate, the project could be commercially viable, depending on risk and liquidity analyses. When the IRR value is equal or lower than the interest rate, the project should not be approved.

The liquidity analysis is performed in the total cash flow table. The liquidity analyses are important to analyze whether or not the project has enough funds to cover the project during each project year. If the cash inflows from sales lag too far behind the cash outflows which keep the project running, the project is forced to stop[145].

[139] Fews Net: Tanzania Food Security Update: July 2000
[140] Distances obtained from: *http://www.tzonline.org/Distance.htm*
[141] Biemond & Romijn, Cost-Benefit Analysis of Projects, TU/e, 2005, page 4
[142] Ibid, page 4
[143] Ibid, page 8
[144] Ibid, page 9
[145] Ibid, page 13

7.1.3 The CBA Calculations: comparisons between Tunnel Drying and Cabinet Drying

Profitability Analyses

The full CBA calculations per region can be viewed in appendix 3. The tables of the non-financial cash flows and the financial cash flows are used to calculate the NPV and the IRR of each project. The charts below show comparisons of the NPV and the IRR between the regions.

Figure 7.2: The Net Present Value of the projects in Tanga, Mwanza, Morogoro and Kagera all show very high NPV's. According to this analysis, all the projects could be approved from a commercial point of view.

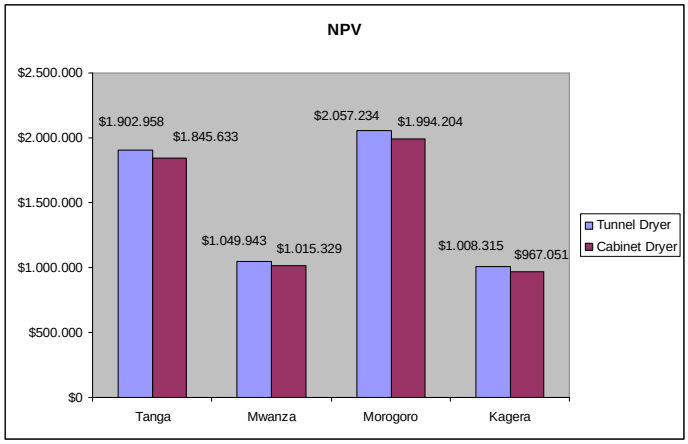
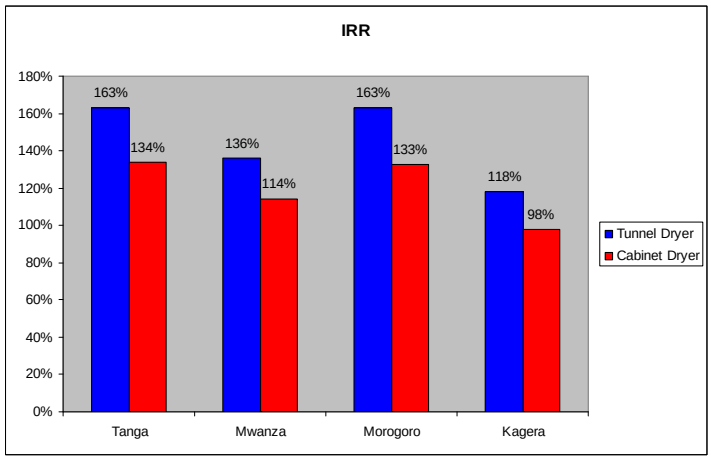


Figure 7.3: The Internal Rate of Returns of the projects in Tanga, Mwanza, Morogoro and Kagera all show very high values. According to this analysis, all the projects could be approved from a commercial point of view.

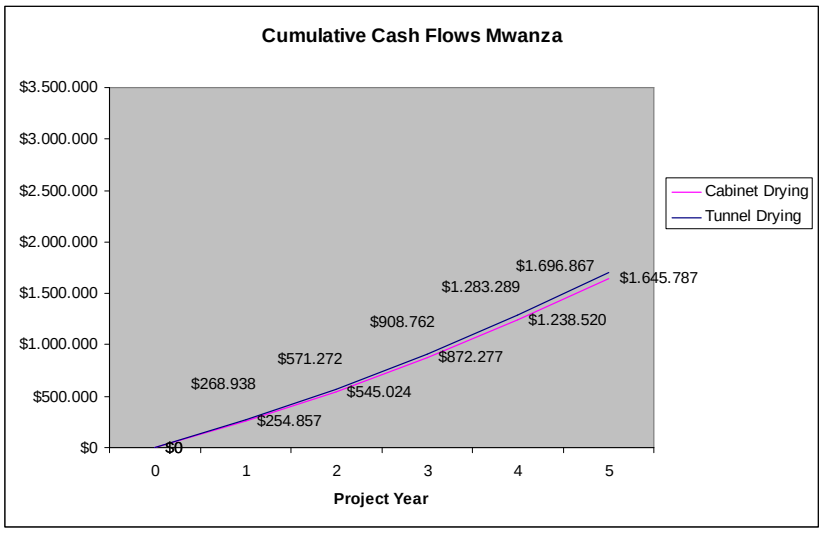


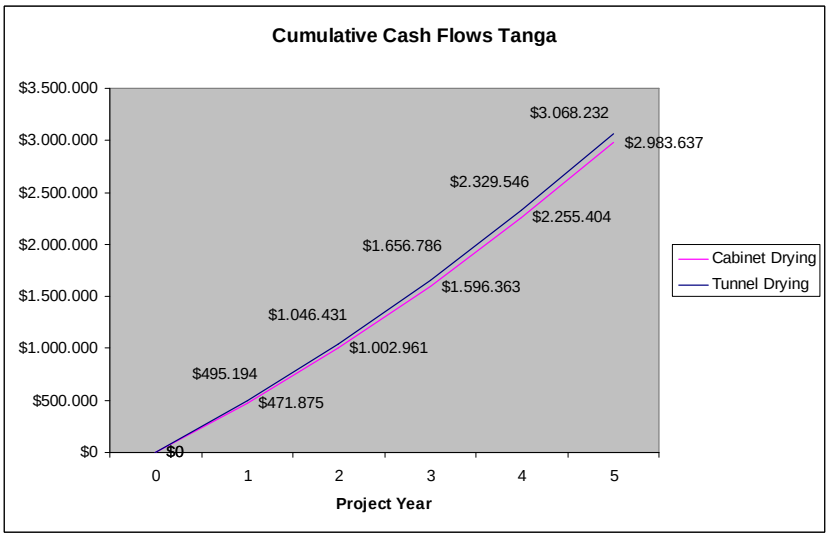
Given the outcomes of the NPV and IRR analyses, the projects' profitability prospects are very good. The Tanga and Morogoro regions are even considerably more profitable than the Mwanza and Kagera regions. This is because of the high amounts of fruits and vegetables in Tanga and Morogoro and also because of the distance to Dar es Salaam from these regions, on which the transport costs are based.

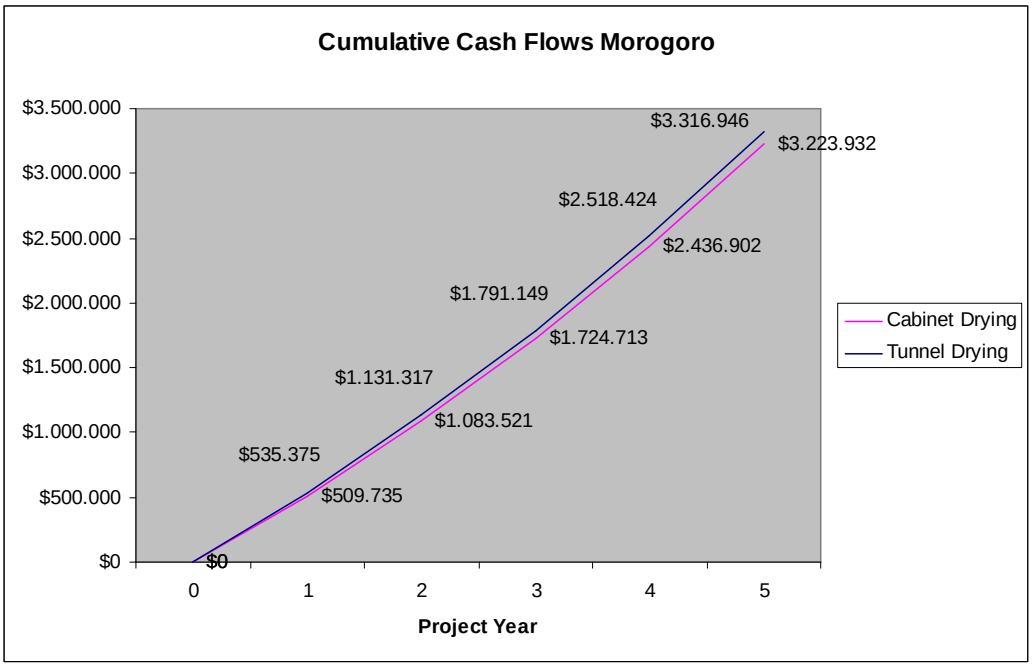
Liquidity Analyses

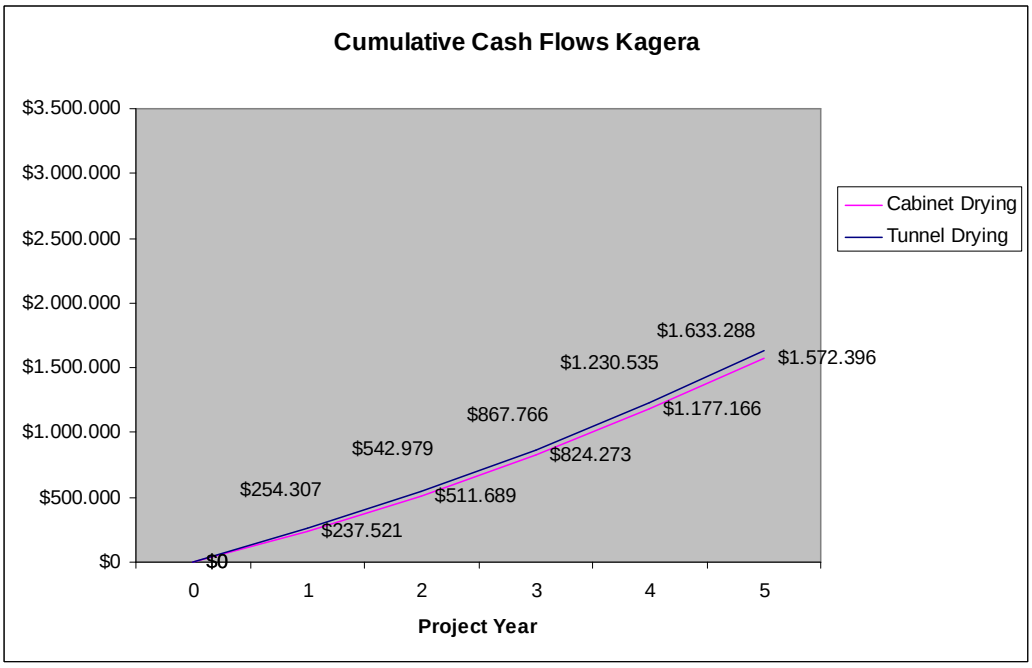
The outcomes of the liquidity analyses are given in the charts below. The charts show the cumulative cash flows comparison of the drying projects in the different regions between tunnel drying and cabinet drying. The graphs are used to give a quick overview of the liquidity positions when using either one of the most suitable technologies in the most promising regions in Tanzania.

Figure 7.4 - 7.7: The charts in the figures show could liquidity prospects for the different scenarios. They also show a small liquidity difference between heavy duty cabinet drying and tunnel drying.









The liquidity analyses show good prospects for both technologies in the different regions. It also shows that both technologies relatively vary little from each other. Refer to appendix 3 for the complete CBA calculations with the profitability and liquidity analysis.

8. Conclusion

8.1 Project proposal

When one wants to implement a successful fruit/vegetable drying sector in Tanzania, the proposed detailed designs are conceivable. This also answers to the primary research question, which was stated in the introduction chapter of this thesis: *What is a suitable technology and project set-up for solar drying of fruits and vegetables in Tanzania?* The answer to this was stated in the previous chapter, being: either a solar tunnel dryer or a heavy duty cabinet dryer in combination with a cooperative organisation structure with the solar dryers centralized as a processing plant. These plants should be located in Morogoro town, Sogera (Tanga region), Mwanza town and/or Bukoba (Kagera region), with a trading cooperation in Dar es Salaam.
The scenarios that were worked out proved to be financially viable, so a centralized drying plant, owned by a cooperative consisting of supplying farmers, in the selected regions, with either tunnel- or cabinet dryers, is an option to presumably successfully start up a dried fruit/vegetable export sector in Tanzania.
The last theoretical step in the chain linked model was the analytic design, the next step, the detailed design and test, is only partly theoretical, this was intercepted by creating detailed scenarios covering all discussed significant characteristics came upon during research. Unfortunately the practical elements of the proposed design were not tested, this should be the next step for the UDSM in this research, testing will probably provide a treasure of information which can enforce a revision of the analytic- and the proposed detailed design.

8.2 Reflection on the research model

8.2.1 Utilisation of the Chain linked model in a low-tech context?

In the introduction of this report it was questioned if Rosenberg and Kline's chain linked model, originally developed for a high-tech environment, can be used in a low-tech context like rural Tanzania, and if it proved suitable as a future framework for innovation implementation in a similar context.
By using the chain linked model as a guideline a framework came into being that declared all needed characteristics for successful production and all factors and possibilities that have to be taken into account in a country like Tanzania. The model gives a clear aim in the form of a potential market, to serve this market certain standards will have to be met. These standards served as a measurement for the final detailed design and obviously the presented scenarios.
This may sound straight forward, but what is a country as Tanzania realistically capable of, the analytic design showed the potential of the technology and the country. The analytic design is not only based on hard statistics but also on personal experiences in Tanzania, this was of great importance because statistical data and, for example, terms of reference of organizations sometimes did not correspond to reality. Also the traditional character of the sector is not pointed out in hard data, but gave important inputs for the characteristics of the project, for example hierarchical society structures and mental objections to certain structures, technologies or used materials. These factors determined the possibilities and the limitations of the project.
The analytic design as it was presented in the article "An overview of Innovation" (1986) by Rosenberg and Kline is aimed at pure technical innovation implementations, factors like humanware, infoware and orgaware which were important in this particular research and generally for the implementation of socio-economic technical innovations which was attempted here, are not considered in the original model. Because the analytical model describes the availability and composition of the currently used principles, it was decided to not only describe the pure technical principals, but basically all elements represented in THIO. Obviously all the elements within this analytic design are connected by feed back loops, to maintain the original inspiration of the model.
The scenarios presented in the detailed design had to meet the measurements stated in the potential market element of the model, but had to be based on the findings in the analytic design.
The model showed it limitations, when using it purely theoretical (as was done here), because of the practical element in the model. The found detailed design will have to be tested, giving input to the next step in the model, redesign, filtering out all impurities of the initial design during production. Than when the produce is finally produced and distributed to the potential markets, new unforeseen markets may come into being, demands in the market can change or other factors may appear that can influence

the project as a whole. The limitations of the model also answer the research question: *Is the Chain-Linked model by Rosenberg and Kline a suitable model for the sustainable implementation of innovation in developing countries?* The answer to this is that it has its limitations because of the practical elements of the model, but one could argue that a practical component in a research model for determining whether an innovation can be implemented or not is indispensable for solid research. So this could be an issue for discussion in every theoretical model.

In short, one can say that the final presented design of the project in this report is not a guarantee for successful implementation, because important practical elements of the model were not accomplished. Note that the model is dynamic meaning that the model is never "finished", for successful implementation, an innovation has to be constantly adjusted, meeting the latest demands in the markets and serving the available technologies in the best way possible, so an integral solution for successful innovation implementation is virtually impossible to cover in a report, when this is done serious doubts can be raised about the proper use of the selected model.
To answer the following research question concretely: *Is it possible to use the Chain-Linked model by Rosenberg and Kline for the sustainable implementation of solar drying technology in Tanzania?*, one could say that the chain-linked model proved applicable for innovation implementation in a low-tech environment as Tanzania, because it showed its capability of taken into account all relevant factors and its capability of creating a sustainable project because of the discussed dynamic character of the model.
When implementing an innovation in a similar low-tech environment, this report can be used as a guideline for the theoretical part, when using the chain-linked model, to realize this implementation. It extensively shows all steps that have to be taken into account in the first three elements of the model.

8.2.2 Can rural farmers be raised from subsistence level with the help of this project?

When the project is implemented in the proposed approach, theoretically rural farmers can be lifted of subsistence level, because they will create higher turnovers since sales, of certain produce, will rise with as much as 50%. To state that farmers will be lifted of subsistence level because of otherwise missed income, due to rotting, is, however basically true, over-simplified and will not do full justice to the research. Because of the centralized character of the project set-up initially only farmers within the co-operatives will profit, they will have guaranteed sales for guaranteed, competitive (based on fair trade prices) prices. But when the project shows to be a success, the project could have a more macro effect. At first when offered prices show competitive to national market prices, farmers in the co-operative will specialize in supplying to the drying plants, selecting certain demanded crops. This will create less stress on the oversupplied national market raising sales of farmers without co-operative membership. In the long run similar projects can be installed in the country so more producer groups can be established. If Tanzania can develop itself to a serious exporter of high quality dried produce, the sector can become a major contributor to the national economy. More welfare of rural farmers will create more welfare in the rural villages. So the initial research aim, lifting rural farmers of subsistence level, can be obtained, furthermore the effect, when the project proves successful, can be much larger.

8.2.3 Prospects for economic sustainability

Initially it was stated that the project has to be self supporting, and in it proposed format it is, meaning that no external cash flow comes into the project. This can be obtained because the project is based on an existing commercial market and utilizes the potential (fertility, infrastructure, present organizations etc.) of the country as good as possible, minimizing investment and subsidies. The CBA's verify that without external cash flows the project will be profitable.

8.3 Recommendations for implementations and policy

The success of the project is dependent on factors outside the project boundaries as well. Good governance is such a factor, currently the TBS does not have standards for dried fruits or food processing as a whole. TBS will give its quality mark to producers who will have to make a specific request, than foreign or international standards will serve as a measurement for the inspection institution TFDA. The TBS has legal authority and can remove products of insufficient quality from the market, but without set standards, measurements are impossible and the legal authority proves to be a redundant instrument. Therefore the Tanzanian government should set up an auditable quality system,

which is monitored regularly, until than products will have to meet CAC standards and the project itself is responsible for good auditing of the quality.
Numerous organizations in Tanzania are involved in the development of technologies and training of and for rural farmers, but often these government supported organizations share territories, creating an unnecessary complicated structure which proves to be very ineffective. Each organization must be given a specific specialty, for example training or technological support. Government budgets can so be aimed at certain goals more specifically, not ten small projects by ten organizations that all want to implement a successful drying project, but one organization that creates the technology one that creates the training etc., the structure will be clearer and budgets can be targeted.

As discussed the chain linked model has not accomplished it full flow path because only the theoretical part of the model could be completed. The practical elements can only be executed when the project is actually implemented. Therefore it is requested and recommended that the UDSM, will execute the practical elements of the model, only than it can be concluded if Rosenberg and Kline's chain linked model will hold in a low-tech environment. This conclusion can only be drawn when the project has been running for a longer period, it can than be compared with the theoretical statements made in this report, the accuracy of these statements will determine the suitability of the chain-linked model in this context.

Appendix 1: Interviews

Interview Agricultural Centre Iringa

Date: 11/09/2006

Personal details:
Name: *Mr. Luvanga (tel. 0784-887850)*
Age:
Job Title: *Iringa District Horticulture Officer*

Location details:
Region: *Iringa*
Population: *254.778 (124.842 males, 129.936 females)*
Number of rural farmers in region: *60% pop. Rural farmer, app.95% pop residing in rural areas.*
Climate: *See Iringa District Council profile*
Produced crops: *tomatoes, vegetables, mangos, mushrooms, pears, plums, passion fruit, water melons, quave, lemon, bananas, avocado, pepper, paprika.*
Harvesting periods: *See vegetable production data in Iringa district*
Educational institutions:

- Pre-primary education
  - Location *almost in every village, paid for by the government*
  - quantity *79*
- Primary education
  - Location *almost in every village, paid for by the government*
  - quantity *118*
- Junior secondary (Ordinary level)
  - Location *located by ward, subsidized by the government, school fee; ca. Tsh 450.000 /per student/year*
  - Quantity *17*
- Senior secondary (Advanced level)
  - location
  - quantity
- Tertiary Education
  - location
  - quantity

Healthcare institutions:

- Locations *available in a few villages, mostly organized per group of villages*
- Quantity *1 hospital, 5 health centres, 56 dispensaries, 70 medical stores/pharmacy, 118 village health posts*
- Quality *controlled by the government*

Sanitary facilities:

- Garbage collection *no garbage collection services, garbage disposed by feeding animals and in pits*
- Waste water disposal *no sewage available, water disposed in pits*

Water:

- To what locations is the tap water distributed? *App. 50% of pop connected to tap water (of the 119 villages, 78 have water schemes, 197.809 people are accessed to clean water, but 60,8% of the entire population (150.932) get water within a range of 400 metres.*
- Is it possible to expand the current tap water network?
    - Feasibility?
    - Which rural locations could be connected relatively easy?
    - What will be the estimated costs to connect these rural areas?
- What other sources of water are used? *Springs and wells*

  How would you qualify these water sources: *water is not treated, it is consumed boiled or untreated*
    - Drinking water
    - Unreliable sources (not appropriate for drinking)
    - Contaminated water
    - Heavily polluted water

Power:

- To what locations is power distributed? *Outside the city a few places*
- What is the reliability of the power network? 1-> very reliable (no power cuts) to 6 -> very unreliable (several power cuts per day) *12 hour powercut twice a week*
- Is it possible to expand the current power network?

  There are plans to expand the current network, to the rural areas, but it is too expansive for most of them, although the government subsidizes power in rural areas for 50%, so the price is Tsh 4500 per year. Kerosene is getting more and more expansive so power is becoming an alternative.
    - Feasibility?
    - Which rural locations could be connected relatively easy?
    - What will be the estimated costs to connect these rural areas?

Organization structure farmers

Are you aware of cooperation structures between farmers?

- What does this cooperation entail? *Sales cooperations*

Are you aware of cooperation between farmers and other actors (i.e. transporters, middlemen, traders)?

- Who are these actors? *Sometimes recourses are shared, this recourse then belongs to the association not to a particular person. Problems are solved within the group, usually in good harmony. Maintenance is executed by the farmers themselves, when this proves to be too difficult someone is hired.*
- What does this cooperation entail?

Are farmers organized in unions or other associations?

Produce output

Which fruits are produced in this region?
In what quantities are each individual fruit produced in this region?
What are the revenues of each individual produced fruit in this region? *Tsh 40 – 80 /kg tomatoes*
Can you estimate the amount of fruit spoilt at farm level? *Prices drastically go down in the harvesting periods of the specific crop. Some crops can be harvested more than once per season, the crops harvested in the rain season create more revenue. Farmers dispose of the unsold crops, to prevent them from spoiling, by selling the fruits at any offered price to those who take the effort to go to the rural farmers. Another problem is that most fruits are harvested in the wet season, which makes most roads inaccessible.*

Distribution

How are the fruits distributed to the end markets? *Trucks are hired or middlemen come to the farmers, transport goes by road*
Where are these end markets? *Dar es Salaam, Zanzibar, Dodoma, Malawi,Kenya.*
Which actors are involved in the distribution network from the rural farmer to the end consumer? *There are no companies involved with exports*

Policies

What government policies will have to be regarded when running a rural farm?

- What do they entail? *Middlemen must pay taxes*

What government policies are specifically aimed at rural farmers?

- What do they entail? *Government gives information training and advice in issues like fertilizing, irrigation systems*

Information network

How is information distributed to the rural farmers? *Posters, leaflets, radio, extension workers (but these mainly stay close to their office) and are often insufficient, exchange visits, farmer field days and study tours are organized for example to introduce new kinds of fruit. Farmers seem to be very conservative and will only change when something is successfully demonstrated ("seeing is believing")*
Are farmers aware of government policies regarding their business? *Yes*

Development organizations

Which development organizations, aimed at agriculture, are operative in this region?

- *Concern*
- *Padep*
- *ASP*
- *ASP seed*
- *CAEFA, Italian, fruit and vegetable processing, buys fruits from farmers, and trains agricultural skills*

What projects were/are executed by these organizations, regarding agriculture?

Status dried fruit

Does this region produce any dried fruits? *Yes, but very few*

- Who produces dried fruits? *SIDO*
- What kind of dried fruits are produced?
- In what quantities are each dried fruit kind produced?

Are there people in your region that have experiences with producing dried fruits? *Yes, see questionnaire user of vegetable dryer Iringa.*
Are there currently, or were there in the past, any projects dealing with the production of dried fruits?

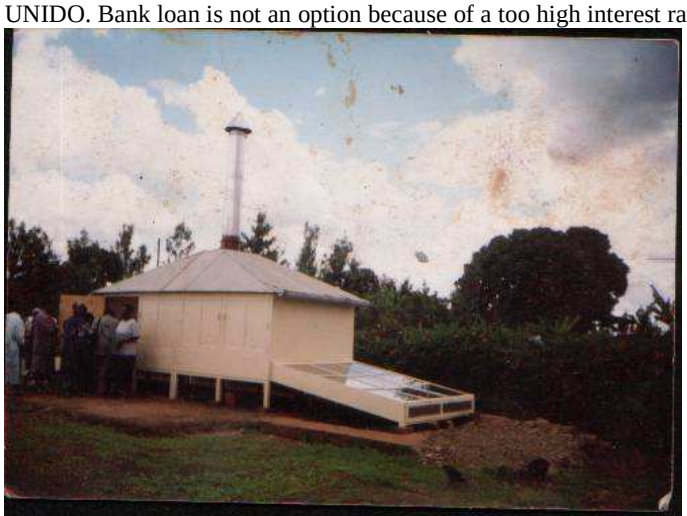
- By who are/were they organized?
- What do/did these projects entail?
- Have there been projects regarding training of rural farmers in producing dried fruit products?
    - If yes, do you know who organised this training and what did the training specifically consist of?

Remarks:
- Juices processed by factories could not cope with the demand but did meet standards

Interview Solar Dryer user Iringa

Date: 11-9-2006

Crops dried: Spinach, Cassava, Mushrooms
Ownership: Women group, 6 people
Produce sold to: Supermarkets (Shoprite), Shops, Retailers
Available standards: TFD standards (Tanzania Food & Drugs Authority), SIDO and UNIDO give training in these standards. TFD has no legal authority, must be seen as a quality label.
Value added dried fruits: No specific data, but value added is significant.
Used solar dryer: SIDO
Planning to buy Solar dryer from USAID, 300.000 KES, approximately $ 4.100, this is a more sophisticated indirect solar dryer, without the disadvantages of direct sunlight, resulting in higher product quality, Capacity of 10.000kg fruit/day. Price however is significantly higher, in comparison to the SIDO dryer (250.000 Tsh, approximately $182). Maintenance of the SIDO dryer can be executed by the user self, maintenance of USAID is more complicated. Money should come from donors like UNIDO. Bank loan is not an option because of a too high interest rate.



The women group self had to contact UNIDO, to explain their needs, UNIDO gave solutions meeting their requirements.

The group received training from SIDO and College from Kenya Tourism (could not find this organization on internet!!)
Training entailed:

- Fruit processing
- Hygienic issues
- Financial management

Clean water is available at the site, regular tap water, which is usually treated (boiled) before drinking.

Product packaging executed in Dar es Salaam at AMKA, used material produced by Simba plastics in Dar es Salaam, on advice of TIRDO.

Interview Rural Farmer Iringa (1)

Interview Details

1. Place: *Iringa region, Mbigili village*
2. Date: *September 11th 2006*

Interviewee Details

1. Name: *Benedict*
2. Level of education: *primary education*
3. Sources of income: *Growing fruits and vegetables only*
4. Number of people dependent on income farm?: *10 persons including himself*
5. What crops are produced?: *Vegetables only*
6. What kind of vegetables are produced?: *Sweet peppers, tomatoes, garlic and maize*
7. What is the dependency of the fruit crops (estimate percentage of fruits to total quantity crop output and financial output)
8. In which quantities are each fruit produced per annum?: *approximately 9000 kg in 2 harvesting periods per year*
9. To whom do you sell your fruits?: *Either sells to traders (middlemen) who come to the village or rents a truck with other farmers in the village to transport the vegetables to Dar es Salaam*

Location

1. Number of farms in ward:
2. Reachability (infrastructure level): *Mbigili is situated just off the main road from Iringa to Morogoro. This road has a tarmac surface and is the main road used by transporters from Zambia through Tanzania*
3. Availability of basic needs (food, water, shelter, sanitation, healthcare, education):
    - Water: *A water tap is available in the village which produces water from a well near the village. The water usually needs to be boiled in order for it to be safe for drinking. However, some people can not afford to boil the water. Food products are not washed before selling*
    - Power: *Power is available when needed, but not every household is connected to the power supply*
    - Sanitation: *There are no sewage facilities in the village. The people just throw the wastewater in pits. Garbage is also thrown in pits are fed to the animals in the village.*
    - Healthcare: *When in need of medical care he goes to a medical dispensary at 10 km from the village. The costs of treatment at this dispensary are TSH 1.000,- per visit. Sometimes the costs can not be paid.*
    - Education: *Primary and secondary education is available in the village*
    - Food availability: *People in the village eat a typical Tanzanian meal with Ugali, vegetables and meat, fish or bean stew.*

Cost structure

1. Can you estimate your income per annum in Tanzanian Shillings?: *approximately TSH 2.000.000,-*
2. Is your income sufficient to make ends meet? *The income is enough to provide for primary education for the children, food and shelter , but not enough to pay for secondary education and sometimes medical costs can not be covered. In his opinion an annual income of TSH 5.000.000,- would be sufficient for basic needs.*
3. What is your approximate revenue per kind of fruit?: *Currently, for 30 kg of tomatoes TSH 1.000,- is paid during the dry season. In the dry season he produces 6000 kg. During the wet season, 3000 kg is produced and sold at a price of TSH 15.000,- per 30 kg. Annually he would have an income of TSH 1.700.000,-*
4. What is your approximate profit per kind of fruit?
5. Do you have any machinery?: *No, however sometimes he rents an ox plough in the village at a price of TSH 10.000,- per acre or uses a tractor at a price of TSH 25.000,- per acre*
6. Do you have any personnel? *No, he only employs family members who are not paid any money*
7. What other resources, than capital and labor, are needed to produce your products?
    - What are the individual costs of these resources?
    - What is the availability of the individual resources?
8. Who sells your produce?:
9. What is the market price for your produce? *At the moment (dry season) the tomatoes are sold at TSH 5.000,- per 30 kg*
10. Do your prices slump when your produce is ready for harvesting? (due to this, level of fruit spoilt at farm level) *Yes, due to large supplies to the market*

Organisation structure

1. Do you cooperate with other companies or organisations?: *The farmers do not cooperate with traders or transporters, because they do not trust each other*
2. What does this cooperation entail?: *Farmers are themselves organised in associations. This is because the government only provides training or other development aid to groups and not individuals*
3. Trough what stages does your produce go before reaching the end market? *Sells directly to market in the village or to traders or transports to market in Dar es Salaam*
4. Do you share resources (human, capital, equipment etc.)?
    1. What Resources do you share?
    2. With whom do you share these resources?
    3. How is the ownership of the specific resource organized?
5. Can you describe your attitude towards cooperation? *They only trust other rural farmers and not traders or other middlemen.*

Educational/technical level

1. Are you able to read and write? *Yes*
2. Can you do simple maths (add, subtract, multiply, divide)? *Yes*
3. How do you receive information concerning your business? *Radio broadcastings and through district extension officer*
4. Are you aware of government policies regarding your business? *The government helps funding for facilities such as offices for village chairman and schools if the villagers help building them. They are aware of these policies through mobile phones and the district council*
5. Do you have any technical skills? *Yes, used to be a car mechanic and worked for the railway constructing company which built part of the TAZARA line.*

Attitude towards change

1. Can you change output depending on market demand? *He changes vegetable kinds depending on market demand*
2. Do you change output depending on market demand? *Last year changed to growing sweet peppers*
3. Are you willing to accept a change in routine? *Yes*
4. In the past have you made changes in business activities? (i.e. products, harvesting, conduct of business, other businesses) *Yes, changed products but harvesting methods have been the same due to lack of financial possibilities*
5. Will you be interested in producing dried fruits? *Yes, if training in producing dried fruits is provided*

Attitude towards risks

1. Have you ever made a big investment in your company? *No, it is too complicated to get a loan and the conditions of the loans are not interesting*
   - How large was this investment?
   - Did you need a loan for this investment?
   - Where did you invest in?
   - Have these investments been successful?
2. Would you invest in a project which could possibly raise your future profits?
   - No
   - I would be willing to invest a part of my savings
   - I would be willing to invest all my savings
   - I would be willing to invest all my savings and take out a small loan
   - I would be willing to invest all my savings and take out a maximum loan

Capital

1. What is the maximum amount of money you can invest considering own recourses?
2. What is the maximum amount of money you can invest considering external resources?
3. Where would you go to get money?
4. Is it possible for you to get a loan?
   - Have you ever taken out a loan?
     - Why did you take out this loan?
     - Did you invest the total amount of this loan on the initial purpose?
     - Where did you get this loan?
     - How much?
   - What will be the interest rate?
   - What will be the pay back period of the loan?
5. What are the criteria to get a loan? (business plan…)

Specific dried fruit knowledge

1. Have you ever heard of dried fruit? *No, but aware of dried vegetables*
2. Do you know about possible benefits or disadvantages of producing dried fruits? *Yes, aware of conservation possibilities*
3. Do you know which fruit kinds are used for dried fruit products?
4. Do you know how it can be produced?
5. Are you aware of any hygienic issues when handling fruit?
6. Do you know in what other products dried fruits are used?
7. Have you ever received training in preparing fresh fruit for drying?

Interview Rural Farmer Iringa (2)

Interview Details

3. Place: *Iringa region, Ruaha Mbuyunii village*
4. Population of the village: *3210*
5. Date: *September 13th 2006*

Interviewee Details

10. Name: *Nasoro*
11. Level of education: *primary education*
12. Sources of income: *Growing sesame, onions, sweet peppers, eggplants, mango, banana and tomatoes*
13. Number of people dependent on income farm?: *8 persons including himself*
14. What crops are produced in the village?: *sesame, maize, rice, beans, onions, sweet peppers, eggplants, tomatoes, mango's, banana's and paw paw*
15. What kind of fruits are produced?: *banana's and mango's*
16. What is the dependency of the fruit crops (estimate percentage of fruits to total quantity crop output and financial output)
17. In which quantities are each fruit produced per annum?: *10 acres of banana's and 10 acres of mango's*
18. To whom do you sell your fruits?: *The products are sold along the Mbeya-Morogoro road and part of the produce is transported in a rented truck to be sold in Dar es Salaam (costs: TSH 500.000,-)*

Location

4. Number of farms in ward: *400 farm owners, other farmers rent land*
5. Reachability (infrastructure level): *Ruaha Mbuyuni is situated just off the main road from Mbeya to Morogoro. This road has a tarmac surface and is the main road used by transporters from Zambia through Tanzania*
6. How much of your produce is spoilt at farm level (estimate): *because of location near the road almost all the produce is sold, however often for very low prices*
7. Availability of basic needs (food, water, shelter, sanitation, healthcare, education):
    - Water: *The people in this village get water from the river. The water needs to be boiled in order for it to be safe for drinking. However, some people can not afford to boil the water. Food products are not washed before selling. There are water pumps that have been placed by the Lutheran church. The pumps are currently out of order and when they do work, they only provide salt water.*
    - Power: *Power is only available to those who own a generator*
    - Sanitation: *There are no sewage facilities in the village. The people just throw the wastewater in pits. Garbage is also thrown in pits are fed to the animals in the village.*
    - Healthcare: *When in need of medical care the people in the village go to a medical dispensary in the village, which is also owned by the Lutheran church. The costs of treatment at this dispensary are TSH 1.000,- per visit. Sometimes the costs can not be paid, but the church will arrange for pay back schemes.*
    - Education: *Primary education is available in the village and secondary education is available in the area*
    - Food availability: *People in the village eat a typical Tanzanian meal with Ugali, vegetables and meat, fish or bean stew.*

Cost structure

11. Can you estimate your income per annum in Tanzanian Shillings?: *approximately TSH 500.000,-*
12. Is your income sufficient to make ends meet? *The income is enough to provide for primary education for the children, food and shelter, but not enough to pay for secondary education and sometimes medical costs can not be covered. An income of around TSH 4.000.000,- would be sufficient.*
13. What is your approximate revenue per kind of fruit?:
14. What is your approximate profit per kind of fruit? *Not sure, but prices are a lot better than last year*
15. Do you have any machinery?: *He does not own any machinery for his farm, however he sometimes rents a hand pump for pesticides, a water pump for irrigation, ox ploughs or a tractor*
16. Do you have any personnel? *He sometimes hires 2 workers to help during harvesting period, who he pays TSH 40.000,- per acre per worker.*
17. What other resources, than capital and labor, are needed to produce your products? *He uses fertilizers (UREA), which he buys for TSH 28,- per bag of 15 kg and 200 kg is needed per acre*
18. Who sells your produce?:
19. What is the market price for your produce?
20. Do your prices slump when your produce is ready for harvesting? (due to this, level of fruit spoilt at farm level) *Yes, due to large supplies to the market*

Organisation structure

6. Do you cooperate with other companies or organisations?: *The farmers are organised in groups together, but they do not cooperate with other companies or traders.*
7. What does this cooperation entail?: *Farmers are themselves organised in associations. This is because the government only provides training or other development aid to groups and not individuals*
8. Trough what stages does your produce go before reaching the end market? *Sells directly to market in the village or to traders or transports to market in Dar es Salaam and Morogoro*
9. Do you share resources (human, capital, equipment etc.)?: *Sometimes pumps or tractors are rented from other farmers who own them*
10. Can you describe your attitude towards cooperation? *The farmers only trust other rural farmers and not traders or other middlemen.*

Educational/technical level

6. Are you able to read and write? *Yes, however approximately 20% of the population in the village is illiterate*
7. Can you do simple maths (add, subtract, multiply, divide)? *Yes*
8. How do you receive information concerning your business? *A government representative provides the villagers with information about government policies, radio broadcastings and they get information about the market from travellers on the main road.*
9. Are you aware of government policies regarding your business? *They need to pay tax over their income from sold products to the district council, they are able to use a irrigation project set up by the government, they need to pay for the use of this irrigation system*
10. Do you have any technical skills? *Yes, has tailoring skills*

Attitude towards change

6. Can you change output depending on market demand? *The people in the village have changed crops according to demand*
7. Do you change output depending on market demand? *Has changed to growing sweet peppers and eggplants*
8. Are you willing to accept a change in routine? *Yes*
9. In the past have you made changes in business activities? (i.e. products, harvesting, conduct of business, other businesses) *Yes, changed products but harvesting methods have been the same due to lack of financial possibilities*
10. Will you be interested in producing dried fruits? *Yes, if training in producing dried fruits is provided*

Attitude towards risks

3. Have you ever made a big investment in your company? *No*
4. Would you invest in a project which could possibly raise your future profits? *He would be willing to take a loan to invest, but depends on conditions and if training is provided for the new technology*

Capital

6. What is the maximum amount of money you can invest considering own recourses? *Does not know*
7. What is the maximum amount of money you can invest considering external resources? *Does not know*
8. Where would you go to get money? *There are people offering loans to people in the village*
9. Is it possible for you to get a loan? *Never taken out a loan due to poor conditions*
10. What are the criteria to get a loan? *Does not know*

Specific dried fruit knowledge

8. Have you ever heard of dried fruit? *Yes, but only the traditional way by boiling and drying in the sun*
9. Do you know about possible benefits or disadvantages of producing dried fruits? *Yes, aware of conservation possibilities*
10. Do you know which fruit kinds are used for dried fruit products? *No*
11. Do you know how it can be produced? *No*
12. Are you aware of any hygienic issues when handling fruit? *No*
13. Do you know in what other products dried fruits are used? *No*
14. Have you ever received training in preparing fresh fruit for drying? *No, only learned the traditional way of fruit and vegetable drying*

Extra Information

1. Are there any development organisations active in the village?: *Concen (gives training in maize cultivation), DADIS (Gives training in cultivation methods), DaiPeSa (gives training in producing good seeds, preserving their crops and harvesting methods)*

Interview Village Representatives Iringa

Date: 12-9-2006

Personal details:
Names / Job titles:
- Mozes: Village Chairman
- Makarius: Village Executive Officer
- Hasan: Ward Agricultural Officer

Location details:
Village: Idodi
Region: Iringa
Population: 3953
Number of rural farmers in village: app. 810 people capable of working
Produced crops: rice, maize, groundnuts, vegetables, fruits
Harvesting periods: dry and wet season
Educational institutions available in village:
- Pre-primary education
- Primary education
- Junior secondary (Ordinary level)

Healthcare institutions: Health centre present in village
Sanitary facilities:
- Garbage collection; feed animals
- Waste water disposal; dispose in pits

Water:
- 30 water points with tap water available in the village, tap water is not drinking water and should be treated (boiled) before consumption.
- Another source for water is the river, this water should also be treated (boiled) before consumption.

Power:
- There is no power available in the village, if they need power they use a generator.
- They are not aware of any government plans to expand the current power network to this village

Reachability (infrastructure level):
- Village reached by sand / gravel road, this is the road that connects Iringa with Ruaha national park
- Distance Farm to connecting tarmac road app. 60 km

Organization structure farmers
Farmers are organized in associations, these associations deal with issues as produce market price, the quantity of produce to sell.
The associations only consist of farmers because of the lack of trust in anyone outside their innercircle, for example middlemen.

Produce output

	banana	mango	cuave	avocado	water melon	paw paw
quantity/year (in tonnes)	3	60	new crop	new crop	20 tonnes	10 tonnes
individual price (in Tsh)	20-50	50-100	new crop	new crop		100-200

When they can sell output to Ruaha National park prices can be high!
According to the interviewees most of the crops do not spoil at farm level, the only crop that does this is Mango, with 50% spoiled at farm level.

Distribution
- To distribute the harvest to the end markets, the farmers hire trucks from their owners.

- Retailers that arrive per truck have previously made agreements, dealing with what to buy and the quantity they want to buy.
- When the farmers hire a truck, the lease is 100.000 Tsh, for transportation to Iringa.
- The end markets of the produce are in Iringa, Ruaha National Park, and the village itself.
- The actors involved in the distribution network, are either selling trough middlemen, or selling of the produce directly to the end market by the farmers themselves. There is no fruit auction in Iringa.

Policies / Information network

- In the village is a government extension service which deals with issues like;
  - Group formation, so that the government can direct for example training at certain groups instead of individuals, which creates higher efficiency.
  - Savings and Credits
  - And other government policies directed at the rural farmers.
- Other information usually runs trough the village chair man, village meetings are organized to inform the other villagers.

Development organizations

Which development organizations, aimed at agriculture, are operative in this region?
Padep; concerned with construction skills, financing groups.
Concern;
Daipesa; NGO development agricultural initiative

Status dried fruit

There is no experience in this village with drying of fruits.

Interview Rural Farmer Iringa (3)

Interview Details

1. Place: *Iringa region, Idodi village*

2. Date: *September 13th 2006*

Company Details

3. Name: *Bahati*

4. Age:

5. Sources of income: *rice, water melons, tomatoes*

6. Number of people dependent on income farm: *8*

7. What crops are produced:

8. What kind of fruits produced: *Rice: 150 kg*
   Water melons: 2000- 3000 water melons
   Tomatoes: 15 tanga's from 0.5 acre, app. 100 kg

9. What is the dependency of the fruit crops (estimate percentage of fruits to total quantity crop output and financial output)

10. In which quantities are each fruit produced per annum:

11. To whom do you sell your fruits? *Rice is sold in Iringa, the rest is sold within the village.*

Location details: see answered questionnaire Idodi Agricultural Extension Office

Cost structure

12. Can you estimate your income per annum in Tanzanian Shillings? *2.500.000 Tsh*
13. Is your income sufficient to make ends meet?
14. What is your approximate revenue per kind of fruit? *No idea, only profitable crop is rice.*
15. What is your approximate profit per kind of fruit?
16. Do you have any machinery? *Only basic tools, some villagers own an ox plough, mr Onesmo has a hand pump for insecticides, which can be borrowed. The cost of such a pump is 80.000-160.000 Tsh.*
17. Do you have any personnel? *Sometimes staff is hired, costs are 2000 Tsh/400m^2*
18. What other resources, than capital and labor, are needed to produce your products? *Industrial fertilizer 24.000 – 28.000 Tsh bought in Iringa*
19. Who sells your produce?
20. What is the market price for your produce?
21. Do your prices slump when your produce is ready for harvesting? (due to this, level of fruit spoilt at farm level) *Prices go down during high season*

Organisation structure

The farmers do not cooperate, only among each other, the only cooperation with "the outside world" according to the farmers are the negotiations about prices for transportation, with transporters.

Educational/technical level

Highest level of finished education: *Primary Education*
Are you able to read and write? *Yes, about 75% of the village is literate*
Can you do simple maths (add, subtract, multiply, divide)? *Yes*

How do you receive information concerning your business? (TV, newspaper, rumours, other) *In Iringa market information is obtained, other sources of information and the distribution of information are, mobile phones and radio broadcasting, there are no people from the government visiting the village.*
Are you aware of government policies regarding your business? *The farmers are aware of government policies regarding credit, loans, group formation (the government encourages this because it can than better aim its training and policy programs to the target groups)*
Do you have any technical skills? *Was never trained in any technical skills but says to have electrical skills.*

Attitude towards change

Can you change output depending on market demand?
Do you change output depending on market demand?
Yes they can and do change output when there is a difference in market demand, recently they were advised to grow paprika's, because of the big market demand, but a lack of experience and no training with this crop, caused this opportunity to fail.
Are you willing to accept a change in routine? *Yes*
In the past have you made changes in business activities? (i.e. products, harvesting, conduct of business, other businesses) *Yes they have, see paprika example, but now are only willing to make changes when they get good instructions.*
Will you be interested in producing dried fruits?

Attitude towards risks

Have you ever made a big investment in your company? *Yes, in crops, but harvest failed because of draught*
Would you invest in a project which could possibly raise your future profits?

- No
- I would be willing to invest a part of my savings
- I would be willing to invest all my savings
- I would be willing to invest all my savings and take out a small loan
- I would be willing to invest all my savings and take out a maximum loan

Capital

The savings of a rural farmer can be neglected, so when they want to invest they have to get a loan, the maximum this interviewee can get, according to him is, 1.500.000 Tsh, with an interest rate of 25%, and a payback period of 6 months, a criteria is that the loan has to be invested in agriculture.
This interviewee has no real experience in investing in "risky" projects.

Specific dried fruit knowledge

Dried fruits are known but they have never eaten it or seen it. For their own consumption there is experience with drying of vegetables in the sun, without a machine. No training was received for this, however training was given for drying of pumpkins for own use.

Interview Rural Farmer Iringa (3)

Interview Details

1. Place: *Iringa region, Idodi village*

2. Date: *September 13th 2006*

Company Details

3. Name: *Asha*

4. Age:

5. Sources of income: *farming*

6. Number of people dependent on income farm: *7*

7. What crops are produced: *maize, vegetables, avocado's, tomatoes*

8. What kind of fruits produced: *Maize: 10 bags*
   Vegetables: ?
   Avocados: ?
   Tomatoes: 400 kg

9. What is the dependency of the fruit crops (estimate percentage of fruits to total quantity crop output and financial output)

10. In which quantities are each fruit produced per annum:

11. To whom do you sell your fruits? *Produce sold in the village, in the near future planning to sell to middlemen*

Location details: see answered questionnaire Idodi Agricultural Extension Office

Cost structure

12. Can you estimate your income per annum in Tanzanian Shillings? *1.500.000 – 2.000.000 Tsh*
13. Is your income sufficient to make ends meet? *No*
14. What is your approximate revenue per kind of fruit?
15. What is your approximate profit per kind of fruit?
16. Do you have any machinery? *Only basic tools, some villagers own an ox plough, mr Onesmo has a hand pump for insecticides, which can be borrowed. The cost of such a pump is 80.000-160.000 Tsh.*
17. Do you have any personnel? *Sometimes staff is hired, costs are 2000 Tsh/400m^2*
18. What other resources, than capital and labor, are needed to produce your products? *Industrial fertilizer 24.000 – 28.000 Tsh bought in Iringa*
19. Who sells your produce?
20. What is the market price for your produce?
21. Do your prices slump when your produce is ready for harvesting? (due to this, level of fruit spoilt at farm level) *Prices go down during high season*

Organisation structure

The farmers do not cooperate, only among each other, the only cooperation with "the outside world" according to the farmers are the negotiations about prices for transportation, with transporters.

Educational/technical level

Highest level of finished education: *Primary Education*
Are you able to read and write? *Yes, about 75% of the village is literate*

Can you do simple maths (add, subtract, multiply, divide)? *Yes*
How do you receive information concerning your business? (TV, newspaper, rumours, other) *In Iringa market information is obtained, other sources of information and the distribution of information are, mobile phones and radio broadcasting, there are no people from the government visiting the village.*
Are you aware of government policies regarding your business? *The farmers are aware of government policies regarding credit, loans, group formation (the government encourages this because it can than better aim its training and policy programs to the target groups)*
Do you have any technical skills? *According to herself her technical skill is cooking, but was never trained in this.*

Attitude towards change

Can you change output depending on market demand?
Do you change output depending on market demand?
Yes they can and do change output when there is a difference in market demand, recently they were advised to grow paprika's, because of the big market demand, but a lack of experience and no training with this crop, caused this opportunity to fail.
Are you willing to accept a change in routine? *Yes*
In the past have you made changes in business activities? (i.e. products, harvesting, conduct of business, other businesses) *Yes they have, see paprika example, but now are only willing to make changes when they get good instructions.*
Will you be interested in producing dried fruits?

Attitude towards risks

Have you ever made a big investment in your company? *Investment in new recommended crops, this investment was not successful, draught caused the harvest to fail.*
Would you invest in a project which could possibly raise your future profits?

- No
- I would be willing to invest a part of my savings
- I would be willing to invest all my savings
- I would be willing to invest all my savings and take out a small loan
- I would be willing to invest all my savings and take out a maximum loan

Capital

The savings of a rural farmer can be neglected, so when they want to invest they have to get a loan, Asha got a loan of 300.000 with an interest rate of 25%, and a payback period of 6 months, a criteria is that the loan has to be invested in agriculture. She invested this money in total in the new failed crop described above.

Specific dried fruit knowledge

Dried fruits are known but they have never eaten it or seen it. For their own consumption there is experience with drying of vegetables in the sun, without a machine. No training was received for this, however training was given for drying of pumpkins for own use.

Interview Rural Farmer Iringa (4)

Interview Details

1. Place: *Iringa region, Idodi village*

2. Date: *September 13th 2006*

Company Details

3. Name: *Ibrahim*

4. Age:

5. Sources of income: *rice, tomatoes, mango*

6. Number of people dependent on income farm: *7*

7. What crops are produced:

8. What kind of fruits produced: *Rice: 80 kg (40 bags)*
   Mango: 3 tonnes

9. What is the dependency of the fruit crops (estimate percentage of fruits to total quantity crop output and financial output)

10. In which quantities are each fruit produced per annum:

11. To whom do you sell your fruits? *Produce sold in the village, wants produce to bring to the market in Iringa.*

Location details: see answered questionnaire Idodi Agricultural Extension Office

Cost structure

12. Can you estimate your income per annum in Tanzanian Shillings? *700.000 – 800.000 Tsh*
13. Is your income sufficient to make ends meet?
14. What is your approximate revenue per kind of fruit? *No idea, only profitable crop is rice.*
15. What is your approximate profit per kind of fruit?
16. Do you have any machinery? *Only basic tools, some villagers own an ox plough, mr Onesmo has a hand pump for insecticides, which can be borrowed. The cost of such a pump is 80.000-160.000 Tsh.*
17. Do you have any personnel? *Sometimes staff is hired, costs are 2000 Tsh/400m^2*
18. What other resources, than capital and labor, are needed to produce your products? *Industrial fertilizer 24.000 – 28.000 Tsh bought in Iringa*
19. Who sells your produce?
20. What is the market price for your produce?
21. Do your prices slump when your produce is ready for harvesting? (due to this, level of fruit spoilt at farm level) *Prices go down during high season*

Organisation structure

The farmers do not cooperate, only among each other, the only cooperation with "the outside world" according to the farmers are the negotiations about prices for transportation, with transporters.

Educational/technical level

Highest level of finished education: *Primary Education*
Are you able to read and write? *Yes, about 75% of the village is literate*
Can you do simple maths (add, subtract, multiply, divide)? *Yes*

How do you receive information concerning your business? (TV, newspaper, rumours, other) *In Iringa market information is obtained, other sources of information and the distribution of information are, mobile phones and radio broadcasting, there are no people from the government visiting the village.*
Are you aware of government policies regarding your business? *The farmers are aware of government policies regarding credit, loans, group formation (the government encourages this because it can than better aim its training and policy programs to the target groups)*
Do you have any technical skills? *Is a trained electrician*

Attitude towards change

Can you change output depending on market demand?
Do you change output depending on market demand?
Yes they can and do change output when there is a difference in market demand, recently they were advised to grow paprika's, because of the big market demand, but a lack of experience and no training with this crop, caused this opportunity to fail.
Are you willing to accept a change in routine? *Yes*
In the past have you made changes in business activities? (i.e. products, harvesting, conduct of business, other businesses) *Yes they have, see paprika example, but now are only willing to make changes when they get good instructions.*
Will you be interested in producing dried fruits?

Attitude towards risks

Have you ever made a big investment in your company? *No*
Would you invest in a project which could possibly raise your future profits?

- No
- I would be willing to invest a part of my savings
- I would be willing to invest all my savings
- I would be willing to invest all my savings and take out a small loan
- I would be willing to invest all my savings and take out a maximum loan

Capital

The savings of a rural farmer can be neglected, so when they want to invest they have to get a loan, the maximum this interviewee can get, according to him is, 1.500.000 Tsh, with an interest rate of 25%, and a payback period of 6 months, a criteria is that the loan has to be invested in agriculture.
This interviewee has no real experience in investing in "risky" projects.

Specific dried fruit knowledge

Dried fruits are known but they have never eaten it or seen it. For their own consumption there is experience with drying of vegetables in the sun, without a machine. No training was received for this, however training was given for drying of pumpkins for own use.

Interview Rural Farmer Iringa (5)

Interview Details

1. Place: *Iringa region, Idodi village*

2. Date: *September 13th 2006*

Company Details

3. Name: *Onesmo*

4. Age:

5. Sources of income: *farming, guesthouse*

6. Number of people dependent on income farm: *5*

7. What crops are produced: *rice, oranges, mango*

8. What kind of fruits produced: *Rice: 300 bags*
   Oranges: ?
   Mango: ?

9. What is the dependency of the fruit crops (estimate percentage of fruits to total quantity crop output and financial output)

10. In which quantities are each fruit produced per annum:

11. To whom do you sell your fruits? *Directly sells his produce to the end consumer himself in Iringa, also takes care of transport to Iringa himself.*

Location details: see answered questionnaire Idodi Agricultural Extension Office

Cost structure

12. Can you estimate your income per annum in Tanzanian Shillings? *15.000.000 Tsh*
13. Is your income sufficient to make ends meet? *Yes*
14. What is your approximate revenue per kind of fruit?
15. What is your approximate profit per kind of fruit?
16. Do you have any machinery? *Mr. Onesmo has a hand pump for insecticides, which can be borrowed. The cost of such a pump is 80.000-160.000 Tsh.*
17. Do you have any personnel? *Sometimes staff is hired, costs are 2000 Tsh/400m^2*
18. What other resources, than capital and labor, are needed to produce your products? *Industrial fertilizer 24.000 – 28.000 Tsh bought in Iringa*
19. Who sells your produce?
20. What is the market price for your produce?
21. Do your prices slump when your produce is ready for harvesting? (due to this, level of fruit spoilt at farm level) *Prices go down during high season*

Organisation structure

The farmers do not cooperate, only among each other, the only cooperation with "the outside world" according to the farmers are the negotiations about prices for transportation, with transporters.

Educational/technical level

Highest level of finished education: *Primary Education*
Are you able to read and write? *Yes, about 75% of the village is literate*
Can you do simple maths (add, subtract, multiply, divide)? *Yes*

How do you receive information concerning your business? (TV, newspaper, rumours, other) *In Iringa market information is obtained, other sources of information and the distribution of information are, mobile phones and radio broadcasting, there are no people from the government visiting the village.*
Are you aware of government policies regarding your business? *The farmers are aware of government policies regarding credit, loans, group formation (the government encourages this because it can than better aim its training and policy programs to the target groups)*
Do you have any technical skills? *This man is a trained driver, which means mechanical skills, for basic repairs on cars, were trained.*

Attitude towards change

Can you change output depending on market demand?
Do you change output depending on market demand?
Yes they can and do change output when there is a difference in market demand, recently they were advised to grow paprika's, because of the big market demand, but a lack of experience and no training with this crop, caused this opportunity to fail.
Are you willing to accept a change in routine? *Yes*
In the past have you made changes in business activities? (i.e. products, harvesting, conduct of business, other businesses) *Yes they have, see paprika example, but now are only willing to make changes when they get good instructions.*
Will you be interested in producing dried fruits?

Attitude towards risks

Have you ever made a big investment in your company? *Investment in guesthouse, this proved to be very successful.*
Would you invest in a project which could possibly raise your future profits?

- No
- I would be willing to invest a part of my savings
- I would be willing to invest all my savings
- I would be willing to invest all my savings and take out a small loan
- I would be willing to invest all my savings and take out a maximum loan

Capital

The investment needed for the guesthouse was financed from own resources.

Specific dried fruit knowledge

Dried fruits are known but they have never eaten it or seen it. For their own consumption there is experience with drying of vegetables in the sun, without a machine. No training was received for this, however training was given for drying of pumpkins for own use.

Interview Rural Farmer Iringa (6)

Interview Details

1. Place: *Iringa region, Idodi village*

2. Date: *September 13th 2006*

Company Details

3. Name: *Ozaima*

4. Age:

5. Sources of income: *farming*

6. Number of people dependent on income farm: *4*

7. What crops are produced: *rice, mango*

8. What kind of fruits produced: *Rice: 50 bags*
   Mango: 20 Tsh per piece, cannot estimate ammount

9. What is the dependency of the fruit crops (estimate percentage of fruits to total quantity crop output and financial output)

10. In which quantities are each fruit produced per annum:

11. To whom do you sell your fruits? *Produce locally sold, rice sold to consumers in Iringa*

Location details: see answered questionnaire Idodi Agricultural Extension Office

Cost structure

12. Can you estimate your income per annum in Tanzanian Shillings? *500.000 Tsh*
13. Is your income sufficient to make ends meet? *No, secondary schooling for her children costs 450.000 per year.*
14. What is your approximate revenue per kind of fruit?
15. What is your approximate profit per kind of fruit?
16. Do you have any machinery? *Only basic tools, some villagers own an ox plough, mr Onesmo has a hand pump for insecticides, which can be borrowed. The cost of such a pump is 80.000-160.000 Tsh.*
17. Do you have any personnel? *Sometimes staff is hired, costs are 2000 Tsh/400m^2*
18. What other resources, than capital and labor, are needed to produce your products? *Industrial fertilizer 24.000 – 28.000 Tsh bought in Iringa*
19. Who sells your produce?
20. What is the market price for your produce?
21. Do your prices slump when your produce is ready for harvesting? (due to this, level of fruit spoilt at farm level) *Prices go down during high season*

Organisation structure

The farmers do not cooperate, only among each other, the only cooperation with "the outside world" according to the farmers are the negotiations about prices for transportation, with transporters.

Educational/technical level

Highest level of finished education: *Primary Education*
Are you able to read and write? *Yes, about 75% of the village is literate*
Can you do simple maths (add, subtract, multiply, divide)? *Yes*

How do you receive information concerning your business? (TV, newspaper, rumours, other) *In Iringa market information is obtained, other sources of information and the distribution of information are, mobile phones and radio broadcasting, there are no people from the government visiting the village.*
Are you aware of government policies regarding your business? *The farmers are aware of government policies regarding credit, loans, group formation (the government encourages this because it can than better aim its training and policy programs to the target groups)*
Do you have any technical skills? *No*

Attitude towards change

Can you change output depending on market demand?
Do you change output depending on market demand?
Yes they can and do change output when there is a difference in market demand, recently they were advised to grow paprika's, because of the big market demand, but a lack of experience and no training with this crop, caused this opportunity to fail.
Are you willing to accept a change in routine? *Yes*
In the past have you made changes in business activities? (i.e. products, harvesting, conduct of business, other businesses) *Yes they have, see paprika example, but now are only willing to make changes when they get good instructions.*
Will you be interested in producing dried fruits?

Attitude towards risks

Have you ever made a big investment in your company? *No*
Would you invest in a project which could possibly raise your future profits?

- No
- I would be willing to invest a part of my savings
- I would be willing to invest all my savings
- I would be willing to invest all my savings and take out a small loan
- I would be willing to invest all my savings and take out a maximum loan

Capital

The savings of a rural farmer can be neglected, so when they want to invest they have to get a loan, Ozaima never invested in her business, so she never took out a loan.

Specific dried fruit knowledge

Dried fruits are known but they have never eaten it or seen it. For their own consumption there is experience with drying of vegetables in the sun, without a machine. No training was received for this, however training was given for drying of pumpkins for own use.

Interview Rural Farmer Iringa (6)

Interview Details

1. Place: *Iringa region, Mbigili village*

2. Date: *September 11th 2006*

Interviewee Details

3. Name: *Benedict*

4. Level of education: *primary education*

5. Sources of income: *Growing fruits and vegetables only*

6. Number of people dependent on income farm?: *10 persons including himself*

7. What crops are produced?: *Vegetables only*

8. What kind of vegetables are produced?: *Sweet peppers, tomatoes, garlic and maize*

9. What is the dependency of the fruit crops (estimate percentage of fruits to total quantity crop output and financial output)

10. In which quantities are each fruit produced per annum?: *approximately 9000 kg in 2 harvesting periods per year*

11. To whom do you sell your fruits?: *Either sells to traders (middlemen) who come to the village or rents a truck with other farmers in the village to transport the vegetables to Dar es Salaam*

Location

12. Number of farms in ward:
13. Reachability (infrastructure level): *Mbigili is situated just off the main road from Iringa to Morogoro. This road has a tarmac surface and is the main road used by transporters from Zambia through Tanzania*
14. Availability of basic needs (food, water, shelter, sanitation, healthcare, education):
    - Water: *A water tap is available in the village which produces water from a well near the village. The water usually needs to be boiled in order for it to be safe for drinking. However, some people can not afford to boil the water. Food products are not washed before selling*
    - Power: *Power is available when needed, but not every household is connected to the power supply*
    - Sanitation: *There are no sewage facilities in the village. The people just throw the wastewater in pits. Garbage is also thrown in pits are fed to the animals in the village.*
    - Healthcare: *When in need of medical care he goes to a medical dispensary at 10 km from the village. The costs of treatment at this dispensary are TSH 1.000,- per visit. Sometimes the costs can not be paid.*
    - Education: *Primary and secondary education is available in the village*
    - Food availability: *People in the village eat a typical Tanzanian meal with Ugali, vegetables and meat, fish or bean stew.*

Cost structure

15. Can you estimate your income per annum in Tanzanian Shillings?: *approximately TSH 2.000.000,-*
16. Is your income sufficient to make ends meet? *The income is enough to provide for primary education for the children, food and shelter , but not enough to pay for secondary education and*

sometimes medical costs can not be covered. In his opinion an annual income of TSH 5.000.000,- would be sufficient for basic needs.

17. What is your approximate revenue per kind of fruit?: *Currently, for 30 kg of tomatoes TSH 1.000,- is paid during the dry season. In the dry season he produces 6000 kg. During the wet season, 3000 kg is produced and sold at a price of TSH 15.000,- per 30 kg. Annually he would have an income of TSH 1.700.000,-*
18. What is your approximate profit per kind of fruit?
19. Do you have any machinery?: *No, however sometimes he rents an ox plough in the village at a price of TSH 10.000,- per acre or uses a tractor at a price of TSH 25.000,- per acre*
20. Do you have any personnel? *No, he only employs family members who are not paid any money*
21. What other resources, than capital and labor, are needed to produce your products?
    - What are the individual costs of these resources?
    - What is the availability of the individual resources?
22. Who sells your produce?:
23. What is the market price for your produce? *At the moment (dry season) the tomatoes are sold at TSH 5.000,- per 30 kg*
24. Do your prices slump when your produce is ready for harvesting? (due to this, level of fruit spoilt at farm level) *Yes, due to large supplies to the market*

Organisation structure

25. Do you cooperate with other companies or organisations?: *The farmers do not cooperate with traders or transporters, because they do not trust each other*
26. What does this cooperation entail?: *Farmers are themselves organised in associations. This is because the government only provides training or other development aid to groups and not individuals*
27. Trough what stages does your produce go before reaching the end market? *Sells directly to market in the village or to traders or transports to market in Dar es Salaam*
28. Do you share resources (human, capital, equipment etc.)?
    4. What Resources do you share?
    5. With whom do you share these resources?
    6. How is the ownership of the specific resource organized?
29. Can you describe your attitude towards cooperation? *They only trust other rural farmers and not traders or other middlemen.*

Educational/technical level

30. Are you able to read and write? *Yes*
31. Can you do simple maths (add, subtract, multiply, divide)? *Yes*
32. How do you receive information concerning your business? *Radio broadcastings and through district extension officer*
33. Are you aware of government policies regarding your business? *The government helps funding for facilities such as offices for village chairman and schools if the villagers help building them. They are aware of these policies through mobile phones and the district council*
34. Do you have any technical skills? *Yes, used to be a car mechanic and worked for the railway constructing company which built part of the TAZARA line.*

Attitude towards change

35. Can you change output depending on market demand? *He changes vegetable kinds depending on market demand*
36. Do you change output depending on market demand? *Last year changed to growing sweet peppers*
37. Are you willing to accept a change in routine? *Yes*
38. In the past have you made changes in business activities? (i.e. products, harvesting, conduct of business, other businesses) *Yes, changed products but harvesting methods have been the same due to lack of financial possibilities*
39. Will you be interested in producing dried fruits? *Yes, if training in producing dried fruits is provided*

Attitude towards risks

40. Have you ever made a big investment in your company? *No, it is too complicated to get a loan and the conditions of the loans are not interesting*
    - How large was this investment?
    - Did you need a loan for this investment?
    - Where did you invest in?
    - Have these investments been successful?
41. Would you invest in a project which could possibly raise your future profits?
    - o No
    - o I would be willing to invest a part of my savings
    - o I would be willing to invest all my savings
    - o I would be willing to invest all my savings and take out a small loan
    - o I would be willing to invest all my savings and take out a maximum loan

Capital

11. What is the maximum amount of money you can invest considering own recourses?
12. What is the maximum amount of money you can invest considering external resources?
13. Where would you go to get money?
14. Is it possible for you to get a loan?
    - Have you ever taken out a loan?
        - Why did you take out this loan?
        - Did you invest the total amount of this loan on the initial purpose?
        - Where did you get this loan?
        - How much?
    - What will be the interest rate?
    - What will be the pay back period of the loan?
15. What are the criteria to get a loan? (business plan…)

Specific dried fruit knowledge

15. Have you ever heard of dried fruit? *No, but aware of dried vegetables*
16. Do you know about possible benefits or disadvantages of producing dried fruits? *Yes, aware of conservation possibilities*
17. Do you know which fruit kinds are used for dried fruit products?
18. Do you know how it can be produced?
19. Are you aware of any hygienic issues when handling fruit?
20. Do you know in what other products dried fruits are used?
21. Have you ever received training in preparing fresh fruit for drying?

Interview Rural Farmer Iringa (7)

Interview Details

6. Place: *Iringa region, Mbigili village*

7. Date: *September 11th 2006*

Interviewee Details

19. Name: *Sauda*

20. Level of education: *primary education*

21. Sources of income: *Growing vegetables only*

22. Number of people dependent on income farm?: *8 persons including herself*

23. What crops are produced?: *Vegetables only*

24. What kind of vegetables are produced?: *Sweet peppers, tomatoes, garlic and maize*

25. What is the dependency of the fruit crops (estimate percentage of fruits to total quantity crop output and financial output)

26. In which quantities are each fruit produced per annum?: *approximately 9000 kg in 2 harvesting periods per year*

27. To whom do you sell your fruits?: *Either sells to traders (middlemen) who come to the village or rents a truck with other farmers in the village to transport the vegetables to Dar es Salaam*

Location

8. Number of farms in ward:
9. Reachability (infrastructure level): *Mbigili is situated just off the main road from Iringa to Morogoro. This road has a tarmac surface and is the main road used by transporters from Zambia through Tanzania*
10. Availability of basic needs (food, water, shelter, sanitation, healthcare, education):
    - Water: *A water tap is available in the village which produces water from a well near the village. The water usually needs to be boiled in order for it to be safe for drinking. However, some people can not afford to boil the water. Food products are not washed before selling*
    - Power: *Power is available when needed, but not every household is connected to the power supply*
    - Sanitation: *There are no sewage facilities in the village. The people just throw the wastewater in pits. Garbage is also thrown in pits are fed to the animals in the village.*
    - Healthcare: *When in need of medical care she goes to a medical dispensary at 10 km from the village. The costs of treatment at this dispensary are TSH 1.000,- per visit. Sometimes the costs can not be paid.*
    - Education: *Primary and secondary education is available in the village*
    - Food availability: *People in the village eat a typical Tanzanian meal with Ugali, vegetables and meat, fish or bean stew.*

Cost structure

21. Can you estimate your income per annum in Tanzanian Shillings?: *approximately TSH 1.500.000,-*
22. Is your income sufficient to make ends meet? *The income is enough to provide for primary education for the children, food and shelter , but not enough to pay for secondary education and sometimes medical costs can not be covered.*

23. What is your approximate revenue per kind of fruit?: *Currently, for 30 kg of tomatoes TSH 1.000,- is paid during the dry season. In the dry season he produces 6000 kg. During the wet season, 3000 kg is produced and sold at a price of TSH 15.000,- per 30 kg. Annually she would have an income of TSH 1.700.000,-*
24. What is your approximate profit per kind of fruit?
25. Do you have any machinery?: *No*
26. Do you have any personnel? *No, he only employs family members who are not paid any money*
27. What other resources, than capital and labor, are needed to produce your products?
    - What are the individual costs of these resources?
    - What is the availability of the individual resources?
28. Who sells your produce?:
29. What is the market price for your produce? *At the moment (dry season) the tomatoes are sold at TSH 5.000,- per 30 kg*
30. Do your prices slump when your produce is ready for harvesting? (due to this, level of fruit spoilt at farm level) *Yes, due to large supplies to the market*

Organisation structure

11. Do you cooperate with other companies or organisations?: *The farmers do not cooperate with traders or transporters, because they do not trust each other*
12. What does this cooperation entail?: *Farmers are themselves organised in associations. This is because the government only provides training or other development aid to groups and not individuals*
13. Trough what stages does your produce go before reaching the end market? *Sells directly to market in the village or to traders or transports to market in Dar es Salaam*
14. Do you share resources (human, capital, equipment etc.)?
    7. What Resources do you share?
    8. With whom do you share these resources?
    9. How is the ownership of the specific resource organized?
15. Can you describe your attitude towards cooperation? *The farmers only trust other rural farmers and not traders or other middlemen.*

Educational/technical level

11. Are you able to read and write? *Yes, however approximately 15% of the population in the village is illiterate*
12. Can you do simple maths (add, subtract, multiply, divide)? *Yes*
13. How do you receive information concerning your business? *Radio broadcastings and through district extension officer*
14. Are you aware of government policies regarding your business? *The government helps funding for facilities such as offices for village chairman and schools if the villagers help building them. They are aware of these policies through mobile phones and the district council*
15. Do you have any technical skills? *No technical skills*

Attitude towards change

11. Can you change output depending on market demand? *Like the other farmers in the village she changes vegetable kinds depending on market demand*
12. Do you change output depending on market demand? *Last year changed to growing sweet peppers*
13. Are you willing to accept a change in routine? *Yes*
14. In the past have you made changes in business activities? (i.e. products, harvesting, conduct of business, other businesses) *Yes, changed products but harvesting methods have been the same due to lack of financial possibilities*
15. Will you be interested in producing dried fruits? *Yes, if training in producing dried fruits is provided*

Attitude towards risks

5. Have you ever made a big investment in your company? *No, it is too complicated to get a loan and the conditions of the loans are not interesting*

- How large was this investment?
- Did you need a loan for this investment?
- Where did you invest in?
- Have these investments been successful?

6. Would you invest in a project which could possibly raise your future profits?
   - o No
   - o I would be willing to invest a part of my savings
   - o I would be willing to invest all my savings
   - o I would be willing to invest all my savings and take out a small loan
   - o I would be willing to invest all my savings and take out a maximum loan

Capital

16. What is the maximum amount of money you can invest considering own recourses?
17. What is the maximum amount of money you can invest considering external resources?
18. Where would you go to get money?
19. Is it possible for you to get a loan?
    - Have you ever taken out a loan?
      - Why did you take out this loan?
      - Did you invest the total amount of this loan on the initial purpose?
      - Where did you get this loan?
      - How much?
    - What will be the interest rate?
    - What will be the pay back period of the loan?
20. What are the criteria to get a loan? (business plan…)

Specific dried fruit knowledge

22. Have you ever heard of dried fruit? *No, but aware of dried vegetables*
23. Do you know about possible benefits or disadvantages of producing dried fruits? *Yes, aware of conservation possibilities, because a project with a solar dryer was in the village, however this project has stopped.*
24. Do you know which fruit kinds are used for dried fruit products? *No*
25. Do you know how it can be produced? *No*
26. Are you aware of any hygienic issues when handling fruit? *No*
27. Do you know in what other products dried fruits are used? *No*
28. Have you ever received training in preparing fresh fruit for drying? *No*

Interview Rural Farmer Iringa (8)

Interview Details

8. Place: *Iringa region, Mbigili village*

9. Date: *September 11th 2006*

Interviewee Details

28. Name: *Julian*

29. Level of education: *primary education*

30. Sources of income: *Growing vegetables only*

31. Number of people dependent on income farm?: *9 persons including himself*

32. What crops are produced?: *Vegetables only*

33. What kind of vegetables are produced?: *Sweet peppers, tomatoes, garlic and maize*

34. What is the dependency of the fruit crops (estimate percentage of fruits to total quantity crop output and financial output)

35. In which quantities are each fruit produced per annum?: *approximately 9000 kg in 2 harvesting periods per year*

36. To whom do you sell your fruits?: *Either sells to traders (middlemen) who come to the village or rents a truck with other farmers in the village to transport the vegetables to Dar es Salaam*

Location

11. Number of farms in ward:
12. Reachability (infrastructure level): *Mbigili is situated just off the main road from Iringa to Morogoro. This road has a tarmac surface and is the main road used by transporters from Zambia through Tanzania*
13. Availability of basic needs (food, water, shelter, sanitation, healthcare, education):
    - Water: *A water tap is available in the village which produces water from a well near the village. The water usually needs to be boiled in order for it to be safe for drinking. However, some people can not afford to boil the water. Food products are not washed before selling*
    - Power: *Power is available when needed, but not every household is connected to the power supply*
    - Sanitation: *There are no sewage facilities in the village. The people just throw the wastewater in pits. Garbage is also thrown in pits are fed to the animals in the village.*
    - Healthcare: *When in need of medical care he goes to a medical dispensary at 10 km from the village. The costs of treatment at this dispensary are TSH 1.000,- per visit. Sometimes the costs can not be paid.*
    - Education: *Primary and secondary education is available in the village*
    - Food availability: *People in the village eat a typical Tanzanian meal with Ugali, vegetables and meat, fish or bean stew.*

Cost structure

31. Can you estimate your income per annum in Tanzanian Shillings?: *approximately TSH 1.250.000,-*
32. Is your income sufficient to make ends meet? *The income is enough to provide for primary education for the children, food and shelter , but not enough to pay for secondary education and sometimes medical costs can not be covered.*

33. What is your approximate revenue per kind of fruit?: *Currently, for 30 kg of tomatoes TSH 1.000,- is paid during the dry season. In the dry season he produces 6000 kg. During the wet season, 3000 kg is produced and sold at a price of TSH 15.000,- per 30 kg. Annually he would have an income of TSH 1.700.000,-*
34. What is your approximate profit per kind of fruit?
35. Do you have any machinery?: *No*
36. Do you have any personnel? *No, he only employs family members who are not paid any money*
37. What other resources, than capital and labor, are needed to produce your products?
    - What are the individual costs of these resources?
    - What is the availability of the individual resources?
38. Who sells your produce?:
39. What is the market price for your produce? *At the moment (dry season) the tomatoes are sold at TSH 5.000,- per 30 kg*
40. Do your prices slump when your produce is ready for harvesting? (due to this, level of fruit spoilt at farm level) *Yes, due to large supplies to the market*

Organisation structure

16. Do you cooperate with other companies or organisations?: *The farmers do not cooperate with traders or transporters, because they do not trust each other*
17. What does this cooperation entail?: *Farmers are themselves organised in associations. This is because the government only provides training or other development aid to groups and not individuals*
18. Trough what stages does your produce go before reaching the end market? *Sells directly to market in the village or to traders or transports to market in Dar es Salaam*
19. Do you share resources (human, capital, equipment etc.)?
    10. What Resources do you share?
    11. With whom do you share these resources?
    12. How is the ownership of the specific resource organized?
20. Can you describe your attitude towards cooperation? *The farmers only trust other rural farmers and not traders or other middlemen.*

Educational/technical level

16. Are you able to read and write? *Yes, however approximately 15% of the population in the village is illiterate*
17. Can you do simple maths (add, subtract, multiply, divide)? *Yes*
18. How do you receive information concerning your business? *Radio broadcastings and through district extension officer*
19. Are you aware of government policies regarding your business? *The government helps funding for facilities such as offices for village chairman and schools if the villagers help building them. They are aware of these policies through mobile phones and the district council*
20. Do you have any technical skills? *No technical skills*

Attitude towards change

16. Can you change output depending on market demand? *Like the other farmers in the village she changes vegetable kinds depending on market demand*
17. Do you change output depending on market demand? *Last year changed to growing sweet peppers*
18. Are you willing to accept a change in routine? *Yes*
19. In the past have you made changes in business activities? (i.e. products, harvesting, conduct of business, other businesses) *Yes, changed products but harvesting methods have been the same due to lack of financial possibilities*
20. Will you be interested in producing dried fruits? *Yes, if training in producing dried fruits is provided*

Attitude towards risks

7. Have you ever made a big investment in your company? *No, it is too complicated to get a loan and the conditions of the loans are not interesting*
   - How large was this investment?
   - Did you need a loan for this investment?
   - Where did you invest in?
   - Have these investments been successful?
8. Would you invest in a project which could possibly raise your future profits?
   - o No
   - o I would be willing to invest a part of my savings
   - o I would be willing to invest all my savings
   - o I would be willing to invest all my savings and take out a small loan
   - o I would be willing to invest all my savings and take out a maximum loan

Capital

21. What is the maximum amount of money you can invest considering own recourses?
22. What is the maximum amount of money you can invest considering external resources?
23. Where would you go to get money?
24. Is it possible for you to get a loan?
    - Have you ever taken out a loan?
      - Why did you take out this loan?
      - Did you invest the total amount of this loan on the initial purpose?
      - Where did you get this loan?
      - How much?
    - What will be the interest rate?
    - What will be the pay back period of the loan?
25. What are the criteria to get a loan? (business plan…)

Specific dried fruit knowledge

29. Have you ever heard of dried fruit? *No, but aware of dried vegetables*
30. Do you know about possible benefits or disadvantages of producing dried fruits? *Yes, aware of conservation possibilities, because a project with a solar dryer was in the village, however this project has stopped.*
31. Do you know which fruit kinds are used for dried fruit products? *No*
32. Do you know how it can be produced? *No*
33. Are you aware of any hygienic issues when handling fruit? *No*
34. Do you know in what other products dried fruits are used? *No*
35. Have you ever received training in preparing fresh fruit for drying? *No*

Interview Rural Farmer Iringa (9)

Interview Details

10. Place: *Iringa region, Mbigili village*

11. Date: *September 11th 2006*

Interviewee Details

37. Name: *Alois*

38. Level of education: *primary education and secondary education*

39. Sources of income: *Growing vegetables only*

40. Number of people dependent on income farm?: 6 *persons including himself*

41. What crops are produced?: *Vegetables only*

42. What kind of vegetables are produced?: *Sweet peppers, tomatoes, garlic and maize*

43. What is the dependency of the fruit crops (estimate percentage of fruits to total quantity crop output and financial output)

44. In which quantities are each fruit produced per annum?: *approximately 9000 kg in 2 harvesting periods per year*

45. To whom do you sell your fruits?: *Either sells to traders (middlemen) who come to the village or rents a truck with other farmers in the village to transport the vegetables to Dar es Salaam*

Location

14. Number of farms in ward:
15. Reachability (infrastructure level): *Mbigili is situated just off the main road from Iringa to Morogoro. This road has a tarmac surface and is the main road used by transporters from Zambia through Tanzania*
16. Availability of basic needs (food, water, shelter, sanitation, healthcare, education):
    - Water: *A water tap is available in the village which produces water from a well near the village. The water usually needs to be boiled in order for it to be safe for drinking. However, some people can not afford to boil the water. Food products are not washed before selling*
    - Power: *Power is available when needed, but not every household is connected to the power supply*
    - Sanitation: *There are no sewage facilities in the village. The people just throw the wastewater in pits. Garbage is also thrown in pits are fed to the animals in the village.*
    - Healthcare: *When in need of medical care he goes to a medical dispensary at 10 km from the village. The costs of treatment at this dispensary are TSH 1.000,- per visit. Sometimes the costs can not be paid.*
    - Education: *Primary and secondary education is available in the village*
    - Food availability: *People in the village eat a typical Tanzanian meal with Ugali, vegetables and meat, fish or bean stew.*

Cost structure

41. Can you estimate your income per annum in Tanzanian Shillings?: *approximately TSH 1.300.000,-*
42. Is your income sufficient to make ends meet? *The income is enough to provide for primary education for the children, food and shelter, but not enough to pay for secondary education and sometimes medical costs can not be covered.*

43. What is your approximate revenue per kind of fruit?: *Currently, for 30 kg of tomatoes TSH 1.000,- is paid during the dry season. In the dry season he produces 6000 kg. During the wet season, 3000 kg is produced and sold at a price of TSH 15.000,- per 30 kg. Annually he would have an income of TSH 1.700.000,-*
44. What is your approximate profit per kind of fruit?
45. Do you have any machinery?: *No*
46. Do you have any personnel? *No, he only employs family members who are not paid any money*
47. What other resources, than capital and labor, are needed to produce your products?
    - What are the individual costs of these resources?
    - What is the availability of the individual resources?
48. Who sells your produce?:
49. What is the market price for your produce? *At the moment (dry season) the tomatoes are sold at TSH 5.000,- per 30 kg*
50. Do your prices slump when your produce is ready for harvesting? (due to this, level of fruit spoilt at farm level) *Yes, due to large supplies to the market*

Organisation structure

21. Do you cooperate with other companies or organisations?: *The farmers do not cooperate with traders or transporters, because they do not trust each other*
22. What does this cooperation entail?: *Farmers are themselves organised in associations. This is because the government only provides training or other development aid to groups and not individuals*
23. Trough what stages does your produce go before reaching the end market? *Sells directly to market in the village or to traders or transports to market in Dar es Salaam*
24. Do you share resources (human, capital, equipment etc.)?
    13. What Resources do you share?
    14. With whom do you share these resources?
    15. How is the ownership of the specific resource organized?
25. Can you describe your attitude towards cooperation? *The farmers only trust other rural farmers and not traders or other middlemen.*

Educational/technical level

21. Are you able to read and write? *Yes, however approximately 15% of the population in the village is illiterate*
22. Can you do simple maths (add, subtract, multiply, divide)? *Yes*
23. How do you receive information concerning your business? *Radio broadcastings and through district extension officer*
24. Are you aware of government policies regarding your business? *The government helps funding for facilities such as offices for village chairman and schools if the villagers help building them. They are aware of these policies through mobile phones and the district council*
25. Do you have any technical skills? *No technical skills*

Attitude towards change

21. Can you change output depending on market demand? *Like the other farmers in the village she changes vegetable kinds depending on market demand*
22. Do you change output depending on market demand? *Last year changed to growing sweet peppers*
23. Are you willing to accept a change in routine? *Yes*
24. In the past have you made changes in business activities? (i.e. products, harvesting, conduct of business, other businesses) *Yes, changed products but harvesting methods have been the same due to lack of financial possibilities*
25. Will you be interested in producing dried fruits? *Yes, if training in producing dried fruits is provided*

Attitude towards risks

9. Have you ever made a big investment in your company? *No, it is too complicated to get a loan and the conditions of the loans are not interesting*
   - How large was this investment?
   - Did you need a loan for this investment?
   - Where did you invest in?
   - Have these investments been successful?
10. Would you invest in a project which could possibly raise your future profits?
    - o No
    - o I would be willing to invest a part of my savings
    - o I would be willing to invest all my savings
    - o I would be willing to invest all my savings and take out a small loan
    - o I would be willing to invest all my savings and take out a maximum loan

Capital

26. What is the maximum amount of money you can invest considering own recourses?
27. What is the maximum amount of money you can invest considering external resources?
28. Where would you go to get money?
29. Is it possible for you to get a loan?
    - Have you ever taken out a loan?
      - Why did you take out this loan?
      - Did you invest the total amount of this loan on the initial purpose?
      - Where did you get this loan?
      - How much?
    - What will be the interest rate?
    - What will be the pay back period of the loan?
30. What are the criteria to get a loan? (business plan…)

Specific dried fruit knowledge

36. Have you ever heard of dried fruit? *No, but aware of dried vegetables*
37. Do you know about possible benefits or disadvantages of producing dried fruits? *Yes, aware of conservation possibilities, because a project with a solar dryer was in the village, however this project has stopped.*
38. Do you know which fruit kinds are used for dried fruit products? *No*
39. Do you know how it can be produced? *No*
40. Are you aware of any hygienic issues when handling fruit? *No*
41. Do you know in what other products dried fruits are used? *No*
42. Have you ever received training in preparing fresh fruit for drying? *No*

Interview Rural Farmer Iringa (10)

Interview Details

12. Place: *Iringa region, Mbigili village*

13. Date: *September 11th 2006*

Interviewee Details

46. Name: *Alex*

47. Level of education: *primary education and secondary education*

48. Sources of income: *Growing vegetables only*

49. Number of people dependent on income farm?: 6 *persons including himself*

50. What crops are produced?: *Vegetables only*

51. What kind of vegetables are produced?: *Sweet peppers, tomatoes, garlic and maize*

52. What is the dependency of the fruit crops (estimate percentage of fruits to total quantity crop output and financial output)

53. In which quantities are each fruit produced per annum?: *approximately 9000 kg in 2 harvesting periods per year*

54. To whom do you sell your fruits?: *Either sells to traders (middlemen) who come to the village or rents a truck with other farmers in the village to transport the vegetables to Dar es Salaam*

Location

17. Number of farms in ward:
18. Reachability (infrastructure level): *Mbigili is situated just off the main road from Iringa to Morogoro. This road has a tarmac surface and is the main road used by transporters from Zambia through Tanzania*
19. Availability of basic needs (food, water, shelter, sanitation, healthcare, education):
    - Water: *A water tap is available in the village which produces water from a well near the village. The water usually needs to be boiled in order for it to be safe for drinking. However, some people can not afford to boil the water. Food products are not washed before selling*
    - Power: *Power is available when needed, but not every household is connected to the power supply*
    - Sanitation: *There are no sewage facilities in the village. The people just throw the wastewater in pits. Garbage is also thrown in pits are fed to the animals in the village.*
    - Healthcare: *When in need of medical care he goes to a medical dispensary at 10 km from the village. The costs of treatment at this dispensary are TSH 1.000,- per visit. Sometimes the costs can not be paid.*
    - Education: *Primary and secondary education is available in the village*
    - Food availability: *People in the village eat a typical Tanzanian meal with Ugali, vegetables and meat, fish or bean stew.*

Cost structure

51. Can you estimate your income per annum in Tanzanian Shillings?: *approximately TSH 1.000.000,-*
52. Is your income sufficient to make ends meet? *The income is enough to provide for primary education for the children, food and shelter, but not enough to pay for secondary education and sometimes medical costs can not be covered.*

53. What is your approximate revenue per kind of fruit?: *Currently, for 30 kg of tomatoes TSH 1.000,- is paid during the dry season. In the dry season he produces 6000 kg. During the wet season, 3000 kg is produced and sold at a price of TSH 15.000,- per 30 kg. Annually he would have an income of TSH 1.700.000,-*
54. What is your approximate profit per kind of fruit?
55. Do you have any machinery?: *No*
56. Do you have any personnel? *No, he only employs family members who are not paid any money*
57. What other resources, than capital and labor, are needed to produce your products?
    - What are the individual costs of these resources?
    - What is the availability of the individual resources?
58. Who sells your produce?:
59. What is the market price for your produce? *At the moment (dry season) the tomatoes are sold at TSH 5.000,- per 30 kg*
60. Do your prices slump when your produce is ready for harvesting? (due to this, level of fruit spoilt at farm level) *Yes, due to large supplies to the market*

Organisation structure

26. Do you cooperate with other companies or organisations?: *The farmers do not cooperate with traders or transporters, because they do not trust each other*
27. What does this cooperation entail?: *Farmers are themselves organised in associations. This is because the government only provides training or other development aid to groups and not individuals*
28. Trough what stages does your produce go before reaching the end market? *Sells directly to market in the village or to traders or transports to market in Dar es Salaam*
29. Do you share resources (human, capital, equipment etc.)?
    16. What Resources do you share?
    17. With whom do you share these resources?
    18. How is the ownership of the specific resource organized?
30. Can you describe your attitude towards cooperation? *The farmers only trust other rural farmers and not traders or other middlemen.*

Educational/technical level

26. Are you able to read and write? *Yes, however approximately 15% of the population in the village is illiterate*
27. Can you do simple maths (add, subtract, multiply, divide)? *Yes*
28. How do you receive information concerning your business? *Radio broadcastings and through district extension officer*
29. Are you aware of government policies regarding your business? *The government helps funding for facilities such as offices for village chairman and schools if the villagers help building them. They are aware of these policies through mobile phones and the district council*
30. Do you have any technical skills? *No technical skills*

Attitude towards change

26. Can you change output depending on market demand? *Like the other farmers in the village she changes vegetable kinds depending on market demand*
27. Do you change output depending on market demand? *Last year changed to growing sweet peppers*
28. Are you willing to accept a change in routine? *Yes*
29. In the past have you made changes in business activities? (i.e. products, harvesting, conduct of business, other businesses) *Yes, changed products but harvesting methods have been the same due to lack of financial possibilities*
30. Will you be interested in producing dried fruits? *Yes, if training in producing dried fruits is provided*

Attitude towards risks

11. Have you ever made a big investment in your company? *No, it is too complicated to get a loan and the conditions of the loans are not interesting*
    - How large was this investment?
    - Did you need a loan for this investment?
    - Where did you invest in?
    - Have these investments been successful?
12. Would you invest in a project which could possibly raise your future profits?
    - o No
    - o I would be willing to invest a part of my savings
    - o I would be willing to invest all my savings
    - o I would be willing to invest all my savings and take out a small loan
    - o I would be willing to invest all my savings and take out a maximum loan

Capital

31. What is the maximum amount of money you can invest considering own recourses?
32. What is the maximum amount of money you can invest considering external resources?
33. Where would you go to get money?
34. Is it possible for you to get a loan?
    - Have you ever taken out a loan?
        - Why did you take out this loan?
        - Did you invest the total amount of this loan on the initial purpose?
        - Where did you get this loan?
        - How much?
    - What will be the interest rate?
    - What will be the pay back period of the loan?
35. What are the criteria to get a loan? (business plan…)

Specific dried fruit knowledge

43. Have you ever heard of dried fruit? *No, but aware of dried vegetables*
44. Do you know about possible benefits or disadvantages of producing dried fruits? *Yes, aware of conservation possibilities, because a project with a solar dryer was in the village, however this project has stopped.*
45. Do you know which fruit kinds are used for dried fruit products? *No*
46. Do you know how it can be produced? *No*
47. Are you aware of any hygienic issues when handling fruit? *No*
48. Do you know in what other products dried fruits are used? *No*
49. Have you ever received training in preparing fresh fruit for drying? *No*

Interview Rural Farmer and leader of fruit drying women group Morogoro

Interview Details

14. Place: *Morogoro region, Ngai Ngai village*

15. Population of the village: *?*

16. Date: *September 14th 2006*

Personal details

55. Name: *Fufumbe and dries fruit since 1997*

56. What kind of fruits are dried?: *Mango, pineapple, jackfruit, banana's and vegetables*

57. Sources of income: *Only the revenue from the dried fruit products*

58. Revenue from dried fruit products: *buys 5 kg of fresh pineapples at TSH 200,-. After drying 200 grams remain and the products are packaged in plastic bags of 100 grams, which are sold at TSH 500,-. Packaging costs TSH 150,- per bag and TSH 40,- per label.*

59. To whom do you sell your products?: *Products are sold in a local shop in Morogoro*

60. Where did you get the technology?: *With the help of the University of Morogoro which cooperated with AMKA. The university paid for the materials of the machine and the difference in price between the materials and the complete solar dryer has to be paid by the farmer.*

61. What other resources do you use?: *water (which is taken from a well), TFDA-license, food processing building and a sewage system.*

62. Do your products have to comply with any food processing standards?: *No, but he brings samples of his products to the university where it is tested according to TFDA regulations (costs TSH 4000 per 100 grams)*

63. Can you estimate your income per year?: *TSH 1.260.500*

64. Does the machine require any maintenance?: *The machine requires small maintenance every 2-3 years and the visqueen plastic has been replaced 2 times since 1997*

65. Did you get any training in food processing?: *Yes, when the project started in 1997 he received training by AMKA*

66. Are there any necessary basic skills required to follow the AMKA training?: *You have to be able to read and write*

67. Are you aware of the major advantages or disadvantages of drying fruits?: *The major advantage lies in the conservational properties of dried fruits, however the quality of the dried fruits is still dependent on the weather*

68. If the fruits are not dried during the day, do you keep the fruits in the dryer over night?: *Yes*

69. Where and by who are the fruits packaged?: *The fruits are packaged by AMKA*

Interview of fruit drying women group Morogoro

Interview Details

17. Place: *Morogoro region, Kinode village*
18. Population of the village: *?*
19. Date: *September 15th 2006*

…

70. Names of people in the group: *Mkdadi, Mwanahamis, Mwajuma*
71. What kind of fruits are dried?: *Mango, pineapple, jackfruit, banana's, paw paw, spices and vegetables*
72. Quantity produced: *50 kg of dried products per year per kind of fruit*
73. Where do you get your fresh products?: *part of it is bought at the market and part of it is grown by themselves*
74. Number of people in your families dependent on your income including yourself?: *6 (Mkdadi), 5 (Mwanahamis), 4 (Mwajuma)*
75. How does your produce reach the end market?: *The products are put into plastic bags and transported to Dar es Salaam where they are sealed and sold in the super markets*
76. Is water available for you?: *Tap water is available*
77. Do you have access to electricity?: *None of the households is connected to electricity, but some people in the village have generators*
78. How do you dispose of your garbage?: *Garbage is used as fertilizer or fed to the animals and the rest is thrown in pits*
79. Are there any sewage facilities?: *No, waste water is thrown away on the streets*
80. Do you have access to healthcare?: *There is a medical dispensary available for the 22.000 people in the region, which costs TSH 100,- for consultation, but medicines have to be paid by themselves.*
81. What kind of education is available in the region?: *A primary school is available in the village and a secondary school is available in the ward.*
82. What is your estimated income per year?: *TSH 200.000,- (Mkdadi), TSH 400.000,- (Mwanahamis), TSH 350.000,- (Mwajuma)*
83. Is your income sufficient?: *No, secondary school and school materials for the children are expensive. They need at least TSH 5.000.000,- per year*
84. Which kind of fruit has the highest revenue?: *Banana's*
85. How is your group organised?: *The group is owner of the fruit dryer and as a group they receive training and buy fruits at the market that are dried.*
86. Do you hire any additional staff?: *No*
87. Do you cooperate with any other organisations?: *They cooperate with other fruit drying groups and PADEP (development organisation) about the markets and transport*

88. How do you receive information concerning your business?: *They get information from development organisations such as PADEP and SIDO about markets, training and from the government extension officer about rules, regulations and policies*

89. Is maintenance on the machine done by yourself?: *No, the group hires a carpenter to replace the visqueen and this is paid for by the government*

90. Do you change output according to demand?: *No, due the climate in the region, it is only possible to produce certain kinds of fruits. However, they are able to change quantities within these kinds of fruit.*

91. Which development organisations are present in the area and what do they do?: *WCST (they help in education), UMADEP (they provide training and advice in food processing), MVIATA*

92. What kind of training did you receive in food processing?: How to dry fruit and business administration by AMKA en hygienic water treatment.

Interview of fruit dryer user Morogoro

Company Details

93. Name: *Sinavyo*

94. Age:

95. Sources of income: *small restaurant, drying of fruits, farming (very little)*

96. Number of people dependent on income farm: *6*

97. What crops are produced:

98. What kind of fruits produced: *Dried fruits are produced; the fruit is bought from other farmers and produced by the group itself. Banana, pineapple, pawpaw, mango, vegetables, jack fruit, cassava, spinach.*

99. What is the dependency of the fruit crops (estimate percentage of fruits to total quantity crop output and financial output)

100. In which quantities are each fruit produced per annum:

101. To whom do you sell your fruits? *Dried fruits are sold in shop in Morogoro, local people can't afford dried fruits.*

To pack, the dried products are transported to Dar es Salaam and packed by AMKA.

To transport the produce to Dar es Salaam, several taxi's and a bus are used, in the bus an extra seat is reserved for the dried products to transport them, total costs will be; 1.500 + 3.000 + 15.000 / 60 kg, the 60 kg is the output of 2 women groups.

Location

20. Region: Morogoro
21. Location: Ngaingai
22. Number of farms in ward:
23. Reachability (infrastructure level):
    Farm reached by *(choose what applies):*
    - Sand road
    - Gravel road

    Distance Farm to connecting tarmac road to Morogoro 40 km
24. Availability of basic needs (food, water, shelter, sanitation, healthcare, education):
    Water:
    - Water at site

    Power:
    - No power at site and no connection possibilities

    Sanitation:
    - Garbage collection, *no garbage collection, some garbage is given to the animals, but they don't have pigs (Muslim community), most of the garbage is thrown in pits.*
    - Wastewater disposal, *Throw wastewater away in the bushes.*

    Healthcare:
    - Who do you contact when in need of healthcare? *dispensary*
    - Distance to basic healthcare (medical practitioner) *15 minutes walk*
    - Can you afford the necessary healthcare? *Yes, she can afford, Costs are 100 Tsh per vist, + possible medicines she needs .*

    Education:
    - Basic Primary Education in village.
    - Secondary Education available in ward.

    Typical meal: Ugali, thee, donuts, meat and vegetables/beans, rice

Cost structure

61. Can you estimate your income per annum in Tanzanian Shillings? *600.000 Tsh*
62. Is your income sufficient to make ends meet? *Yes*
63. What is your approximate revenue per kind of fruit?
64. What is your approximate profit per kind of fruit? *The profits on dried fruits are significantly higher than profits on fresh products*
65. Do you have any machinery? *The fruitdryer (costs; 208.000 Tsh (year:2000)), no other machinery*
    Related costs -
    - *Water (1000 Tsh / month),*
    - *Packaging material,*
    - *Sealing.*

    Maintenance costs:
    - *Visqueen plastic, replaced twice (in six years)50.000Tsh per replacement*
    - *Wiremash, replacement once every 2 years, 7000 Tsh per meter, 25 meter; 175.000 Tsh per replacement*
66. Do you have any personnel? *Sometimes, for the preparation of fruits.*
    If yes, - How much? *6 – 8 people per day*
    - What is their salary? *1500 - 2000 Tsh per person per day, for family*
      1000 Tsh per person per day, other than family
67. What other resources, than capital and labor, are needed to produce your products?
    - What are the individual costs of these resources?
    - What is the availability of the individual resources?
68. Who sells your produce? *The shop in Morogoro*
69. What is the market price for your produce? *See interview mr. Mafumbe.*
70. Do your prices slump when your produce is ready for harvesting? (due to this, level of fruit spoilt at farm level)

Organisation structure

31. Do you cooperate (in any way) with *(choose what applies)*:
    - Transporters

32. What does this cooperation entail? *All the dried fruits of the village are collected and than brought to Dar es Salaam by one person, usually mr. Mafumbe.*
33. Trough what stages does your produce go before reaching the end market? *Harvesting or Buying fresh fruits, preparing them for drying (peeling, washing and cutting), drying, transporting dried products to Dar es Salaam, packaging and labelling in Dar es Salaam by Amka, transport to Morogoro, products sold to end consumer in shop.*
34. Do you share resources (human, capital, equipment etc.)? *Human resources are shared within the family.*
5. Can you describe your attitude towards cooperation? *They cooperate with other drying groups, and organisations like universities.*

Educational/technical level

1. Highest level of education?
   - Primary education
   - Electrical College
31. Are you able to read and write? *yes*
32. Can you do simple maths (add, subtract, multiply, divide)? *yes*
33. How do you receive information concerning your business? (TV, newspaper, rumours, other) *Through other villagers and extension officers.*
34. How did you become aware of the dried fruit project? UMADEP (Uluguru Mountains Development Project) told her about it.

Capital

13. Have you ever made a big investment in your company? *Yes, the dryer.*
14. Is it possible for you to get a loan? *Yes, she got a loan with the same conditions as Mr. Mafumbe, she did not get money but the machine, and has to pay back part of this.*

Specific dried fruit knowledge

50. Do you know about possible benefits or disadvantages of producing dried fruits? *No disadvantages, only maybe that she thinks the local end market is too small. Benefits, preserving fruits over a longer time.*
51. Have you ever received training in preparing fresh fruit for drying? *Her mother received training in the drying of fruits with a solar dryer, her mother taught her before she died. Her mother received her training from AMADEP.*
52. Were your fruits ever checked by an official institution like the TFDA? *No.*

Remarks:
According to the interviewee, the marketsize of dried fruits is too small, to make enough money from dried fruits alone.

Interview of rural farmer Tanga

Company Details

102. Name: *Jamari*

103. Sources of income: *Farming*

104. Number of people dependent on income farm: *6*

105. What crops are produced: *Cashew, Maize, Cassava, Oranges, Pineapple, Pawpaw.*

106. What kind of fruits produced: *Oranges, Pineapple, Pawpaw*

107. What is the dependency of the fruit crops (estimate percentage of fruits to total quantity crop output and financial output)

108. In which quantities are each fruit produced per annum: *Main crop pawpaw, 2,5 tonnes*

109. To whom do you sell your fruits? *Fruit sold in Tanga, transported by themselves by bicycle, and sold on the farm by traders also by bicycle.*

Location

25. Region: *Tanga district*
26. Location: *Manzara*
27. Number of farms in ward:
28. Reachability (infrastructure level):
    Farm reached by*: Very narrow dirt track, created by pedestrians and bicycles, a jeep can pass but with trouble, uses the sides of the track instead of the track itself, always impassable for trucks and impassable for jeeps during wet season.*
    Distance Farm to connecting road: *35 km, connecting road is the gravel road from Tanga to Mombassa (Kenya).*
29. Availability of basic needs (food, water, shelter, sanitation, healthcare, education):
    Water *(choose what applies)*:
        No Water at site
        Source of water *well, only salt water, not fit for drinking but. Tap water is sold in jerry cans, from the village on the Mombassa road that has tap water points.*
    Power *(choose what applies)*:
        No power at site and no connection possibilities
    Sanitation *(choose what applies)*:
        Garbage collection: *Not available*
        Wastewater disposal: *Not available*
    Healthcare:
        - Who do you contact when in need of healthcare? *The Dispensary*
        - Distance to basic healthcare (medical practitioner *9* km
        - Can you afford the necessary healthcare? *A small fixed amount is paid per year*
    Education:
        - Basic Education at *7* km
        - Secondary Education at *9* km

Cost structure

71. Can you estimate your income per annum in Tanzanian Shillings? *It is too difficult to estimate income per year because of big fluctuations in income. He can estimate the average price for a pawpaw which is TSH 50.*
72. Is your income sufficient to make ends meet? *The income per annum proves to be insufficient*
73. What is your approximate revenue per kind of fruit? *See 1*
74. What is your approximate profit per kind of fruit?
75. Do you have any machinery? *No*
    If yes, - what kind?
    - what are the costs?
        - purchase price
        - Running
        - Maintenance
76. Do you have any personnel? *Sometimes during busy harvesting periods*
    If yes, - How much?
    - What is their salary? *Tsh 500/day*
    - How many hours do they work per week?
    - How many weeks per year?
77. What other resources, than capital and labor, are needed to produce your products? *No other resources*
    - What are the individual costs of these resources?
    - What is the availability of the individual resources?
78. Who sells your produce? *Traders*
79. What is the market price for your produce?
80. Do your prices slump when your produce is ready for harvesting? (due to this, level of fruit spoilt at farm level) *Yes, prices fluctuate, and a large portion (40%) is spoilt at farmlevel*

Organisation structure

35. Do you cooperate (in any way) with *(choose what applies)*: *Cooperates with other farmers*
36. What does this cooperation entail? *The government wants farmers to organize in crop specific groups, to more efficiently aim training for topics concerning this specific crop.*

37. Trough what stages does your produce go before reaching the end market?
38. Do you share resources (human, capital, equipment etc.)? *No*
    19. What Resources do you share?
    20. With whom do you share these resources?
    21. How is the ownership of the specific resource organized?
5. Can you describe your attitude towards cooperation?

Educational/technical level

2. What is your highest level of education: *Primary education*
35. Are you able to read and write? *Yes*
36. Can you do simple maths (add, subtract, multiply, divide)? *Yes*
37. How do you receive information concerning your business? (TV, newspaper, rumours, other) *Through agricultural extension officer*
38. Are you aware of government policies regarding your business?
    - Which policies?
    - What do they imply?
    - Do you implement them?
    - How did you become aware of these policies?
39. Do you have any technical skills? *He is an electrician*

Attitude towards change

31. Can you change output depending on market demand? *Yes*
32. Do you change output depending on market demand? *Yes, they have changed crops before*
33. Are you willing to accept a change in routine? *Yes*
34. In the past have you made changes in business activities? (i.e. products, harvesting, conduct of business, other businesses) *Nothing besides crop changes*
35. Will you be interested in producing dried fruits? *Yes*

Attitude towards risks

15. Have you ever made a big investment in your company? *No, never taken out a loan and never heard of conditions that are connected to a loan.*
    - How large was this investment?
    - Did you need a loan for this investment?
    - Where did you invest in?
    - Have these investments been successful?
16. Would you invest in a project which could possibly raise your future profits? *Yes*
    - No
    - I would be willing to invest a part of my savings
    - I would be willing to invest all my savings
    - I would be willing to invest all my savings and take out a small loan
    - I would be willing to invest all my savings and take out a maximum loan

Capital

36. What is the maximum amount of money you can invest considering own recourses?
37. What is the maximum amount of money you can invest considering external resources?
38. Where would you go to get money?
39. Is it possible for you to get a loan?
    - Have you ever taken out a loan?
        - Why did you take out this loan?
        - Did you invest the total amount of this loan on the initial purpose?
        - Where did you get this loan?
        - How much?
    - What will be the interest rate?
    - What will be the pay back period of the loan?
40. What are the criteria to get a loan? (business plan…)

Specific dried fruit knowledge

53. Have you ever heard of dried fruit? *No, heard of drying in open air for own consumption, but not with machinery for commercial production*
54. Do you know about possible benefits or disadvantages of producing dried fruits? *No*
55. Do you know which fruit kinds are used for dried fruit products?
56. Do you know how it can be produced?
57. Are you aware of any hygienic issues when handling fruit?
58. Do you know in what other products dried fruits are used?
59. Have you ever received training in preparing fresh fruit for drying?

Interview National Microfinance Bank in Dar es Salaam

Interview details:
Name: *Bas Nierop*
Job description: *Chief Commercial Officer*
Date: *10/10/2006*

Procedure
Do you categorize businesses? *Every credit case is judged individually, factors like business structure, kredietwaardigheid afnemers, play an important role. The amount of capital owned by the business is also an important factor. Weken met zogenaamde warehouse receipt system http://www.nri.org/projects/wrs/tanzania.htm*

- On what criteria do you categorize businesses? *See above*
- Do you have different credit conditions for these categories? *Yes, judged per case*
    - What are these conditions?
    - What are the different interest rates for different businesses?

How can you apply for a loan as a beginning entrepreneur*? (Criteria for credit)

- What is the maximum amount a beginning entrepreneur can receive?
- On what criteria do you base this amount? (Business plan….)
- What are the conditions? (Interest, pay back period…etc.)

How can rural farmers at subsistence level** apply for a loan? (Criteria for credit)

- What is the maximum amount a rural farmer at subsistence level can receive? *Cases are judged individually, very small loans are distributed from the NMB to individuals by NGO's like PRIDE, because they can work more efficient than a large bank like NMB.*
- On what criteria do you base this amount? (Crops, amount of land, business plan…..)
- What are the conditions?

** Recently graduated student with a Bsc degree, with no relevant working experience.*
*** Very small scale family or one man run farms, generating a small income and no savings, survive because thy can live of own produce.*

Risk aversion
Do you consider it a risk to give loans to farmers at subsistence level? *This depends on the organization structure of the farmers and the number of important (trustworthy, capital powerful) players in the farmers network. For example when farmers are organized in solid organized cooperations and can have guaranteed buyers of their crops, risks for the NMB are lowered considerably. This of course has a positive influence on the loan criteria for these individuals. Another problem with rural farmers is that they are not familiar with the concept of loans, problems are that they see it as a gift and are not aware of facts like interest and that they have to pay back the lend amount.*

- What concrete measures are taken to control risks in giving loans to investors at subsistence level? *The NMB assists in creating solid cooperation structures among farmers. And has already done so with tobacco, coffee and sugarcane farmers. A big advantage for these farmers is a big and solid industry that processes there crops, this in contradiction to the rural fruit farmers which sell their crops individually to small middlemen.*

Are there different conditions on which you provide credit to different businesses?
Do you monitor businesses in order for you to control risks?

- What businesses do you monitor?
- How do you monitor these businesses?

Do you stimulate people to form certain business structures to control risk? *Yes, cooperations, which are structured in a solid way. The NMB creates cooperations important factors are; voting power, a smaller farmer should have less power then a big farmer (more capital in the cooperation = more power). A cooperation should run "lean and mean", meaning that it should be non (or almost non) profit, and always considering the best solution for the farmers, the money that flows into the cooperation should flow to the farmers, only deducted by the amount of money needed to run the cooperation. In order to create some capital power for the cooperation all participating farmers should pay a certain amount of money, and let this capital grow by for example a 1% tax on crop output, in this way the power of the cooperation will grow steadily. (this structure is comparable to the Dutch*

Boerenleenbank (Rabobank) system, which started out as a cooperation between farmers, and is now one of the largest banks of The Netherlands, and a big shareholder in the NMB)

Projects

Do you cooperate with developing organizations in certain projects?

- Which developing organizations?
- In what kind of projects are you involved?
- What is your organizations part in these projects?

Is there a difference in loan conditions when, a loan is needed by "high risk lenders"*, for a project that is backed up by a renowned institution (like UDSM)?

- If yes, what are the differences in these conditions?
- What parameters do you use to judge if a project has potential?

**In this case beginning Entrepreneurs and rural farmers at subsistence level.*

Information

How do you contact your potential customers?

Do you also contact customers in rural areas?

- How do you contact this group? (offices in rural areas, visits agricultural centers, plan village meetings)

Actor Network

Do you receive government support in giving loans to farmers at subsistence level?

- What does this support entail?

Do you receive support in giving loans to farmers at subsistence level from other organizations?

- Who are these organizations?
- What does this support entail?

Does your organization cooperate with other organizations?

- Who are these organizations?
- What does this cooperation entail?

Remarks:

According to Bas Nierop of the NMB, the concept of individual dryers for farmers is "doomed to fail", and therefore the NMB would not provide credit to the initial project plan of the UDSM. Only when farmers are organized in a group (cooperation) and have big reliable buyers of their crops, credit for this project can be provided.

Questionnaire SIDO Dar es Salaam

Date: 13/10/2006

Interviewee
Name: *Linus C. Gedi*
Job Title: *Agro-Food Specialist*

"SIDO works with so called micro's, people who have small income without proper education. They offer, among others, skills training in food processing and entrepreneurship. Then they can start their own business, and can grow along the way."

Programs regarding rural farming

1. Does your organization have experiences with investors who live at subsistence level? *Microcredit is offered by Tanzania Gatsby trust for foodprocessing (UN, TAFU), Micro credits are financed by government funds (NEDF). Criteria;22-26% interest payback period 6 months – 2 years.*
2. Does your organization support group formation among rural farmers? *SIDO does support group formation among farmers*
    - What criteria do you use to form these groups? *Group formation per crop*
    - What is the goal of group formation among rural farmers? *To facilitate more efficient training*

Programs regarding small entrepreneurs (machine builders)

1. When does an innovative entrepreneur qualify for the incubator program? *When an entrepreneur wants to try real new innovative ideas, this is judged per case by SIDO.*
    - Does a producer of the fruit drying machine qualify for the incubator program? *Basically yes.*
2. What resources can you make available for small entrepreneurs, regarding capital and labor? *The incubator program will provide the entrepreneur with space, advice (technical, marketing and financial), promotion (marketing, by for example taking the entrepreneurs to events where they can display their produce)*
3. What does the, in the incubator program described, access to financial services entail? *Micro credit possibilities financed by NEDF.*
4. What does the, in the incubator program described, marketing facilitation entail? *See 2*
5. What specific support can your organization offer in developing rural agricultural machinery? *They can provide an entrepreneur with specific technical knowledge, information, and technical advice, given by engineers that are working for SIDO.*
6. What other development institutions can assist in rural agricultural machinery development? *There are numerous organizations in Tanzania that deal with entrepreneurship development, technical assistance and micro credit, but SIDO is the only organization which offers these facilities in one "package".*
7. The offered technical assistance, in the incubator program, is this assistance with: *see 5*
    - machinery,
    - knowledge,
    - Other types of assistance, namely……...
8. What criteria do you consider to be important when defining a successful entrepreneur? *Clear concept about business, clear goals. The incubator might have a set of specific criteria, but the interviewee is not aware of them.*
9. Are you aware of any programs where an entrepreneur will run a machine for an entire population? *There is a successful cooperation structure with a fruit dryer among farmers in the Tanga region.*

WED program

1. Among other things, this program is focused at poverty alleviation, how do you measure this? *They adopted the definition stated by the World bank in their development goals, $1 per day, food, clean water, shelter, medication.*
2. How does your organization define the poverty line? *See 1*

Cooperation

1. Does your organization cooperate with other organizations? *Yes, among others with UNIDO*
2. Which organization do you cooperate with? *See 1*

Solar Drying SIDO

AMKA is not part of SIDO, although they did cooperate in the Solar drying project.

1. What does the training program for solar drying entail?
   - *Food hygiene (HACCP standard)*
   - *Food processing*
   - *Food safety*

   They use simple dryers , with wooden frames wire mash trays and visqueen plastic, SIDO has these materials in stock.
2. What topics are considered in the solar drying training of rural farmers? *See1*
3. What course material do you use? *The courses are based on the NRI manuals, this UK manual is adapted for Tanzania by SIDO according to their own views.*
4. What methods of training do you use: *the training is practical as well as theoretical*
5. Is it necessary to be literate, to participate in the training program? *Yes, primary education is sufficient*
6. Is it necessary to be capable of doing simple math, to participate in the training program? *yes*
7. Are the potential fruit drying groups contacted by SIDO? *Regions inform the rural areas about the possibilities offered by SIDO, but it is also possible for people to contact SIDO themselves.*
8. Does the dried fruit produce meet any standards? *According to the interviewee some dried products are tested by the TFDA and met their standards*
9. Was the produce ever tested by food quality institutions, like the TFDA? *Yes, see 8*

Packaging

1. What is the price of the machine you use for the packaging of dried fruits?
2. What material do you use to pack the dried fruits? *PET (50 Tsh per bag including labeling)*
   - Why do you use this specific material?
3. What are the costs of packaging? *See 2*
4. What are the costs of labeling? *See 2*

Dryer

1. What are the costs of the dryer? *Depends on the size of the dryer, smallest and cheapest is Tsh 200.000,- this dryer has a batch size of 20kg of fresh fruit.*
2. Did you ever execute a market research for the Solar Dryer?
3. Does the machine comply with any standards? *The machine or the production area of the dried fruits in the SIDO projects do not comply with the standards for dried fruit processing defined by the WHO, but according to the interviewee, this cannot be a constrain, because of the different circumstances in the rural areas. (doubtful JD.)*
4. Are there special credit facilities for farmers who want to buy a dryer?

Interview AMKA Dar es Salaam

30/10/2006

L. Muze
Ag. General Manager of Kwanza Collection co. ltd

- AMKA was involved with the construction of solar dryers and linking its products to the (national) market, they train the drying itself, maintenance, selling and costing and involve local carpenters in the building process so that they are able to construct a solar dryer themselves.
- The AMKA project stopped because of the sponsor (APT, a UK NGO) pulled out of the project, because of "internal problems" (Dr. Njau pointed out that ATP pulled out because of mismanagement of AMKA).
- Kwanza (among other things) was concerned with the trading of the dried fruit products.
- AMKA was the organization that introduced the technology for the solar dryer in Tanzania in 1999, after visiting a trade fare in the UK, where dried fruits were displayed, they got in contact with an organization called tropical fruits sponsored by NRI, which have a similar very successful project in Uganda (fruits of the Nile).
- The project was mainly aimed at individual rural farmers.
- The project is still running in Moshi, where there is a centrally located packaging facility.
- The value added of the dried fruit produce, to fresh fruits, is substantial, but the figures were outdated so he was not able to, and did not, show us the exact value added.
- Dryers were given to rural farmers as a loan, and the pay back period was adjusted to the time it takes to make money out of the machine. There is no interest rate.
- The dryers were sold for Tsh 350.000,- , for a big one, and Tsh 150.000,- , for a small one.
- The machine or the produce did not comply to any standards, this would raise costs, and they were aiming at serving the local market and not at exports. Exports were to come in at the second part of the project, after they have build up their capabilities in fruit drying.
- A problem with many NGO supported projects is that the given money creates inefficiency, for successful and sustainable implementation the project should be aimed at making profits from day 1.
- The idea of centrally located food processing plants, was approved of, a key for success according to the interviewee is ownership, the plant should be community owned by the rural farmers, to create sustainable commitment (This backs up the cooperation idea from Nierop (NMB) and the possible delivering problems mentioned by Osman (TDTC))
- The interviewee agrees with the by the NMB mentioned problem of individual loan management, and agrees that it is easier to manage one big loan than a 100 very small loans (for example the costs made to trace a lender, could be higher then the loan itself). The interviewee does point to the strong social control in rural areas which makes it difficult for people to hide, it also creates good possibilities to give out group loans because than the social control within this group will be even stronger.
- AMKA is not a part of SIDO, they do rent their property from them, collaborate in certain projects and visit SIDO trade fares.

Interview Ministry of Agriculture Dar es Salaam

Date: 18/10/2006

Name: Mr. Mtambo
Job description: Director Post harvest management Services

- When you want to produce a small scale solar dryer for rural farmers the max. price according to Mr. Mtambo, is estimated at Tsh 250.000
- The ministry of agriculture (MA) already builds dryers for community use, but has difficulties with organizing the users. These Dryers are placed in a central location and people are free to use them (no ownership).
- An important aspect when you want to export is the traceability of the produce, this is a big challenge because of the current organization structure of the farmers.
- The MA gives training to rural farmers and trainers of trainers (TOT's), the MA produces training manuals for food processing, packaging…etc. But faces difficulties in efficiency because the rural farmers are decentralized. The idea of centralized food processing plants is seen as a possible solution to undermine this inefficiency.
- The government has no specific subsidies or policies regarding rural farmers.
- A policy that could be interesting for our project is that processing materials for poverty elevation are not taxed.
- In Ghana a project with hydrate machines is running, these machines are Canadian made, and very expensive, but can dry very large batches of fruit of a constant and good quality, Mr. Matambo does not know if this project was successful.
- There is a project in Muheza in the Tanga region executed by Tirdo (after visiting this centralized dryer, we established that this project is run by SIDO in cooperation with the UN), with a big centralized solar dryer.

Interview TDTC University of Dar es Salaam

Date: 17/10/2006

Mr. Osman

- TASAF reserved 1 billion Tsh for small entrepreneurs
- Mango and Pineapple most popular dried products
- The European market for dried fruits is mainly supplied by south east Asian countries like, Thailand Vietnam and the Philippines
- The market for dried fruits in north America is not that busy jet and so there is potential for market access in that region
- Canada already showed interest and delivered a proposal for dried fruit supply to that region, this offer is available at the majors office, City council office
- According to Osman;
    - Proposed solution by us: central drying is a possible solution (farmers sell their fresh produce to a central located food processing plant, there it is dried and packed according to relevant standards, in a secure and hygienic surrounding by qualified people, these food processing plants should be attached to an umbrella organization, which has a contract with a secure buyer)

        Problems according to Osman:

        - Transport problems with fresh fruits, transport by rural farmers often result in bruised and damaged low quality fruits.
        - When farmers have an "easy" and "secure" fruit buyer farmers have the tendency to raise prices. Experiences in the past showed that farmers feel deceived when they get lower prices for their produce, the fact that they will receive nothing at all when their fruits get spoiled at farm level, does not seem to be an argument.
    - Other possible solution according to Osman, is the Fruits of the Nile (Uganda) procedure, where fresh produce is dried at a small scale by rural farmers. Their dried produce is transported to a single big food processing plant, which freeze-dries and so disinfect the produce, and packed. This factory has a big UK client, which demands a certain constant output with constant quality.
- Indirect vs direct drying: Direct drying is cheap and simple and can handle big batch sizes, disadvantages are a lower quality of produce and longer drying times. Indirect drying is more expensive and can handle only small batch sizes, but dry chamber conditions can be regulated resulting in higher quality produce, and shorter drying times.
- Hohenheim dryer, a tunnel dryer, is according to Osman, a cheap and good alternative combining direct and indirect drying combining the advantages of both drying methods.
- Another interesting dryer project; Danish institute of technology, Ghana solar dryer
- Every drying entrepreneur has to comply with; TBA, TFDA, TBS, copyright law
- 4 main problems with current fruitdrying projects; lack of, technology, knowledge, capital and market access.
- The manual for solar drying training at SIDO is aimed at entrepreneurship and leaves the "all important" quality aspect out!
- PH meter is needed to measure PH level in fruits, and check if they do not exceed the stated limits
- CeOT can assist graduated students in becoming an entrepreneur in manufacturing of solar dryers.
- The shop of mr Fufumbe in Morogoro is also a cluster cooperation of organized farmers.

Interview Small & Medium Enterprise Competitiveness Facility (SCF) Dar es Salaam

Date: 19/10/2006

Name: Mr. Sambua
Job description: Manager SCF

- The organization is supported by the Danish government and operates under the Ministry of Industry and Marketing.
- Their organization deals with international trade multilateral and bilateral trade agreements, try to add value to products by post harvesting methods.
- SCF will invest in a project, when an entrepreneur has at least 2 years experience in his field, can show prove of a potential market. SCF will then look into the required standards and consumer desires in the selected potential markets (this information has SCF not on hand, but they are willing to pay for a relevant market research).
- When SCF approves of a project and decide to fund it, it will only grant 50% of the required budget, the other 50% has to be raised by the entrepreneur, other NGO funding for this 50% is not accepted, other financial support is accepted. Because when a project is feasible, other parties should be interested as well, when this is not the case the project might not be that feasible as presented to SCF. Grants can have a value of $5.000 to $30.000.
- SCF also offer funds for training and manuals, they prefer in investing in TOT's, instead in individual rural farmers, to simplify the organization structure.
- Grants that were given to similar projects like MIM an NGO that exports vegetables.
- IMO will supervise the funding by executing a pre-audit, audit and post-audit.

Interview UNIDO Dar es Salaam and Muheza

Date: 21/10/2006 & 23/10/2006

Muheza, Centralized food processing plant

Project that was sponsored by UNIDO

- Heavy duty indirect dryer, build in an existing building, with 2 large heat collectors installed on the roof.
- The batch size of the machine is 100 kg of fresh fruits
- Drying time: oranges: 15 hrs
  Vegetables: 8 hrs
- Temperature regulation within the drying chambers by thermostat
- To create extra heat a Pegasus 35 (Italian) alternative heat source was installed to create enough heat when there is insufficient sun heat.
- Heat is collected by solar, diesel. The fans in the chambers are run on electricity or diesel.
- Drying trays are made of stainless steel covered with detachable plastic wire mash

- No TBS standard, but this is currently in progress for their fruit juices, there are no national TBS standards for dried fruits.
- The products are labelled with a universal label for all products, the produce is not tracable.
- The trajectory of fresh fruits to dried products; wash, cut, wash, loaded on trays, in the dryer, weighing, packaging, sealing.
- Sufficient and good tools are available, plastic cutting boards, stainless steel trays, bakes and knives.
- Special clothing is worn, white apron, hat and shoes, after each production cycle the clothing is washed
- Produce is sold locally
- Fresh fruit is collected in woven baskets and picked up with a truck

- The costs of the project are 25,000,000 Tsh, paid by UNIDO
- The people were trained by SIDO, Soikone University and UNIDO
- When the project was started up, no external experience was consulted, so training and production were done with a trail and error method
- Training was short, and there was little to no practice training only theoretical
- When the machine breaks down there is no expert to repair the machine.
- The produce is packed and sealed in simba plastic on site.

Interview TIRDO Dar es Salaam

Date: 23/10/2006

Name: Mr. Anslem Moshi
Function: Senior Research and Development Officer

TIRDO produces direct dryers (box dryer, mixed dryer) and indirect dryers (stand alone cabinet dryer). These dryers are made available for groups of poor farmers existing of 10-15 people, TIRDO will fund 30-40% of the project, the dryer remains property of TIRDO.

TIRDO provides training in the use of their machinery.

TIRDO is a R&D organization that, among other things, does research in the field of solar dryers. Design inputs can than be given to entrepreneurs that build the machines. These entrepreneurs can use the TIRDO workshop with the necessary tools to build the machinery, for an agreed price.

The price of an average box dryer is 800,000 – 1,000,000 Tsh
The price of an indirect stand alone cabinet dryer is 1,300,000 Tsh and has a batch of 40 kg and a drying time of 3-4 hours.

According to the interviewee the products are produced according to standards set by TBS (note: TBS has no standards for solar drying)

To find suitable farmer groups for the solar drying projects TIRDO contacts extension officers that can point out suitable groups.
When a group is located a survey is executed to determine the suitability of the group
If the group shows to be suitable TIRDO starts producing the dryer and the training of the group.

TIRDO cooperates with the following actors:

- UDSM (Mr. Osman)
- MKUTUTA, poverty reduction economic growth program
- Africare

Interview Small Entrepreneurs Loan Facility (SELF) Dar es Salaam

Date: 26/10/2006

- SELF is a government organization; this organisation will distribute the funding for microfinance given by the government to local distributors of microfinance, they also check these institutions.
- Their criterion is poverty reduction.
- The interviewee could not give us any loan criteria for microfinance
- An appointment will be made to speak to the person who could inform us about the criteria for getting microfinance. Details about this meeting will be given, by SELF, on the 27th of October.

30/10/2006

- SELF did not contact us at the 27th, so we contacted SELF, they replied that they could not see the relevance of us interviewing them, and they will contact Dr Njau for further details.

Off the record;

Njau: *"SELF is a government institution, these institution often have big problems with corruption, certainly an institution like SELF that is responsible for large amounts of money that are difficult to trace. It could well be that SELF employees invest this government money in more profitable projects. The relevance of us interviewing them is quite obvious, it is crucial to know the amount of money that a rural farmer can spend on a project like ours"*

Appendix 2: Hazard Analysis and Critical Control Points (HACCP)

Hazard Analysis and Critical Control Points (HACCP) is a systematic preventative approach to food safety that addresses physical, chemical and biological hazards as a means of prevention rather than finished product inspection. HACCP is used in the food industry to identify potential food safety hazards, so that key actions, known as Critical Control Points (CCP's) can be taken to reduce or eliminate the risk of the hazards being realised. The system is used at all stages of food production and preparation processes.

The HACCP Seven Principles
HACCP is based around seven established principles.

Principle 1: Conduct a hazard analysis. Plants determine the food safety hazards identify the preventive measures the plant can apply to control these hazards.

Principle 2: Identify critical control points. A critical control point (CCP) is a point, step, or procedure in a food process at which control can be applied and, as a result, a food safety hazard can be prevented, eliminated, or reduced to an acceptable level. A food safety hazard is any biological, chemical, or physical property that may cause a food to be unsafe for human consumption.

Principle 3: Establish critical limits for each critical control point. A critical limit is the maximum or minimum value to which a physical, biological, or chemical hazard must be controlled at a critical control point to prevent, eliminate, or reduce to an acceptable level.

Principle 4: Establish critical control point monitoring requirements. Monitoring activities are necessary to ensure that the process is under control at each critical control point. In the United States, the FSIS is requiring that each monitoring procedure and its frequency be listed in the HACCP plan.

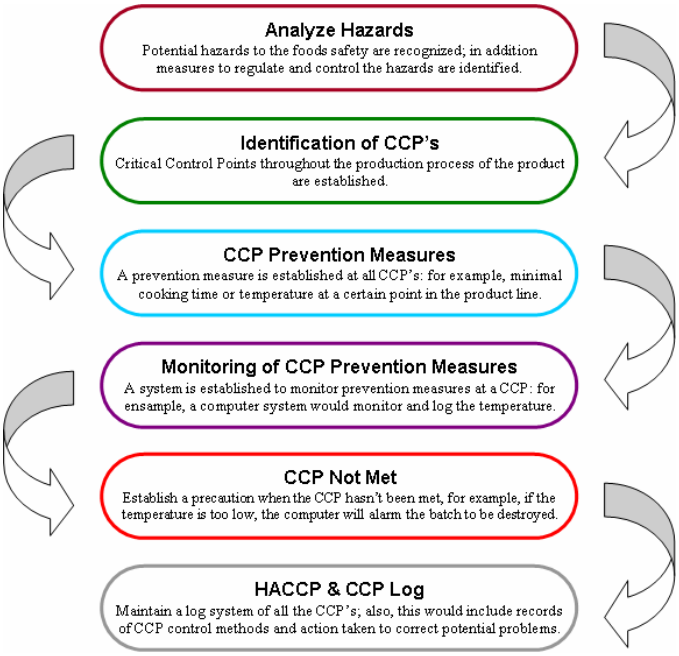
Principle 5: Establish corrective actions. These are actions to be taken when monitoring indicates a deviation from an established critical limit. The final rule requires a plant's HACCP plan to identify the corrective actions to be taken if a critical limit is not met. Corrective actions are intended to ensure that no product injurious to health or otherwise adulterated as a result of the deviation enters commerce.

Principle 6: Establish record keeping procedures. The HACCP regulation requires that allplants maintain certain documents, including its hazard analysis and written HACCP plan, and records documenting the monitoring of critical control points, critical limits, verification activities, and the handling of processing deviations.

Principle 7: Establish procedures for verifying the HACCP system is working as intended. Validation ensures that the plans do what they were designed to do; that is, they are successful in ensuring the production of safe product. Plants will be required to validate their own HACCP plans. FSIS will not approve HACCP plans in advance, but will review them for conformance with the final rule.

Verification ensures the HACCP plan is adequate, that is, working as intended. Verification procedures may include such activities as review of HACCP plans, CCP records, critical limits and microbial sampling and analysis. FSIS is requiring that the HACCP plan include verification tasks to be performed by plant personnel. Verification tasks would also be performed by FSIS inspectors. Both FSIS and industry will undertake microbial testing as one of several verification activities. the occurrence of the identified food safety hazard.

This flow diagram is representative of HACCP for the food industry; the HACCP program can be adapted for other industries as well.



Appendix 3: CBA Spread Sheets

CBA calculations Tunnel Drying in Tanga

Monetary Information:

17,0%	interest
7,0%	inflation
9,3%	real interest

Data Input for CBA calculations:

Costs of Solar Tunnel Dryer[146]:	$8.000,00
Costs of fruit preperation building[147]:	
Construction	$25.000,00
Utilities (water, electricity)	$1.200,00
Cutting table	$2.000,00
Total	**$56.400,00**
Costs fruit preparation equipment[148]:	
Cutting equipment	$3.000,00
Clothes	$2.000,00
Sealing/packaging machine	$1.800,00
Total:	**$13.600,00**
Selling price of dried fruits and vegetables per kg[149]:	
Mangos	$0,71
Oranges	$0,80
Tomatoes	$0,81
Bananas	$0,63
Casava	$0,60
Coconut	$0,68

Annual amount of fruit and vegetables produced[150]:

Mangos:	35641000	kg
Oranges:	65210000	kg
Tomatoes:	10852000	kg
Bananas:	34126000	kg
Casava:	0	kg
Coconut:	26329000	kg
Total:	**172158000**	**kg**

[146] Price based on selling price of tunnel dryers manufactured by Innotech Ingenieursgesellschaft mbH
[147] Prices based on Rockefeller funding report by the University of Dar es Salaam with 100% contingency
[148] Ibid
[149] Based on prices by Fairtrade Labelling Organizations International, 2005
[150] Ministry of Agriculture Tanzania, *National Sample Census of Agriculture 2002/2003, volume II*, Dar es Salaam

Fruit and vegetables used for drying:	0,5%	860790	kg
Weight products after preperation(50%)[151]:		430395	kg
Weight of dried products (40% of fresh)[152]:		172158	kg
Tunnel dryers needed[153]:		36	
Cost of packaging/labelling per kg:		$0,00	
Costs of maintenance per 200kg:		$5,00	
Distance Tanga-DSM[154]:		354	km
Costs of transport to DSM per kg[155]:		$0,05	

Annual income from selling dried fruits and vegetables

Mangos:	$126.525,55
Oranges:	$260.840,00
Tomatoes:	$43.950,60
Bananas:	$107.496,90
Casava:	$0,00
Coconut:	$89.518,60
Total	**$628.331,65**

[151] Weight determined after peeling, stoning and cutting
[152] Based on dehydration to approx. 15% moisture content according to www.thefruitpages.com
[153] Based on annual capacity of tunnel dryers by Innotech
[154] www.tzonline.org/Distance.htm
[155] Based on distance to Dar es Salaam and inflation corrected prices from: Fews Net, *Tanzania Food Security Updaty*, July 2000

CBA Cash Flow Tables:

non-financial cashflows:											
Year	**Solar Dryer**	**Tools**	**Buildings**	**Maintenance**	**Transport**	**Labour costs**	**Packaging**	**Income**	**Total**	**Discount Factor**	**Total Discounted**
0	-$286.930,00	-$13.600,00	-$56.400,00						-$356.930,00	1,000	-$356.930
1		-$13.600,00		-$10.759,88	-$9.141,59	-$8.607,90	$0,00	$628.331,65	$586.222,29	0,915	$536.118
2		-$13.600,00		-$10.759,88	-$9.141,59	-$8.607,90	$0,00	$628.331,65	$586.222,29	0,836	$490.296
3		-$13.600,00		-$10.759,88	-$9.141,59	-$8.607,90	$0,00	$628.331,65	$586.222,29	0,765	$448.390
4		-$13.600,00		-$10.759,88	-$9.141,59	-$8.607,90	$0,00	$628.331,65	$586.222,29	0,700	$410.066
5		-$13.600,00		-$10.759,88	-$9.141,59	-$8.607,90	$0,00	$628.331,65	$586.222,29	0,640	$375.018
Total											**$1.902.958**

financial cashflows:						
Year	**Loan**	**Interest**	**Repayment**	**Total**	**Discount Factor**	**Total Discounted**
0	$356.930,00			$356.930,00	1,000	$356.930,00
1		-$60.678,10	-$71.386,00	-$132.064,10	0,855	-$112.875,30
2		-$48.542,48	-$71.386,00	-$119.928,48	0,731	-$87.609,38
3		-$36.406,86	-$71.386,00	-$107.792,86	0,624	-$67.302,69
4		-$24.271,24	-$71.386,00	-$95.657,24	0,534	-$51.047,49
5		-$12.135,62	-$71.386,00	-$83.521,62	0,456	-$38.095,14
Total						**$0**

Profitability and Liquidity Analyses:

NPV and IRR:			
Year	**Net non-fin inflow**	**Discount factor**	**Discounted cashflows**
0	-$356.930,00	1,000	-$356.930,00
1	$586.222,29	0,915	$536.117,82
2	$586.222,29	0,836	$490.295,78
3	$586.222,29	0,765	$448.390,16
4	$586.222,29	0,700	$410.066,21
5	$586.222,29	0,640	$375.017,82
NPV			**$1.902.957,79**
IRR	**162,93%**		

Liquidity Position:						
Year	**Constant Total NF-cashflow**	**Inflation**	**Current Total NF-cashflow**	**Current Total F-cashflow**	**Total Cashflows**	**Cumulative**
0	-$356.930,00	1,000	-$356.930,00	$356.930,00	$0,00	$0,00
1	$586.222,29	1,070	$627.257,85	-$132.064,10	$495.193,75	$495.193,75
2	$586.222,29	1,145	$671.165,89	-$119.928,48	$551.237,41	$1.046.431,16
3	$586.222,29	1,225	$718.147,51	-$107.792,86	$610.354,65	$1.656.785,81
4	$586.222,29	1,311	$768.417,83	-$95.657,24	$672.760,59	$2.329.546,40
5	$586.222,29	1,403	$822.207,08	-$83.521,62	$738.685,46	$3.068.231,86

CBA calculations Cabinet Drying in Tanga

Monetary Information:

17,0%	interest
7,0%	inflation
9,3%	real interest

Data Input for CBA calculations:

Costs of Solar Cabinet Dryer[156]:	$32.750,00
Costs of fruit preperation building[157]:	
Construction	$25.000,00
Utilities (water, electricity)	$1.200,00
Cutting table	$2.000,00
Total	**$56.400,00**
Costs fruit preparation equipment[158]:	
Cutting equipment	$3.000,00
Clothes	$2.000,00
Sealing/packaging machine	$1.800,00
Total:	**$13.600,00**
Selling price of dried fruits and vegetables per kg[159]:	
Mangos	$0,71
Oranges	$0,80
Tomatoes	$0,81
Bananas	$0,63
Casava	$0,60
Coconut	$0,68

Annual amount of fruit and vegetables produced[160]:		
Mangos:	35641000	kg
Oranges:	65210000	kg
Tomatoes:	10852000	kg
Bananas:	34126000	kg
Casava:	0	kg
Coconut:	26329000	kg
Total:	**172158000**	**kg**

[156] Price based on selling price of cabinet dryers manufactured by Innotech Ingenieursgesellschaft mbH
[157] Prices based on Rockefeller funding report by the University of Dar es Salaam with 100% contingency
[158] Ibid
[159] Based on prices by Fairtrade Labelling Organizations International, 2005
[160] Ministry of Agriculture Tanzania, *National Sample Census of Agriculture 2002/2003, volume II*, Dar es Salaam

Fruit and vegetables used for drying:	0,5%	860790	kg
Weight products after preperation(50%)[161]:		430395	kg
Weight of dried products (40% of fresh)[162]:		172158	kg
Cabinet dryers needed[163]:		11	
Cost of packaging/labelling per kg:		$0,00	
Costs of maintenance per 200kg:		$5,00	
Distance Tanga-DSM[164]:		354	km
Costs of transport to DSM per kg[165]:		$0,05	

Annual income from selling dried fruits and vegetables

Mangos:	$126.525,55
Oranges:	$260.840,00
Tomatoes:	$43.950,60
Bananas:	$107.496,90
Casava:	$0,00
Coconut:	$89.518,60
Total	**$628.331,65**

[161] Weight determined after peeling, stoning and cutting
[162] Based on dehydration to approx. 15% moisture content according to www.thefruitpages.com
[163] Based on annual capacity of tunnel dryers by Innotech
[164] www.tzonline.org/Distance.htm
[165] Based on distance to Dar es Salaam and inflation corrected prices from: Fews Net, *Tanzania Food Security Updaty*, July 2000

CBA Cash Flow Tables:

non-financial cashflows:											
Year	**Solar Dryer**	**Tools**	**Buildings**	**Maintenance**	**Transport**	**Labour costs**	**Packaging**	**Income**	**Total**	**Discount Factor**	**Total Discounted**
0	-$367.069	-$13.600,00	-$56.400,00						-$437.069	1,000	-$437.069
1		-$13.600,00		-$10.759,88	-$9.141,59	-$2.690	$0,00	$628.331,65	$592.140	0,915	$541.530
2		-$13.600,00		-$10.759,88	-$9.141,59	-$2.690	$0,00	$628.331,65	$592.140	0,836	$495.245
3		-$13.600,00		-$10.759,88	-$9.141,59	-$2.690	$0,00	$628.331,65	$592.140	0,765	$452.917
4		-$13.600,00		-$10.759,88	-$9.141,59	-$2.690	$0,00	$628.331,65	$592.140	0,700	$414.206
5		-$13.600,00		-$10.759,88	-$9.141,59	-$2.690	$0,00	$628.331,65	$592.140	0,640	$378.804
Total											**$1.845.633**

financial cashflows:						
Year	**Loan**	**Interest**	**Repayment**	**Total**	**Discount Factor**	**Total Discounted**
0	$437.069			$437.069	1,000	$437.069
1		-$74.302	-$87.414	-$161.715	0,855	-$138.218
2		-$59.441	-$87.414	-$146.855	0,731	-$107.280
3		-$44.581	-$87.414	-$131.995	0,624	-$82.414
4		-$29.721	-$87.414	-$117.134	0,534	-$62.509
5		-$14.860	-$87.414	-$102.274	0,456	-$46.648
Total						**$0**

Profitability and Liquidity Analyses:

NPV and IRR:

Year	Net non-fin inflow	Discount factor	Discounted cashflows
0	-$437.069	1,000	-$437.069
1	$592.140	0,915	$541.530
2	$592.140	0,836	$495.245
3	$592.140	0,765	$452.917
4	$592.140	0,700	$414.206
5	$592.140	0,640	$378.804
NPV			**$1.845.633**
IRR	**134%**		

Liquidity Position:

Year	Constant Total NF-cashflow	Inflation	Current Total NF-cashflow	Current Total F-cashflow	Total Cashflows	Cumulative
0	-$437.069	1,000	-$437.069	$437.069	$0	$0
1	$592.140	1,070	$633.590	-$161.715	$471.875	$471.875
2	$592.140	1,145	$677.941	-$146.855	$531.086	$1.002.961
3	$592.140	1,225	$725.397	-$131.995	$593.402	$1.596.363
4	$592.140	1,311	$776.175	-$117.134	$659.041	$2.255.404
5	$592.140	1,403	$830.507	-$102.274	$728.233	$2.983.637

CBA calculations Tunnel Drying in Mwanza

Monetary Information:

17,0%	interest
7,0%	inflation
9,3%	real interest

Data Input for CBA calculations:

Costs of Tunnel Dryer[166]:	$8.000,00
Costs of fruit preperation building[167]:	
Construction	$25.000,00
Utilities (water, electricity)	$1.200,00
Cutting table	$2.000,00
Total	**$56.400,00**
Costs fruit preparation equipment[168]:	
Cutting equipment	$3.000,00
Clothes	$2.000,00
Sealing/packaging machine	$1.800,00
Total:	**$13.600,00**
Selling price of dried fruits and vegetables per kg[169]:	
Mangos	$0,71
Oranges	$0,80
Tomatoes	$0,81
Bananas	$0,63
Casava	$0,60
Coconut	$0,68

Annual amount of fruit and vegetables produced[170]:

Mangos:	56094000	kg
Oranges:	22737000	kg
Tomatoes:	10714000	kg
Bananas:	12351000	kg
Casava:	1794000	kg
Coconut:	263000	kg
Total:	**103953000**	**kg**

[166] Price based on selling price of tunnel dryers manufactured by Innotech Ingenieursgesellschaft mbH
[167] Prices based on Rockefeller funding report by the University of Dar es Salaam with 100% contingency
[168] Ibid
[169] Based on prices by Fairtrade Labelling Organizations International, 2005
[170] Ministry of Agriculture Tanzania, *National Sample Census of Agriculture 2002/2003, volume II*, Dar es Salaam

Fruit and vegetables used for drying:	0,5%	519765	kg
Weight products after preperation(50%)[171]:		259882,5	kg
Weight of dried products (40% of fresh)[172]:		103953	kg
Tunnel dryers needed[173]:		22	
Cost of packaging/labelling per kg:		$0,00	
Costs of maintenance per 200kg:		$5,00	
Distance Mwanza-DSM[174]:		1.148	km
Costs of transport to DSM per kg[175]:		$0,17	

Annual income from selling dried fruits and vegetables

Mangos:	$199.133,70
Oranges:	$90.948,00
Tomatoes:	$43.391,70
Bananas:	$38.905,65
Casava:	$5.382,00
Coconut:	$894,20
Total	**$378.655,25**

[171] Weight determined after peeling, stoning and cutting
[172] Based on dehydration to approx. 15% moisture content according to www.thefruitpages.com
[173] Based on annual capacity of tunnel dryers by Innotech
[174] www.tzonline.org/Distance.htm
[175] Based on distance to Dar es Salaam and inflation corrected prices from: Fews Net, *Tanzania Food Security Updaty*, July 2000

CBA Cash Flow Tables:

non-financial cashflows:											
Year	**Solar Dryer**	**Tools**	**Buildings**	**Maintenance**	**Transport**	**Labour costs**	**Packaging**	**Income**	**Total**	**Discount Factor**	**Total Discounted**
0	-$173.255,00	-$13.600,00	-$56.400,00						-$243.255,00	1,000	-$243.255
1		-$13.600,00		-$6.497,06	-$17.900,71	-$5.197,65	$0,00	$378.655,25	$335.459,83	0,915	$306.788
2		-$13.600,00		-$6.497,06	-$17.900,71	-$5.197,65	$0,00	$378.655,25	$335.459,83	0,836	$280.567
3		-$13.600,00		-$6.497,06	-$17.900,71	-$5.197,65	$0,00	$378.655,25	$335.459,83	0,765	$256.587
4		-$13.600,00		-$6.497,06	-$17.900,71	-$5.197,65	$0,00	$378.655,25	$335.459,83	0,700	$234.656
5		-$13.600,00		-$6.497,06	-$17.900,71	-$5.197,65	$0,00	$378.655,25	$335.459,83	0,640	$214.600
Total											**$1.049.943**

financial cashflows:						
Year	**Loan**	**Interest**	**Repayment**	**Total**	**Discount Factor**	**Total Discounted**
0	$243.255,00			$243.255,00	1,000	$243.255,00
1		-$41.353,35	-$48.651,00	-$90.004,35	0,855	-$76.926,79
2		-$33.082,68	-$48.651,00	-$81.733,68	0,731	-$59.707,56
3		-$24.812,01	-$48.651,00	-$73.463,01	0,624	-$45.868,14
4		-$16.541,34	-$48.651,00	-$65.192,34	0,534	-$34.789,90
5		-$8.270,67	-$48.651,00	-$56.921,67	0,456	-$25.962,61
Total						**$0**

Profitability and Liquidity Analyses:

NPV and IRR:

Year	Net non-fin inflow	Discount factor	Discounted cashflows
0	-$243.255,00	1,000	-$243.255,00
1	$335.459,83	0,915	$306.788,05
2	$335.459,83	0,836	$280.566,85
3	$335.459,83	0,765	$256.586,78
4	$335.459,83	0,700	$234.656,28
5	$335.459,83	0,640	$214.600,19
NPV			**$1.049.943,15**
IRR	**136,02%**		

Liquidity Position:

Year	Constant Total NF-cashflow	Inflation	Current Total NF-cashflow	Current Total F-cashflow	Total Cashflows	Cumulative
0	-$243.255,00	1,000	-$243.255,00	$243.255,00	$0,00	$0,00
1	$335.459,83	1,070	$358.942,02	-$90.004,35	$268.937,67	$268.937,67
2	$335.459,83	1,145	$384.067,96	-$81.733,68	$302.334,28	$571.271,95
3	$335.459,83	1,225	$410.952,72	-$73.463,01	$337.489,71	$908.761,66
4	$335.459,83	1,311	$439.719,41	-$65.192,34	$374.527,07	$1.283.288,72
5	$335.459,83	1,403	$470.499,77	-$56.921,67	$413.578,10	$1.696.866,82

CBA calculations Cabinet Drying in Mwanza

Monetary Information:

17,0%	interest
7,0%	inflation
9,3%	real interest

Data Input for CBA calculations:

Costs of Cabinet Dryer[176]:	$32.750,00
Costs of fruit preperation building[177]:	
Construction	$25.000,00
Utilities (water, electricity)	$1.200,00
Cutting table	$2.000,00
Total	**$56.400,00**
Costs fruit preparation equipment[178]:	
Cutting equipment	$3.000,00
Clothes	$2.000,00
Sealing/packaging machine	$1.800,00
Total:	**$13.600,00**

Selling price of dried fruits and vegetables per kg[179]:	
Mangos	$0,71
Oranges	$0,80
Tomatoes	$0,81
Bananas	$0,63
Casava	$0,60
Coconut	$0,68

Annual amount of fruit and vegetables produced[180]:		
Mangos:	56094000	kg
Oranges:	22737000	kg
Tomatoes:	10714000	kg
Bananas:	12351000	kg
Casava:	1794000	kg
Coconut:	263000	kg
Total:	**103953000**	**kg**

[176] Price based on selling price of cabinet dryers manufactured by Innotech Ingenieursgesellschaft mbH
[177] Prices based on Rockefeller funding report by the University of Dar es Salaam with 100% contingency
[178] Ibid
[179] Based on prices by Fairtrade Labelling Organizations International, 2005
[180] Ministry of Agriculture Tanzania, *National Sample Census of Agriculture 2002/2003, volume II*, Dar es Salaam

Fruit and vegetables used for drying:	0,5%	519765	kg
Weight products after preperation(50%)[181]:		259882,5	kg
Weight of dried products (40% of fresh)[182]:		103953	kg
Cabinet dryers needed[183]:		7	
Cost of packaging/labelling per kg:		$0,00	
Costs of maintenance per 200kg:		$5,00	
Distance Mwanza-DSM[184]:		1.148	km
Costs of transport to DSM per kg[185]:		$0,17	

Annual income from selling dried fruits and vegetables

Mangos:	$199.133,70
Oranges:	$90.948,00
Tomatoes:	$43.391,70
Bananas:	$38.905,65
Casava:	$5.382,00
Coconut:	$894,20
Total	**$378.655,25**

[181] Weight determined after peeling, stoning and cutting
[182] Based on dehydration to approx. 15% moisture content according to www.thefruitpages.com
[183] Based on annual capacity of tunnel dryers by Innotech
[184] www.tzonline.org/Distance.htm
[185] Based on distance to Dar es Salaam and inflation corrected prices from: Fews Net, *Tanzania Food Security Updaty*, July 2000

CBA Cash Flow Tables:

non-financial cashflows:											
Year	**Solar Dryer**	**Tools**	**Buildings**	**Maintenance**	**Transport**	**Labour costs**	**Packaging**	**Income**	**Total**	**Discount Factor**	**Total Discounted**
0	-$221.645	-$13.600,00	-$56.400,00						-$291.645	1,000	-$291.645
1		-$13.600,00		-$6.497,06	-$17.900,71	-$1.624	$0,00	$378.655,25	$339.033	0,915	$310.056
2		-$13.600,00		-$6.497,06	-$17.900,71	-$1.624	$0,00	$378.655,25	$339.033	0,836	$283.556
3		-$13.600,00		-$6.497,06	-$17.900,71	-$1.624	$0,00	$378.655,25	$339.033	0,765	$259.320
4		-$13.600,00		-$6.497,06	-$17.900,71	-$1.624	$0,00	$378.655,25	$339.033	0,700	$237.156
5		-$13.600,00		-$6.497,06	-$17.900,71	-$1.624	$0,00	$378.655,25	$339.033	0,640	$216.886
Total											**$1.015.329**

financial cashflows:						
Year	**Loan**	**Interest**	**Repayment**	**Total**	**Discount Factor**	**Total Discounted**
0	$291.645			$291.645	1,000	$291.645
1		-$49.580	-$58.329	-$107.908	0,855	-$92.229
2		-$39.664	-$58.329	-$97.993	0,731	-$71.585
3		-$29.748	-$58.329	-$88.077	0,624	-$54.992
4		-$19.832	-$58.329	-$78.161	0,534	-$41.710
5		-$9.916	-$58.329	-$68.245	0,456	-$31.127
Total						**$0**

Profitability and Liquidity Analyses:

NPV and IRR:

Year	Net non-fin inflow	Discount factor	Discounted cashflows
0	-$291.645	1,000	-$291.645
1	$339.033	0,915	$310.056
2	$339.033	0,836	$283.556
3	$339.033	0,765	$259.320
4	$339.033	0,700	$237.156
5	$339.033	0,640	$216.886
NPV			**$1.015.329**
IRR	**114%**		

Liquidity Position:

Year	Constant Total NF-cashflow	Inflation	Current Total NF-cashflow	Current Total F-cashflow	Total Cashflows	Cumulative
0	-$291.645	1,000	-$291.645	$291.645	$0	$0
1	$339.033	1,070	$362.766	-$107.908	$254.857	$254.857
2	$339.033	1,145	$388.159	-$97.993	$290.167	$545.024
3	$339.033	1,225	$415.330	-$88.077	$327.254	$872.277
4	$339.033	1,311	$444.403	-$78.161	$366.243	$1.238.520
5	$339.033	1,403	$475.512	-$68.245	$407.267	$1.645.787

CBA calculations Tunnel Drying in Morogoro

Monetary Information:

17,0%	interest
7,0%	inflation
9,3%	real interest

Data Input for CBA calculations:

Costs of Tunnel Dryer[186]:	$8.000,00
Costs of fruit preperation building[187]:	
Construction	$25.000,00
Utilities (water, electricity)	$1.200,00
Cutting table	$2.000,00
Total	**$56.400,00**
Costs fruit preparation equipment[188]:	
Cutting equipment	$3.000,00
Clothes	$2.000,00
Sealing/packaging machine	$1.800,00
Total:	**$13.600,00**

Selling price of dried fruits and vegetables per kg[189]:	
Mangos	$0,71
Oranges	$0,80
Tomatoes	$0,81
Bananas	$0,63
Casava	$0,60
Coconut	$0,68

Annual amount of fruit and vegetables produced[190]:		
Mangos:	69490000	kg
Oranges:	30883000	kg
Tomatoes:	21747000	kg
Bananas:	47415000	kg
Casava:	1794000	kg
Coconut:	17963000	kg
Total:	**189292000**	**kg**

[186] Price based on selling price of tunnel dryers manufactured by Innotech Ingenieursgesellschaft mbH
[187] Prices based on Rockefeller funding report by the University of Dar es Salaam with 100% contingency
[188] Ibid
[189] Based on prices by Fairtrade Labelling Organizations International, 2005
[190] Ministry of Agriculture Tanzania, *National Sample Census of Agriculture 2002/2003, volume II*, Dar es Salaam

Fruit and vegetables used for drying:	0,5%	946460	kg
Weight products after preperation(50%)[191]:		473230	kg
Weight of dried products (40% of fresh)[192]:		189292	kg
Tunnel dryers needed[193]:		39	
Cost of packaging/labelling per kg:		$0,00	
Costs of maintenance per 200kg:		$5,00	
Distance Morogoro-DSM[194]:		196	km
Costs of transport to DSM per kg[195]:		$0,03	

Annual income from selling dried fruits and vegetables

Mangos:	$246.689,50
Oranges:	$123.532,00
Tomatoes:	$88.075,35
Bananas:	$149.357,25
Casava:	$5.382,00
Coconut:	$61.074,20
Total	**$674.110,30**

[191] Weight determined after peeling, stoning and cutting
[192] Based on dehydration to approx. 15% moisture content according to www.thefruitpages.com
[193] Based on annual capacity of tunnel dryers by Innotech
[194] www.tzonline.org/Distance.htm
[195] Based on distance to Dar es Salaam and inflation corrected prices from: Fews Net, *Tanzania Food Security Updaty*, July 2000

CBA Cash Flow Tables:

non-financial cashflows:											
Year	**Solar Dryer**	**Tools**	**Buildings**	**Maintenance**	**Transport**	**Labour costs**	**Packaging**	**Income**	**Total**	**Discount Factor**	**Total Discounted**
0	-$315.486,67	-$13.600,00	-$56.400,00						-$385.486,67	1,000	-$385.487
1		-$13.600,00		-$11.830,75	-$5.565,18	-$9.464,60	$0,00	$674.110,30	$633.649,77	0,915	$579.492
2		-$13.600,00		-$11.830,75	-$5.565,18	-$9.464,60	$0,00	$674.110,30	$633.649,77	0,836	$529.962
3		-$13.600,00		-$11.830,75	-$5.565,18	-$9.464,60	$0,00	$674.110,30	$633.649,77	0,765	$484.667
4		-$13.600,00		-$11.830,75	-$5.565,18	-$9.464,60	$0,00	$674.110,30	$633.649,77	0,700	$443.242
5		-$13.600,00		-$11.830,75	-$5.565,18	-$9.464,60	$0,00	$674.110,30	$633.649,77	0,640	$405.358
Total											**$2.057.234**

financial cashflows:						
Year	**Loan**	**Interest**	**Repayment**	**Total**	**Discount Factor**	**Total Discounted**
0	$385.486,67			$385.486,67	1,000	$385.486,67
1		-$65.532,73	-$77.097,33	-$142.630,07	0,855	-$121.906,04
2		-$52.426,19	-$77.097,33	-$129.523,52	0,731	-$94.618,69
3		-$39.319,64	-$77.097,33	-$116.416,97	0,624	-$72.687,33
4		-$26.213,09	-$77.097,33	-$103.310,43	0,534	-$55.131,61
5		-$13.106,55	-$77.097,33	-$90.203,88	0,456	-$41.143,00
Total						**$0**

Profitability and Liquidity Analyses:

NPV and IRR:			
Year	**Net non-fin inflow**	**Discount factor**	**Discounted cashflows**
0	-$385.486,67	1,000	-$385.486,67
1	$633.649,77	0,915	$579.491,67
2	$633.649,77	0,836	$529.962,46
3	$633.649,77	0,765	$484.666,53
4	$633.649,77	0,700	$443.242,04
5	$633.649,77	0,640	$405.358,10
NPV			**$2.057.234,13**
IRR	**163,07%**		

Liquidity Position:						
Year	**Constant Total NF-cashflow**	**Inflation**	**Current Total NF-cashflow**	**Current Total F-cashflow**	**Total Cashflows**	**Cumulative**
0	-$385.486,67	1,000	-$385.486,67	$385.486,67	$0,00	$0,00
1	$633.649,77	1,070	$678.005,25	-$142.630,07	$535.375,18	$535.375,18
2	$633.649,77	1,145	$725.465,62	-$129.523,52	$595.942,10	$1.131.317,28
3	$633.649,77	1,225	$776.248,21	-$116.416,97	$659.831,24	$1.791.148,51
4	$633.649,77	1,311	$830.585,58	-$103.310,43	$727.275,16	$2.518.423,67
5	$633.649,77	1,403	$888.726,57	-$90.203,88	$798.522,69	$3.316.946,37

CBA calculations Cabinet Drying in Morogoro

Monetary Information:

17,0%	interest
7,0%	inflation
9,3%	real interest

Data Input for CBA calculations:

Costs of Cabinet Dryer[196]:	$32.750,00
Costs of fruit preperation building[197]:	
Construction	$25.000,00
Utilities (water, electricity)	$1.200,00
Cutting table	$2.000,00
Total	**$56.400,00**
Costs fruit preparation equipment[198]:	
Cutting equipment	$3.000,00
Clothes	$2.000,00
Sealing/packaging machine	$1.800,00
Total:	**$13.600,00**

Selling price of dried fruits and vegetables per kg[199]:	
Mangos	$0,71
Oranges	$0,80
Tomatoes	$0,81
Bananas	$0,63
Casava	$0,60
Coconut	$0,68

Annual amount of fruit and vegetables produced[200]:		
Mangos:	69490000	kg
Oranges:	30883000	kg
Tomatoes:	21747000	kg
Bananas:	47415000	kg
Casava:	1794000	kg
Coconut:	17963000	kg
Total:	**189292000**	**kg**

[196] Price based on selling price of cabinet dryers manufactured by Innotech Ingenieursgesellschaft mbH
[197] Prices based on Rockefeller funding report by the University of Dar es Salaam with 100% contingency
[198] Ibid
[199] Based on prices by Fairtrade Labelling Organizations International, 2005
[200] Ministry of Agriculture Tanzania, *National Sample Census of Agriculture 2002/2003, volume II*, Dar es Salaam

Fruit and vegetables used for drying:	0,5%	946460	kg
Weight products after preperation(50%)[201]:		473230	kg
Weight of dried products (40% of fresh)[202]:		189292	kg
Cabinet dryers needed[203]:		12	
Cost of packaging/labelling per kg:		$0,00	
Costs of maintenance per 200kg:		$5,00	
Distance Morogoro-DSM[204]:		196	km
Costs of transport to DSM per kg[205]:		$0,03	

Annual income from selling dried fruits and vegetables

Mangos:	$246.689,50
Oranges:	$123.532,00
Tomatoes:	$88.075,35
Bananas:	$149.357,25
Casava:	$5.382,00
Coconut:	$61.074,20
Total	**$674.110,30**

[201] Weight determined after peeling, stoning and cutting
[202] Based on dehydration to approx. 15% moisture content according to www.thefruitpages.com
[203] Based on annual capacity of tunnel dryers by Innotech
[204] www.tzonline.org/Distance.htm
[205] Based on distance to Dar es Salaam and inflation corrected prices from: Fews Net, *Tanzania Food Security Updaty*, July 2000

CBA Cash Flow Tables:

non-financial cashflows:

Year	Solar Dryer	Tools	Buildings	Maintenance	Transport	Labour costs	Packaging	Income	Total	Discount Factor	Total Discounted
0	-$403.601	-$13.600	-$56.400						-$473.601	1,000	-$473.601
1		-$13.600		-$11.831	-$5.565	-$2.958	$0	$674.110	$640.157	0,915	$585.442
2		-$13.600		-$11.831	-$5.565	-$2.958	$0	$674.110	$640.157	0,836	$535.405
3		-$13.600		-$11.831	-$5.565	-$2.958	$0	$674.110	$640.157	0,765	$489.644
4		-$13.600		-$11.831	-$5.565	-$2.958	$0	$674.110	$640.157	0,700	$447.794
5		-$13.600		-$11.831	-$5.565	-$2.958	$0	$674.110	$640.157	0,640	$409.521
Total											**$1.994.204**

financial cashflows:

Year	Loan	Interest	Repayment	Total	Discount Factor	Total Discounted
0	$473.601			$473.601	1,000	$473.601
1		-$80.512	-$94.720	-$175.232	0,855	-$149.771
2		-$64.410	-$94.720	-$159.130	0,731	-$116.247
3		-$48.307	-$94.720	-$143.028	0,624	-$89.302
4		-$32.205	-$94.720	-$126.925	0,534	-$67.734
5		-$16.102	-$94.720	-$110.823	0,456	-$50.547
Total						**$0**

Profitability and Liquidity Analyses:

NPV and IRR:

Year	Net non-fin inflow	Discount factor	Discounted cashflows
0	-$473.601	1,000	-$473.601
1	$640.157	0,915	$585.442
2	$640.157	0,836	$535.405
3	$640.157	0,765	$489.644
4	$640.157	0,700	$447.794
5	$640.157	0,640	$409.521
NPV			**$1.994.204**
IRR	**133%**		

Liquidity Position:

Year	Constant Total NF-cashflow	Inflation	Current Total NF-cashflow	Current Total F-cashflow	Total Cashflows	Cumulative
0	-$473.601	1,000	-$473.601	$473.601	$0	$0
1	$640.157	1,070	$684.968	-$175.232	$509.735	$509.735
2	$640.157	1,145	$732.915	-$159.130	$573.785	$1.083.521
3	$640.157	1,225	$784.219	-$143.028	$641.192	$1.724.713
4	$640.157	1,311	$839.115	-$126.925	$712.190	$2.436.902
5	$640.157	1,403	$897.853	-$110.823	$787.030	$3.223.932

CBA calculations Tunnel Drying in Kagera

Monetary Information:

17,0%	interest
7,0%	inflation
9,3%	real interest

Data Input for CBA calculations:

Costs of Tunnel Dryer[206]:	$8.000,00
Costs of fruit preperation building[207]:	
Construction	$25.000,00
Utilities (water, electricity)	$1.200,00
Cutting table	$2.000,00
Total	**$56.400,00**
Costs fruit preparation equipment[208]:	
Cutting equipment	$3.000,00
Clothes	$2.000,00
Sealing/packaging machine	$1.800,00
Total:	**$13.600,00**
Selling price of dried fruits and vegetables per kg[209]:	
Mangos	$0,71
Oranges	$0,80
Tomatoes	$0,81
Bananas	$0,63
Casava	$0,60
Coconut	$0,68

Annual amount of fruit and vegetables produced[210]:		
Mangos:	0	kg
Oranges:	0	kg
Tomatoes:	0	kg
Bananas:	1239219000	kg
Casava:	0	kg
Coconut:	0	kg
Total:	**1239219000**	**kg**

[206] Price based on selling price of tunnel dryers manufactured by Innotech Ingenieursgesellschaft mbH
[207] Prices based on Rockefeller funding report by the University of Dar es Salaam with 100% contingency
[208] Ibid
[209] Based on prices by Fairtrade Labelling Organizations International, 2005
[210] Ministry of Agriculture Tanzania, *National Sample Census of Agriculture 2002/2003, volume II*, Dar es Salaam

Fruit and vegetables used for drying:	0,05%	619609,5	kg
Weight products after preperation(50%)[211]:		309804,8	kg
Weight of dried products (40% of fresh)[212]:		123921,9	kg
Tunnel dryers needed[213]:		26	
Cost of packaging/labelling per kg:		$0,00	
Costs of maintenance per 200kg:		$5,00	
Distance Kagera-DSM[214]:		1.588	km
Costs of transport to DSM per kg[215]:		$0,24	

Annual income from selling dried fruits and vegetables

Mangos:	$0,00
Oranges:	$0,00
Tomatoes:	$0,00
Bananas:	$390.353,99
Casava:	$0,00
Coconut:	$0,00
Total	**$390.353,99**

[211] Weight determined after peeling, stoning and cutting
[212] Based on dehydration to approx. 15% moisture content according to www.thefruitpages.com
[213] Based on annual capacity of tunnel dryers by Innotech
[214] www.tzonline.org/Distance.htm
[215] Based on distance to Dar es Salaam and inflation corrected prices from: Fews Net, *Tanzania Food Security Updaty*, July 2000

CBA Cash Flow Tables:

non-financial cashflows:

Year	Solar Dryer	Tools	Buildings	Maintenance	Transport	Labour costs	Packaging	Income	Total	Discount Factor	Total Discounted
0	-$206.537	-$13.600	-$56.400						-$276.537	1,000	-$276.537
1		-$13.600		-$7.745	-$29.518	-$6.196	$0	$390.354	$333.295	0,915	$304.808
2		-$13.600		-$7.745	-$29.518	-$6.196	$0	$390.354	$333.295	0,836	$278.756
3		-$13.600		-$7.745	-$29.518	-$6.196	$0	$390.354	$333.295	0,765	$254.931
4		-$13.600		-$7.745	-$29.518	-$6.196	$0	$390.354	$333.295	0,700	$233.142
5		-$13.600		-$7.745	-$29.518	-$6.196	$0	$390.354	$333.295	0,640	$213.215
Total											**$1.008.315**

financial cashflows:

Year	Loan	Interest	Repayment	Total	Discount Factor	Total Discounted
0	$276.537			$276.537	1,000	$276.537
1		-$47.011	-$55.307	-$102.319	0,855	-$87.452
2		-$37.609	-$55.307	-$92.916	0,731	-$67.877
3		-$28.207	-$55.307	-$83.514	0,624	-$52.144
4		-$18.804	-$55.307	-$74.112	0,534	-$39.550
5		-$9.402	-$55.307	-$64.710	0,456	-$29.515
Total						**$0**

Profitability and Liquidity Analyses:

NPV and IRR:

Year	Net non-fin inflow	Discount factor	Discounted cashflows
0	-$276.537	1,000	-$276.537
1	$333.295	0,915	$304.808
2	$333.295	0,836	$278.756
3	$333.295	0,765	$254.931
4	$333.295	0,700	$233.142
5	$333.295	0,640	$213.215
NPV			**$1.008.315**
IRR	**118%**		

Liquidity Position:

Year	Constant Total NF-cashflow	Inflation	Current Total NF-cashflow	Current Total F-cashflow	Total Cashflows	Cumulative
0	-$276.537	1,000	-$276.537	$276.537	$0	$0
1	$333.295	1,070	$356.625	-$102.319	$254.307	$254.307
2	$333.295	1,145	$381.589	-$92.916	$288.673	$542.979
3	$333.295	1,225	$408.300	-$83.514	$324.786	$867.766
4	$333.295	1,311	$436.881	-$74.112	$362.769	$1.230.535
5	$333.295	1,403	$467.463	-$64.710	$402.753	$1.633.288

CBA calculations Cabinet Drying in Kagera

Monetary Information:

17,0%	interest
7,0%	inflation
9,3%	real interest

Data Input for CBA calculations:

Costs of Cabinet Dryer[216]:	$32.750,00
Costs of fruit preperation building[217]:	
Construction	$25.000,00
Utilities (water, electricity)	$1.200,00
Cutting table	$2.000,00
Total	**$56.400,00**
Costs fruit preparation equipment[218]:	
Cutting equipment	$3.000,00
Clothes	$2.000,00
Sealing/packaging machine	$1.800,00
Total:	**$13.600,00**

Selling price of dried fruits and vegetables per kg[219]:	
Mangos	$0,71
Oranges	$0,80
Tomatoes	$0,81
Bananas	$0,63
Casava	$0,60
Coconut	$0,68

Annual amount of fruit and vegetables produced[220]:		
Mangos:	0	kg
Oranges:	0	kg
Tomatoes:	0	kg
Bananas:	1239219000	kg
Casava:	0	kg
Coconut:	0	kg
Total:	**1239219000**	**kg**

[216] Price based on selling price of cabinet dryers manufactured by Innotech Ingenieursgesellschaft mbH
[217] Prices based on Rockefeller funding report by the University of Dar es Salaam with 100% contingency
[218] Ibid
[219] Based on prices by Fairtrade Labelling Organizations International, 2005
[220] Ministry of Agriculture Tanzania, *National Sample Census of Agriculture 2002/2003, volume II*, Dar es Salaam

Fruit and vegetables used for drying:	0,05%	619609,5	kg
Weight products after preperation(50%)[221]:		309804,8	kg
Weight of dried products (40% of fresh)[222]:		123921,9	kg
Cabinet dryers needed[223]:		8	
Cost of packaging/labelling per kg:		$0,00	
Costs of maintenance per 200kg:		$5,00	
Distance Kagera-DSM[224]:		1.588	km
Costs of transport to DSM per kg[225]:		$0,24	

Annual income from selling dried fruits and vegetables

Mangos:	$0,00
Oranges:	$0,00
Tomatoes:	$0,00
Bananas:	$390.353,99
Casava:	$0,00
Coconut:	$0,00
Total	**$390.353,99**

[221] Weight determined after peeling, stoning and cutting
[222] Based on dehydration to approx. 15% moisture content according to www.thefruitpages.com
[223] Based on annual capacity of tunnel dryers by Innotech
[224] www.tzonline.org/Distance.htm
[225] Based on distance to Dar es Salaam and inflation corrected prices from: Fews Net, *Tanzania Food Security Updaty*, July 2000

CBA Cash Flow Tables:

non-financial cashflows:

Year	Solar Dryer	Tools	Buildings	Maintenance	Transport	Labour costs	Packaging	Income	Total	Discount Factor	Total Discounted
0	-$264.221	-$13.600	-$56.400						-$334.221	1,000	-$334.221
1		-$13.600		-$7.745	-$29.518	-$1.936	$0	$390.354	$337.554	0,915	$308.704
2		-$13.600		-$7.745	-$29.518	-$1.936	$0	$390.354	$337.554	0,836	$282.319
3		-$13.600		-$7.745	-$29.518	-$1.936	$0	$390.354	$337.554	0,765	$258.189
4		-$13.600		-$7.745	-$29.518	-$1.936	$0	$390.354	$337.554	0,700	$236.121
5		-$13.600		-$7.745	-$29.518	-$1.936	$0	$390.354	$337.554	0,640	$215.940
Total											**$967.051**

financial cashflows:

Year	Loan	Interest	Repayment	Total	Discount Factor	Total Discounted
0	$334.221			$334.221	1,000	$334.221
1		-$56.818	-$66.844	-$123.662	0,855	-$105.694
2		-$45.454	-$66.844	-$112.298	0,731	-$82.036
3		-$34.091	-$66.844	-$100.935	0,624	-$63.021
4		-$22.727	-$66.844	-$89.571	0,534	-$47.800
5		-$11.364	-$66.844	-$78.208	0,456	-$35.671
Total						**$0**

Profitability and Liquidity Analyses:

NPV and IRR:

Year	Net non-fin inflow	Discount factor	Discounted cashflows
0	-$334.221	1,000	-$334.221
1	$337.554	0,915	$308.704
2	$337.554	0,836	$282.319
3	$337.554	0,765	$258.189
4	$337.554	0,700	$236.121
5	$337.554	0,640	$215.940
NPV			**$967.051**
IRR	**98%**		

Liquidity Position:

Year	Constant Total NF-cashflow	Inflation	Current Total NF-cashflow	Current Total F-cashflow	Total Cashflows	Cumulative
0	-$334.221	1,000	-$334.221	$334.221	$0	$0
1	$337.554	1,070	$361.183	-$123.662	$237.521	$237.521
2	$337.554	1,145	$386.466	-$112.298	$274.168	$511.689
3	$337.554	1,225	$413.519	-$100.935	$312.584	$824.273
4	$337.554	1,311	$442.465	-$89.571	$352.894	$1.177.166
5	$337.554	1,403	$473.437	-$78.208	$395.230	$1.572.396

Appendix 4: Price List of Solar Dryers by Innotech

INNOTECH
Ingenieursgesellschaft mbH

Type of Dryer	Price Standard version Euro	Cost Packaging Euro	Price EXW without installation, transport, etc. Euro
Solar Tunnel Dryer	5.800, --	332,--	6.132,--
Cabinet Dryer HT 4	11.047,--	432,--	11.479,--
Cabinet Dryer HT 4d	15.772,--	432,--	16.204,--
Cabinet Dryer HT 8	16.590,--	473,--	17.063,--
Cabinet Dryer HT 8d	23.677,--	473,--	24.150,--
Cabinet Dryer MHT 8	19.590,--	432,--	20.063,--
Cabinet Dryer MHT 8d	26.677,--	473,--	27.150,--
Cabinet Dryer HT 15	25.195,--	524,--	25.719,--
Cabinet Dryer HT 15d	35.956,--	524,--	36.480,--
Cabinet Dryer HT 25	35.702,--	550,--	36.252,--
Cabinet Dryer HT 25d	50.950,--	550,--	51.500,--
Drying Chamber	109.900,--	0,--	109.900,--

Appendix 5: Codex Alimentarius Commission (CAC)

RECOMMENDED INTERNATIONAL CODE OF HYGIENIC PRACTICE
FOR DRIED FRUITS
(CAC/RCP 3-1969)

SECTION I - SCOPE
This code of practice applies to all fruits that have been dried by natural or artificial means or a combination of both. The fruit is dried to the extent that the greater part of the moisture has been removed, and in addition the fruit may be subjected to a safe and appropriate treatment in preparation and packing, to permit marketing in normal trade channels. Fruits covered by this code include apples, apricots, peaches, pears, nectarines, prunes, figs, dates, and vine fruits such as raisins and currants. Fruits other than vine fruits prior to drying, if desired, and applicable for the particular fruit, may be cored, or pitted, sliced, diced, quartered, halved, or otherwise subdivided. This code does not apply to fruits commonly known as "dehydrated fruits" with a moisture content not exceeding 5%.

SECTION II - DEFINITIONS
None considered necessary for this code of practice.

SECTION III - RAW MATERIAL REQUIREMENTS
A. Environmental Sanitation in Growing and Food Production Areas
1. Sanitary disposal of human and animal wastes. Adequate precaution should be taken to ensure that human and animal wastes are disposed of in such a manner as not to constitute a public health or hygienic hazard and extreme care should be taken to protect the fruit from contamination with these wastes.
2. Sanitary quality of irrigation water. Water used for irrigation should not constitute a public health hazard to the consumer through the fruit.
3. Animal, plant pest and disease control. Growing areas should be kept free from rotten or decomposing fruit that is attractive to insects, rodents and birds. Where control measures are undertaken, treatment with chemical, biological or physical agents should be done only in accordance with the recommendations of the appropriate official agency, by or under the direct supervision of personnel with a thorough understanding of the hazards involved, including the possibility of toxic residues being retained by the fruit.

B. Sanitary Harvesting and Food Production
1. Equipment and product containers. Equipment and product containers should not constitute a hazard to health. Containers which are reused should be of such material and construction as will facilitate thorough cleaning, and should be so cleaned and maintained as not to constitute a source of contamination to the fruit.
2. Sanitary techniques. Harvesting and production operations, methods and procedures should be lean and sanitary.
3. Removal of obviously unfit materials. Unfit products should be segregated during harvesting and production to the fullest extent practicable and should be disposed of in an appropriate manner. The harvested fruit should be examined by competent persons to ensure that it is fit for further processing into food.
4. Protection of product from contamination. Suitable precautions should be taken to prevent the raw fruit from being contaminated by animals, insects, vermin, birds, chemical or microbiological contaminants or other objectionable substances during handling and storage. The nature of the fruit and the methods of harvesting will indicate the type and degree of protection required. The raw or dried fruit should be moved to suitable storage, or to the processing area for immediate processing, as soon as possible after harvesting or drying. Where fruits are likely to have become infested with insects or mites during or after harvesting or drying as a preventive measure, suitable treatment such as fumigation should be applied. Fruit held for processing should be stored in closed containers, buildings, or under suitable type of covering that protects it from rodents, insects, birds, debris and dust. Fumigation methods and chemicals used should be approved by legal authorities having jurisdiction.
5. Drying yards. Where fruit is dried by the sun in drying yards, such yards should be recognized as food processing yards whether drying is carried out on a grower's property or as a commercial

operation. Such yards should as far as possible comply with such of the provisions of Section IV of this code as are applicable, and in particular with the following requirements.

(a) *Location.* Drying yards should in all cases be located a sufficient distance from cattle feed lots, settling pods and/or other waste collection areas to prevent contamination from these sources. They should also be so located that they have proper and adequate drainage.

(b) *Construction*. The drying yard should be so surfaced that it will permit maintenance of clean yard surfaces and prevent contamination of drying fruit. The drying yard should be fenced, where necessary, to keep out animals as far as practicable, and the area around the drying yard should be kept clean, free from weeds and other debris that can blow into the yard. Cutting sheds in which fruit is pitted, cut or otherwise prepared and spread on trays for drying should preferably be closed buildings with screened windows that do not permit access by rodents, insects, or birds. Where cutting is done in open sheds, adequate precautions should be taken to protect against insect, rodent and bird contamination or harbourage. The sheds should be adequately lit and ventilated, and adequate, clean toilet and hand-washing facilities should be provided. Both fresh fruit for processing and the dried fruit should be stored in areas where it is protected from rodent, insect and bird depredations, and storage time should be kept to a minimum consistent with good manufacturing practice. There should be an adequate supply of clean potable water for hand-washing, equipment cleaning, and raw product washing. Standards of potability shall not be less than those contained in the "International Standards for Drinking Water", World Health Organization,1971.

(c) *Hygienic operating requirements*. Drying trays, cutting equipment, and storage bins should be kept clean and free from fruit residue and foreign substances that may cause contamination of the fruit.

C. Transportation

1. Facilities. Conveyance for transporting the harvested crop or raw product from the production area, place of harvest or storage should be adequate for the purpose intended and should be of such material and construction as will permit thorough cleaning and should be so cleaned and maintained as not to constitute a source of contamination to the fruit.
2. Handling procedures. All handling procedures should be such as will prevent the product from being contaminated. Extreme care should be taken in transporting perishable products to prevent spoilage or deterioration. Special equipment - such as refrigeration equipment - should be used if the nature of the product or distances involved so indicate. If ice is used in contact with the fruit, it should be of sanitary quality as required in Section IV - A (2c).

SECTION IV - PLANT FACILITIES AND OPERATING REQUIREMENTS

A. Plant Construction and Layout

1. Location, size and sanitary design. The building and surrounding area should be such as can be kept reasonably free of objectionable odours, smoke, dust, or other contamination; should be of sufficient size for the purpose intended without crowding of equipment or personnel; should be of sound construction and kept in good repair; should be of such construction as to protect against the entrance or harbouring of insects or birds or vermin; and should be so designed as to permit easy and adequate cleaning. In areas experiencing high concentrations of air-borne pollutants, equipment should be used to remove pollutants from the air blown across or through the product.
2. Sanitary facilities and controls:
   (a) *Separation of processes*. Areas where raw materials are received or stored should be so separated from areas in which final product preparation or packaging is conducted as to preclude contamination of the finished product. Areas and compartments used for storage, manufacture or handling of edible products should be separate and distinct from those used for inedible materials. The food handling area should be completely separated from any part of the premises used as living quarters.
   (b) *Water supply*. An ample supply of cold water should be available and an adequate supply of hot water where necessary. The water supply should be of potable quality. Standards of potability shall not be less than those contained in the "International Standards for Drinking Water", World Health Organization, 1971.
   (c) *Ice*. Ice should be made from water of potable quality and should be manufactured, handled, stored and used, so as to protect it from contamination.
   (d) *Auxiliary water supply*. Where non-potable water is used - for such purposes as fire control – it must be carried in completely separate lines, identified preferably by colour and with no crossconnection or back-siphonage with the lines carrying potable water.

(e) *Plumbing and waste disposal*. All plumbing and waste disposal lines (including sewer systems) must be large enough to carry peak loads. All lines must be water-tight and have adequate traps and vents. Disposal of waste should be effected in such a manner as not to permit contamination of potable water supplies. The plumbing and the manner of waste disposal should be approved by the official agency having jurisdiction.

(f) *Lighting and ventilation*. Premises should be well lit and ventilated. Special attention should be given to the venting of areas and equipment producing excessive heat, steam, obnoxious fumes or vapours, or contaminating aerosols. Good ventilation is important to prevent both condensation (which may drip into the product) and mould growth in overhead structures – which growth may fall into the food. Light bulbs and fixtures suspended over food in any step of preparation should be of the safety type or otherwise protected to prevent food contamination in the case of breakage.

(g) *Toilet-rooms and facilities*. Adequate and convenient toilets should be provided and toilet areas should be equipped with self-closing doors. Toilet rooms should be well lit and ventilated and should not open directly into a food handling area. They should be kept in a sanitary condition at all times. There should be associated hand-washing facilities within the toilet area and the notices should be posted requiring personnel to wash their hands after using the toilet.

(h) *Hand-washing facilities*. Adequate and convenient facilities for employees to wash and dry their hands should be provided wherever the process demands. They should be in full view of the processing floor. Single-use towels are recommended, where practicable, but otherwise the method of drying should be approved by the official agency having jurisdiction. The facilities should be kept in a sanitary condition at all times.

B. Equipment and Utensils

1. Materials. All food contact surfaces should be smooth; free from pits, crevices and loose scale; nontoxic; unaffected by food products; and capable of withstanding repeated exposure to normal cleaning; and non-absorbent unless the nature of a particular and otherwise acceptable process renders the use of a surface, such as wood, necessary.
2. Sanitary design, construction and installation. Equipment and utensils should be so designed and constructed as will prevent hygienic hazards and permit easy and thorough cleaning. Stationary equipment should be installed in such a manner as will permit easy and thorough cleaning.
3. Equipment and Utensils. Equipment and utensils used for inedible or contaminating materials should be so identified and should not be used for handling edible products.
4. Drying equipment. Equipment used for drying should be so constructed and operated that the product cannot be adversely affected by the drying medium.

C. Hygienic Operating Requirements

While additional and more specific requirements may be established for certain products, the following should apply as minimal in all food production, handling, storage and distribution:

1. Sanitary maintenance of plant, facilities and premises. The building, equipment, utensils and all other physical facilities of the plant should be kept in good repair and should be kept clean and maintained in an orderly, sanitary condition. Waste materials should be frequently removed from the working area during plant operation and adequate waste receptacles should be provided. Detergents and disinfectants employed should be appropriate to the purpose and should be so used as to present no hazard to public health.
2. Vermin Control. Effective measures should be taken to protect against the entrance into the premises and the harbourage on the premises of insects, rodents, birds or other vermin.
3. Exclusion of domestic animals. Dogs, cats and other domestic animals, should be excluded from areas where food is processed or stored.
4. Personnel health. Plant management should advise personnel that any person afflicted with infected wounds, sores, or any illness, notably diarrhoea, should immediately report to management.Management should take care to ensure that no person, while known to be affected with a disease capable of being transmitted through food, or known to be a carrier of such disease microorganisms, or while afflicted with infected wounds, sores, or any illness, is permitted to work in any area of a food plant in a capacity in which there is a likelihood of such person contaminating food or food contact surfaces with pathogenic organisms.
5. Toxic substances. All rodenticides, fumigants, insecticides or other toxic substances should be stored in separate locked rooms or cabinets and handled only by properly trained personnel. They

should be used only by or under the direct supervision of personnel with a thorough understanding of the hazards involved, including the possibility of contamination of the product.

6. Personnel hygiene and food handling practices:
   (a) All persons working in a food plant should maintain a high degree of personal cleanliness while on duty. Clothing including suitable headdress should be appropriate to the duties being performed and should be kept clean.
   (b) Hands should be washed as often as necessary to conform to hygienic operating practices.
   (c) Spitting, eating and the use of tobacco or chewing gum should be prohibited in food handling areas.
   (d) All necessary precautions should be taken to prevent the contamination of the food product or ingredients with any foreign substance.
   (e) Minor cuts and abrasions on the hands should be appropriately treated and covered with a suitable waterproof dressing. Adequate first-aid facilities should be provided to meet these contingencies so that there is no contamination of the food.
   (f) Gloves used in food handling should be maintained in a sound, clean and sanitary condition; gloves should be made of an impermeable material except where their usage would be inappropriate or incompatible with the work involved.

D. Operating Practices and Production Requirements

1. Raw material handling
   (a) Acceptance criteria. The raw material should not be accepted by the plant if known to contain decomposed, toxic or extraneous substances which will not be removed to acceptable levels by normal plant procedures of sorting or preparation.
   (b) Storage. Raw materials stored on the plant premises should be maintained under conditions that will protect against contamination and infestation and minimize deterioration.
   (c) Water. Water used for conveying raw materials into the plant should be from such a source or suitably treated as not to constitute a public health hazard and should be used only by permission of the official agency having jurisdiction.
2. Inspection and sorting. Prior to introduction into the processing line, or at a convenient point within it, raw materials should be inspected, sorted or culled as required to remove unfit materials. Such operations should be carried out in a clean and sanitary manner. Only clean, sound materials should be used in further processing.
3. Washing or other preparation. Raw materials should be washed as needed to remove soil or other contamination. Water used for such purposes should not be recirculated unless suitably treated to maintain it in a condition as will not constitute a public health hazard. Water used for washing, rinsing, or conveying final food products should be of potable quality.
4. Preparation and processing. Preparatory operations leading to the finished product and the packaging operations should be so timed as to permit expeditious handling of consecutive units in production under conditions which would prevent contamination, deterioration, spoilage, or the development of infectious or toxigenic microorganisms.
5. Packaging of finished product
   (a) Materials. Packaging materials should be stored in a clean and sanitary manner and should not transmit to the product objectionable substances beyond limits acceptable to the official agency having jurisdiction and should provide appropriate protection from contamination.
   (b) Techniques. Packaging should be done under conditions that preclude the introduction of contamination into the product.
6. Preservation of finished product. Methods of preservation or treatment of the finished product should be such as to kill any insects or mites remaining after processing and to result in protection against contamination, deterioration, or development of a public health hazard. The finished product should be of such moisture content that it can be held in the localities of origin and distribution under any normally foreseeable conditions for those localities without significant deterioration by decay, mould, enzymatic changes, or other causes. In addition to applicable drying, the finished product may be treated with chemical preservatives at levels approved by the Codex Alimentarius Commission, as referenced in the Codex Commodity standards, heat processed and/or packed in hermetically sealed containers so that the product will remain safe and will not spoil under normal non-refrigerated storage conditions.
7. Storage and transport of finished products. The finished products should be stored and transported under such conditions as will preclude the contamination with or development of pathogenic or toxicogenic microorganisms and protect against rodent and insect infestation and deterioration of the product or of the container.

(a) The product should be stored under suitable conditions of time, temperature, humidity, and atmosphere, to prevent significant deterioration.
(b) Where dried fruits are stored under conditions in which they may become infested by insects and mites, appropriate methods of protection should be used regularly. Dried fruits should be stored in such a manner, that they can be fumigated in situ or so stored that they can be removed elsewhere for fumigation in special facilities (e.g. fumigation chambers, steel barges, etc.). Cold storage can be used, either to prevent infestation in localities where insects are likely to be present in ordinary storage or to prevent insects damaging the fruit.

E. Sanitation Control Programme
It is desirable that each plant in its own interest designate a single individual, whose duties are preferably divorced from production, to be held responsible for the cleanliness of the plant. His staff should be a permanent part of the organization and should be well trained in the use of special cleaning tools, methods of disassembling equipment for cleaning, and in the significance of contamination and the hazards involved.
Critical areas, equipment for cleaning and materials should be designated for specific attention as part of a permanent sanitation schedule.

F. Laboratory Control Procedures
In addition to any control by the official agency having jurisdiction, it is desirable that each plant in its own interest should have its own or access to laboratory control of the sanitary quality of the products processed. The amount and type of such control will vary with the fruit as well as the needs of management. Such control should reject all fruits that are unfit for human consumption. Analytical procedures should follow recognized or standard methods in order that the results may be readily interpreted.

SECTION V - END PRODUCT SPECIFICATIONS
Appropriate methods should be used for sampling, analysis, and determination in the following specifications.
A. To the extent possible in good manufacturing practice the products should be free from objectionable matter.
B. The products should not contain any pathogen microorganisms or any toxic substance originating from microorganisms.
C. The products should comply with the requirements set forth by the Codex Alimentarius Committees on Pesticide Residues and Food Additives as contained in permitted lists or Codex commodity standards.

Appendix 6: Contacts in Tanzania

National finance bank (NMB)

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Appendix 7: M. Sc. Theses In Technology and Development Studies

M. Sc.Theses In Technology and Development Studies: 2005

05.01 Mara Wijnker: Design of a methodology to determine ex-ante the sustainability of rural electricity systems. Based on a case study in Oruro, Bolivia.

05.02 Michèle Koper: Decentral, Renewable Energy System in Rural Bolivia. Evaluation of case studies and a framework for effective project design.

05.03 Irene Vloerbergh: Implementation & Diffusion of a Foreign Innovative Technology in the Residential Construction Industry. Case study on the diffusion of the HBB-system (Heysterum Bouw & Beheer) in the large scale low-income housing sector on Java, Indonesia.

05.04 Jeroen Matthijs: Access to spatial geographic information on mountainous areas. Building Spatial Data Infrastructure in Tanzania.

05.06 Diane van Herpen: Onbenut potentieel aan vastgoed in Paramaribo – Suriname. Exploratief onderzoek naar onbenut potentieel aan vastgoed in Paramaribo in bezit van in Nederland wonende eigenaren en ideeontwikkeling voor de inzet daarvan ten behoeve van woningbouw en stadsherstel.

05.07 Saskia Benda: Capacity Building in the Tanzanian Construction Industry. Identifying conditions for foreign-domestic collaborations to lead to technology transfer.

05.08 Herjan Siegers: Designing an Appropiate Drinking Water Facility: Iris, an island in the Nile,
Sudan.

05.09 Joris de Groot: Technological trajectories and diffusion of photovoltaic technology. South Africa.

M. Sc. Theses In Technology and Development Studies: 2006

06.01 Rik Luiten: Power Supply Performance: Tanzanian Manufacturing Sector Aim.

06.02 Janske van Eijck: Transition towards Jatropha Biofuels in Tanzania? An Analysis with Strategic Niche Management.

06.03 Arend Driest: The role of entrepreneurs in the innovation process in Ghana's timber exporting sector.

06.04 Martine Teeselink: The Vietnamese Software Industry: Export Success or Domestic Strenght?

06.05 Jeanet Eggengoor: Exploring the feasibility of minimizing the waste product. Fly ash from the Indonesian Textile Industry by co-processing in the Indonesian Cement Industry.

M. Sc. Theses In Technology and Development Studies: 2007

07.01 Hans van Dijkhuizen: Overcoming bottlenecks with implementation of new technologies. African aviation system.

07.02 Ina de Visser: Design and implementation of biomass energy systems in rural India.

07.03 Maarten Louwerse: Prospects for ICT service sector growth in the Indian state of Kerala.