Making Ends Meet

Local socio-technological transformations in the South: based on case studies from Tanzania

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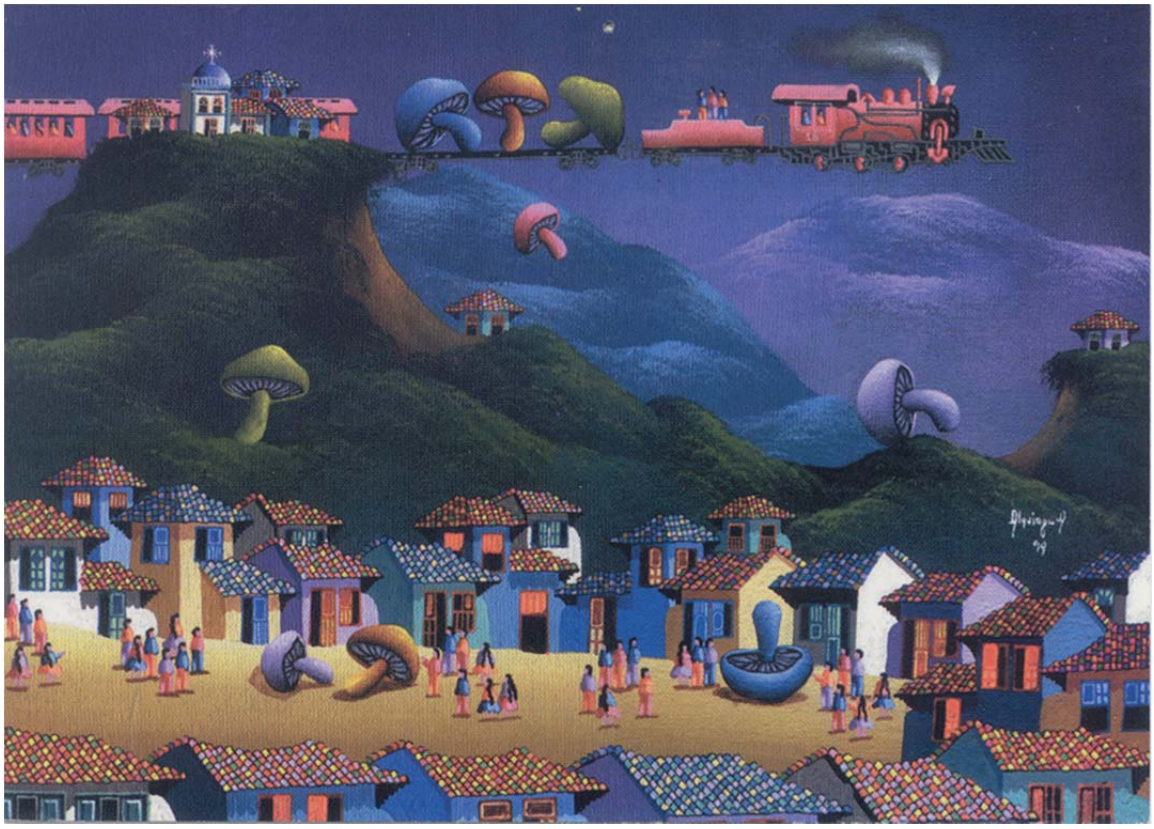

Where is the Southern technology train heading?

Jens Müller (ed.)

August 2011

Department of Development and Planning
Aalborg University
Denmark

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Preface

The issue of local or endogenous generation of technological innovations has often been ignored. A fundamental problem is that the micro-innovative strengths that really exist often remain isolated and encapsulated. This book is an attempt to explicate the informal segments of the national technology systems in the South by identifying their most important constituents. The purpose is to highlight the innovative capability of informal endogenous technology change agents.

This necessitates a broader theoretical outlook than conventional euro-centric conceptual frameworks allow. Therefore, a wider analytical framework than usually is used in development studies is introduced and applied, in particular in regard of the conception of technology. It is shown that local knowledge systems and organisational forms constitute unique production systems that indicate the formation of an *other* and *different* evolutionary *path* or trajectory than *the* technological evolution experienced in the North.

In order to mobilise the local technological dynamism in the South, a much closer *link* than exists to day needs to be established between the formal/exogenous and the informal/endogenous segments of the national systems of innovation. A first condition for such links to be established is that the informal technologists are *recognised* and their conditions of operations fully understood and appreciated.

This book is primarily based on a number of case studies in Tanzania of local socio-technological transformations, some dating back to the beginning of the 1970's. The studies were initially focusing on village blacksmiths, but were gradually expanded to encircle the rural artisan sector as such. In this process, some similar case studies from other regions of the South were referred to, allowing for concluding generalisations and some tentative recommendations.

The book is dedicated to the numerous village artisans who patiently allowed us to make the interviews on which the main part of the empirical records is based. And it is addressed to the government and non-government practitioners, and dedicated researchers – including their foreign counterparts – who daily are trying to facilitate a genuine rural development process in the South wherever they are working.

Finally I want to acknowledge and express my great appreciation for the good collaboration with many research colleagues abroad and at home, in particular those who have contributed with several chapters of the book.

Aalborg, August 2011

Jens Müller

Authors' bio-notes

Bitrina Diyamett is Executive Director of African Technology Policy Studies – Tanzania – an NGO charged with independent policy research in science, technology and innovation. She previously worked with the Tanzania Commission for Science and Technology as programme officer for the coordination of social science research, including policy research in science, technology and innovation. She has earned a fair share of consultancies and publications in this area, focused on systems of innovation in the context of least developed countries.

Eginald Mihanjo is Associate Professor in Department of History - and currently Acting Deputy Vice Chancellor and Dean of Faculty of Humanities and Education – at St. John's University, Tanzania. He started 1986 at University of Dar es Salaam and progressed to Senior Lecturer. Later he joined St. Augustine University of Tanzania, before moving to St. John's University. He has served in a number of administrative positions, done research studies and consultancies, including on indigenous knowledge system, and has published articles and book manuscripts.

Mona Dahms is Associate Professor Emeritus at Department of Development and Planning, Aalborg University, Denmark. She has many years of experience in development research, specializing in the role of information and communication technology in development, mainly in Tanzania. She has also been engaged in international activities within the UNESCO Center for Problem Based Learning (UCPBL) giving lectures, presentations, workshops etc. on problem based learning throughout the world.

Pernille Bertelsen is trained as a socio-technological planner, currently working as Associate Professor and Deputy Head of Department at Department of Development and Planning, Aalborg University, Denmark. Since 1991 occupied with research in technology-society relation, with particular focus on user participation in development and operation of infrastructure (roads, irrigation, ICT) as well as traditional technology development. She has been engaged in assignments with ILO and international NGO's and is speaking Kiswahili.

Jens Müller is Associate Professor Emeritus at Department of Development and Planning, Aalborg University, Denmark. He has more than 30 year experience in development research and in project appraisal and evaluation, mainly in East Africa and Central America. Since 1980 he has been engaged in curricula development and teaching of social science at the Faculty of Science and Technology. His research has been on technology-society relations with particular focus on international technology transfer and national technology transformations in the South.

List of abbreviations

ASP	Artisan Support Programme
ATPS	African Technology Policy Studies
BRELA	Business Registration and Licensing Agency
BTB	Blacksmith Training Project
CBO	Community-Based Organization
CCM	Chana Cha Mapinduzi (p.t. the ruling party in Tanzania)
COSTECH	Commission for Science and Technology - Tanzania
DANIDA	Danish International Development Agency
EPZ	Export Processing Zone
ESR	Education for Selfreliance
FDC	Folk Development College
FDI	Foreign Direct Investment
FINNIDA	Finnish International Development Agency
FTZ	Free Trade Zone
GDP	Gross Domestic Product
ICT	Information and Communication Technology
IFRTD	International Forum for Rural Transport and Development
IKS	Indigenous Knowledge System
ILO	International Labour Organisation
IPI	Institute of Policy Innovation
IPR	Intellectual Property Rights
LAZOA	Lake Zone Artisans Association
LGTP	Local Gornment Tansfort Programme
MCT	Multipurpose Community Telecentre
MIRTP	Makete Integrated Rural Transport Project
MSE	Micro and Small-scale Enterprises
NACO	Nature Conversation Foundation
NBTIP	National Business/Technology Incubator Programme
NGO	Non-Government Organization
NSI	National Systems of Innovation
PPP	Public Private Partnership
R&D	Research & Development
RIPS	Rural Integrated Project Support programme
S&T	Science and Technology
SACCO	Savings and Credit Cooperative Societies
SIDO	Small Industries Development Organization
SLEM	Support to Local Economy in Mwanza
SME	Small and Medium scale Enterprises
TASTA	Tanzania Awards for Scientific and Technological Achievement
TFSR	Tools For Self Reliance
TRA	Tanzania Revenue Authority
TTCL	Tanzania Telecommunication Company Limited
UDSM	University of Dar es Salaam
UFI	Ubungo Farm Implement factory
UN	United Nations
VET	Vocational Education Training
VETA	Vocational Education and Training Authority
VTTP	Village Travel and Transport Programme in Tanzania

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Introduction

The trend in the South[1] under the present globalisation of production systems appears to be a widening of the international technological divide. Under policies of state directed development in the 1960-70's a number of import substitution arrangements were made together with the establishment of national Research & Development (R&D) organizations. These policies were abandoned during the 1980's under pressure for neo-liberal structural adjustments. Privatization, deregulation, trade liberalization and currency devaluation were introduced, e.g. leading to reduction in real wages, increased unemployment, and credit squeeze for small-scale producers (Dijkstra 1996).

Many local large-scale companies either merged with multinational companies or closed down. And local small and medium scale enterprises (SMEs), including those that acted as sub-contractors to large-scale companies, diminished in number (Gwynne & Kay 2000). Countless SMEs have been forced to exit the formal market altogether, and whatever national research and development of novel technologies that existed are also in a state of decline (Katz 2001).

However, this apparent '*de*-industrialization' process (Mkandawire 1991; Sachikonye 1999) has been accompanied by a process of *re*-industrialization: we find expanding multinational large-scale investments, primarily in free zone arrangements for exports, and an increasing level of expansion in local micro and small-scale enterprises (MSEs) in the so-called *informal* sector.

The issue of local or *endogenous* technological innovations has often been underestimated in analyses and policy interventions. A fundamental problem is that the micro-innovative strengths that really exist often remain isolated and encapsulated, thus weakening their potential contribution to the up-keep and viability, let alone the international competitiveness, of national economies (Arocena & Sutz 2002; De Soto 1989).

Yet, the majority of peasants and artisans in the South are reproducing their livelihood through innovative technological transformations and diversifications in response to their continually changing social, economic and environmental conditions of production. If they did not, they would not survive. They are highly knowledgeable and skilled, certainly not ignorant as the public is commonly told. In other words, it is our contention that *a significant social and productive potential is being disregarded and not seriously considered in conventional development research in general and by policy makers in particular*.

Background

Between 1974 and 1977 the editor of this book undertook a research project in Tanzania about village blacksmiths (Müller 1980). The purpose was to find what 'appropriate technology' (Divan & Livingston 1979) could be transferred from Europe to Africa in order to assist the development of their production systems. One of the conclusions was that *the blacksmiths were already using the most appropriate technology*, given the local conditions of production. Whatever other technologies could be transferred appeared not to be practicable in the local settings.

However, another conclusion was that the traditional craftsmanship apparently was undergoing a process of liquidation. The products, a multitude of agricultural and other tools, practically disappeared from the markets in the period. The reason appeared to be that the local conditions of production of the rural artisans were deteriorating.

[1] In this book the brief term 'the South' mainly refers to Africa and Latin America.

Most of the Tanzanian civil servants, politicians and academics interviewed during that research project did not really appreciate the recordings made from the field work: "Why study these indigenous artisans, they are backward, lazy and crazy – ignorant". Yet, in this regard, the conclusion of the research was that the village blacksmiths are *skilled, industrious and sane – wise* (Müller 1980). This conclusion did even offend the director of the Small Industries Development Organization (SIDO) in Tanzania who originally had provided research clearance and other assistance; he totally rejected the analyses and the research report.

However, in 1994 a brief follow up research visit was made to Bukoba, the main town in Kagera Region at the West shore of Lake Victoria (recently renamed Lake Nyanza), where the first blacksmith study was initiated. The purpose was to see to what extent the relatively pessimistic conclusion of that study would be confirmed.

Digging hoe trade mark stamped *SUPER 1995*

Surprisingly, the Bukoba market was now bursting with goods of all kinds. And several market stands had a wide range of products made by the local village blacksmiths. A bombshell detail was that some of these tools had even been 'trade-marked' *SUPER 1994* with a rough chisel. This gave reason to come back the next year for an extended research visit. Now the blacksmiths' products from the same market stand were (of course) stamped *SUPER 1995*. These observations obviously had to be more closely investigated and resulted in a preliminary conclusion that, yes, the local conditions of production of the blacksmiths had undergone substantial changes (Müller 2001). The questions for further research now did focus on what changes in the local condition had taken place, how and why.

The follow-up research project

This book connects the above mentioned research projects with new observations and records from a follow-up research project conducted jointly by Pernille Bertelsen and Jens Müller from the Department of Development and Planning, Aalborg University, Denmark. The project was titled *Indigenous Systems of Innovation in East Africa* (1998-2003), and done in collaboration with Eginald Mihanjo, Department of History, University of Dar es Salaam, Tanzania; Bernhard Nsana, Institute of Development Management, Mzumbe, Tanzania; and Bitrina Diyamett, Commission of Science and Technology, Tanzania[2] (Nsana et al. 2002).

The points of departure of the research project were the following objectives:

- to highlight the dynamism of selected local systems of innovation in rural Tanzania;
- to contribute to a broader theoretical paradigm in technology studies in the South;
- to explicate possible policies and interventions that may facilitate mobilisation of the technological knowledge and organisational capabilities of rural artisans.

[2] Collaboration was also initiated with Department of History at the Mondlane University, Maputo, Mozambique. Additional research was carried out in Central America together with Department of History, International and Social Studies, Aalborg University; Centro Internacional de Política Económica para el Desarrollo Sostenible, Universidad Nacional, Costa Rica; Escuela de Economía Agrícola, Universidad Nacional Autónoma, Nicaragua; and Fundación Nacional pare Desarrollo, El Salvador (Johnson et al. 2009).

The project linked up to the general development research agenda, which attempts to uncover the impact of the globalisation and structural adjustment processes presently at work. A particular focus was on the structure and institutional setting of the national technology systems in general and of the systems of innovation in the informal sector in particular.

Initially, selected case studies were made in Tanzania of local technologies used for tool making by village blacksmiths and for boat building in the artisanal fishing sector. Historical evidence of the formation of the connected local systems of innovation was collected in order to bring forward an understanding of the dynamics or otherwise of these systems.

This book deals primarily with *manufacturing* enterprises – mainly in rural areas – that operate in the so-called informal sector. The entrepreneurs and workers in this sector are referred to as craftsmen.

The guiding research question of the project was: *What social processes are reproducing and transforming the indigenous systems of innovation?* In the research process the scope was expanded to indicate answers to the following more general questions:

- what local socio-technological transformations are taking place in the South?
- how are these transformations occurring?
- why – in spite of all the obstacles encountered – are they apparently relatively successful?

Having provided some answers to these questions, this book concludes by an attempt to indicate that an *other* technological transformation is taking place in the South than in the North. This transformation diverts from the conventional one-dimensional conception of what technology development entails.

The concluding proposal for needed policy change is therefore pointing at the necessity for full recognition and strengthening of the local systems of innovation, i.e. for interventions that not just have the conventional, but fruitless, 'catching-up' technology policy outlook on the agenda.

The question is: How to open the global technology bar?

The present situation (2010)

Fortunately, in the late 1990'ies we met Tanzanian and other researchers with a critical outlook of the euro-centric conception of technological development. In other words, there seems to be an encouraging change underway of past times ideological conceptions of technology and development in the South. Reference to likeminded researchers will be made throughout. This book attempts to highlight some of the emerging opportunities, but also potential pitfalls, for understanding, appreciating and possibly even supporting the local socio-technological transformations in the South.

Impressive work is being done e.g. by the African Technology Policy Studies (ATPS) network (Juma et al. 1993), a director of which recently stated:

> "There is a strong understanding that without an appropriate science and technology (S&T) policy to anchor and support the economic policies, the economic recovery and renaissance in Africa will be weak at best" (Ogbu 2004).

Thus, ATPS and other likeminded Southern organisations have over the last decade worked intensively to formulate in great detail an appropriate S&T policy. Generally speaking, however, the proposals appear mainly concerned with the euro-centric notion of how the South one day may 'catch-up' technologically with the North. Still, very few refer to the urban and

rural artisans in the informal sector. In this regard, most interventions – if any – are still focussing, more or less directly, to promote 'appropriate technology'; however, still with little reference – if at all – to the need to create appropriate *local conditions*. The relative failure of this form of activity will be discussed in various chapters in this book.

A first step would be to *recognise* the resources of the local artisans, and then to include them in whatever policies that may be formulated and implemented. Some movement towards this end seems to be underway. Here we refer to efforts by the Government of the Republic of South Africa that in 2004 did a first step towards formulating and promote an explicit Indigenous Knowledge Systems (IKS) policy (www.dst.gov.za).

And 25 years after the SIDO director had rejected the initial blacksmith study report, Jens Müller was asked by the Ministry of Agriculture and Food Security in Tanzania to take part in the design of a project that would mobilise the village blacksmiths to boost agricultural development (Diyamett et al. 2005). By then, interviewing SIDO and other practioners in rural technological development gave reason to believe that the previous ideological disregards of the village artisans have changed.

Given the present world-wide finance, climate and governance crises that beyond doubt are leading to an unprecedented global systems crisis (Klein 2007), it is high time to facilitate the mobilisation of all hitherto neglected resources. One of the most conspicuous and obvious consequence of these crises is what is generally referred to as the food crisis, which will be central – although implicit – to the discussions in this book.

Methodology and outline

The book advances back and forth between theory, conceptual explications, empirical recordings and analysis, i.e. using a dual inductive-deductive case study methodology. The field work was arranged both as snapshot and as multiple visits over time to selected artisan worksites.

These case studies were selected from various areas of North-West and South-East in Tanzania. With reference to similar studies from rural Tanzania we are able to provide a generalized case study presentation of the rural informal artisan sector in Tanzania. Knowing well that the Tanzanian society is embedded in a particular cultural setting with a particular socio-political history, we nevertheless, with reference to similar studies from many countries in the South, venture into an overall picture of how we may conceive the local socio-technological transformations in the South. In other words, a 3 level case study approach is applied.

Part I starts out with a critical stance of the euro-centric notion of what science entails in general and in particular of how technology is conceived. It then introduces a holistic conception and model of technology that facilitates decisive operational analyses of the relations between technology and its socio-political and -economic as well as cultural confines, i.e. a socio-technological theoretical framework. This is coupled with the National Systems of Innovation (NSI) methodological approach. Particularly relevant dichotomies, institutions and structures are explicated, which form the main analytical tools for the subsequent parts of the book.

Part II provides the empirical background of the study with reference to past and contemporary recordings. The focus is set to our concrete case studies, mainly from the rural artisan sector in Tanzania. In depth case recordings are in particular provided of the changes that have been observed of the village blacksmith segment, which to a large extent forms the backbone of most artisan operations. Then further case studies of local boatbuilding and pottery are presented that inter alia illustrate concomitant user-producer commodity relations. This leads to an outline in Part III of how the changing conditions of production apparently

are affecting the technological transformations in Tanzania in particular and in the South in general.

The analyses provided in Part IV attempt both to forward a general empirical picture of the technological transformations observed in the informal sector in the South, and to provide some new theoretical inductions that can be drawn from these observations. We then provide a systems analysis of apparent diverging social constructions of technology in the South, ending up with an attempted global view of diverging technology transformation paths.

Finally, Part V concludes by pointing at what particular lessons can be deducted, what policy changes are needed and what further research is called for, in order to establish the necessary link that may facilitate making the diverging paths meet.

The topic of technological transformation has been dealt with from many angles in numerous publications. The reader will therefore find many references throughout the book that we find relevant, and that in one way or the other may be useful for follow-up research.

Part I: Theoretical framework

Although numerous new conceptions and theoretical frameworks have been forwarded in recent decades that attempt to abandon the euro-centric notions and approaches in development research (Pieterse 2000), these have mainly been within the social and political sciences confines. For some reason *the concept of technology as such has not really been challenged.*

Very few, if any, development researchers make an explicit effort to specify how they define technology; it seems – so to speak – to go without saying, and the concepts of technique and technology are often used interchangeably.

In this part of the book we set out by presenting an initial general critique of the predominant euro-centric theoretical outlook in development research. Next, we zoom in on key concepts related to technology and its social relations. A number of analytical tools are explicated that were developed and applied during the protracted research period. Finally we refer to conceptual frameworks from social and political sciences and empirical recordings, which were elaborated by others during the same period, and which we found to be most relevant for our purpose.

1. The colonial scientist

Jens Müller

Over the past four decades it became more and more apparent that what Basalla (1967: 611-622) called the 'dependent colonial scientist' is not capable of providing adequate and relevant insight and knowledge about the development processes in the South. Sagasti (2004: 1) elaborates this:

> "The colonial scientist is dependent in the sense that the sources of his education and training, the origin of the scientific traditions that he adheres to, the orientation of his activities and the ways of obtaining recognition for his work, are all defined in the metropolitan scientific power and not in the country or region in which he lives and works".

Recently the Tanzanian government declared the 21st century to be *Karne ya Sayansi na Teknolojia* (Century of Science and Technology) supposedly in compliance with the challenges of the current process of globalisation. Partly in reaction to this, the Kiswahili expression *teke-linalokujia* was coined. Its direct translated meaning is 'the kick aimed at you'. But its subtle indirect meaning is jokingly to say that either you avoid the kick or it hits you.

Why avoiding technology and why would it kick you? We all know that we do not survive without technology, so why not let us be prepared for the kick? Is technology something to joke about? The answers of course depend not only on your mood, but on how technology and a lot of other things are defined. In search of that, let us have a close look of recent critiques of the whole development discourse.

Are we talking about technology in its ontological meaning; or are we referring to the current globally perpetuated euro-centric discourse of technological development? The latter may be conceived as the joke of our time, but certainly nothing to joke about.

Sardar (1999: 46) appears to be joking when he says:

> "In its euro-centric vision of the future, technology is projected as an autonomous and desirable force: as the advertisement for a brand of toothpaste declares, we are heading towards a brighter, whiter future".

On the other hand he is dead serious in his introductory section:

> "The real power of the West is not located in its economic muscle and technological might. Rather, it resides in its power to define. The West defines what is, for example, freedom, progress and civil behaviour; law, tradition and community; reason, mathematics and science; what is real and what it means to be human. The non-Western civilisations have simply to accept these definitions or be defined out of existence" (ibid: 44).

In other words, there is an urgent need for scrutiny of the conception of technology as such. Being Northern European, I am ill equipped to do so, but have tried (Müller 1973, 1980 and 2003), and I hereby invite concerned Southerners to join in a dialogue.

What hopefully may come out of such a dialogue would be a much deeper understanding of the relations between technology, society and culture. Scholars have suggested that technology is culture, and vice versa, and proposed the notion of a 'seamless web' (Bijker & Law 1994: 273). Inviting as this analogy may be, it would make the study of explicit technology-society interrelations very complicated.

And we should go along with Alvares (1991: 3) where he notes:

> "African anthropologists' analysis of the ethnocentrism supporting the main body of anthropological literature on African peoples can be repeated in areas as diverse as political standing of technology and culture in the world at large".

What is called for is that African scientists and technologists analyse the ethnocentrism of literature on African peoples' past and present technology. Alvares later elaborates by saying:

> "European music was music, all other music anthropology. The study of white men, even, was a separate science called sociology: anthropology was for the rest. Methodologies of knowledge acquisition that ignored the scientific frame of reference were permanently unreliable or ideological" (ibid: 6).

History thus becomes important and we may start with Tucker (1999: 8) where he states:

> "Societies that deviate from the European techno-economic standards are designated as 'traditional' or 'primitive' despite the fact that they are contemporaneous with those who label them as such… In the real world there are no traditional societies, only ways of looking at societies as traditional".

He also warns us with reference to the euro-centric analytical tools at our disposal by saying:

> "Totalling theories by their nature colonise and subsume other histories and existence rationalities. These theories are essentially imperial and cannot do justice to the diversity of discourses and cosmologies to be found in different societies" (ibid: 11).

We therefore need to go 'back to history' as Young (1990) has pledged. But he also asks: which one? Is it possible to write history that avoids the trap of euro-centrism? And he finally tells us that decolonising history is a deconstruction of the West.

As for the Southern countries the vision would be eventually to decolonise their history in general, something that has being worked at for years now (Ogot 1999). But also their history of technology, something we have seen very little about, although Kjekshus (1996) and Koponen (1988) have done very essential recordings of pre-colonial and colonial history in East Africa with reference to technological developments.

A first step though would be to try to deconstruct the history of technology of Europe. Doing so may help us disentangle what has become commonly understood as *the* technological evolution, progress, advancement, innovation etc. Attempts to do so have been made in Europe, e.g. by Bijker et al. (1987) and in particular by Noble (1984) telling us about 'the roads not taken'. Such attempts were made with some success to counter the predominant technological

determinism: the nuclear plant was always there since the Stone Age, it has just been waiting for man to be clever enough to discover it. This would go for, say, the neutron bomb as well:

> "…the height of human backwardness, which destroys people, but keeps buildings (and presumably, dollars) intact" (Alvares 1991: 213).

Or as Sardar (1999: 64) puts it with reference to science:

> "The West elevated mathematics into Platonic reality: it really exists, there is a pi in the sky, laws of physics are laid down in heaven in mathematical formulae and mathematics simply discovers them. This approach elevates mathematics pretty close to God in traditional theology. Mathematics is part of the world, but it also transcends it. It must exist before and after the universe. Most scientists and mathematicians operate as if Platonism is true, regardless of whether they believe that it is".

What still is needed is to rinse even the critique of science and technology of its euro-centricity. It will not be easy for Northern scholars to do so. So again, we need assistance from the South, from Southerners, that is, who are not equally infested from primary school and upwards in the ideologies of their colonisers (Juma et al. 1993). We would not find many Southern scholars with PhDs from say, Aalborg University, who were not put to work to comply with European academic standards, and thus ultimately with its ideologies.

For as Sardar (1999: 53) tells us:

> "The ideology of science and technology is the most formidable of all forces that keep development entrenched and ensure that euro-centrism continues unabated. It is a rationality of domination….Science and technocratic consciousness maintains the status quo and legitimises the present structures within nations and between nations".

Table 1.1 winds up this discussion with the following schema that highlights some of the points I have tried to make in this chapter. It illustrates what is commonly understood, however misconceived on my opinion, as features of the so-called international technology divide.

Northern Technologies	**Southern Technologies**	**Comments**
High	Low	Presumably a measure of labour productivity, but not of capital or knowledge investments
Advanced	Backward	Signifying the common one-dimensional perception of socio-technological transformations
Modern	Traditional	Taken from the modernist "stages of growth" perception
Developed	Underdeveloped	Assuming the need for Southern countries to "catch up" to become a par with Northern countries
Complex	Simple	Referring mainly to the vertical not the horizontal division of labour
Sophisticated	Rudimentary	Wrong: sophistication is synonym for wisdom, rather applicable for Southern technologists
Evoluting	Devoluting	Again assuming only a one-path technological trajectory
Innovative	Imitative	Not considering that all innovations very often imply all kinds of imitation

Table 1.1: Misconceived notions of technology in North and South.

2. Holistic conception of technology

Jens Müller

A first step towards de-colonising the concept of technology would be to elaborate a holistic and ontological universal definition of technology. What is needed is an open-ended technology conception that enables us to comprehend the relations between technological and social change, and to elaborate inter-disciplinary methods to identify and solve problems related to technological transformation. For a relevant discussion of different definitions of technology, see McLoughlin (1999).

2.1 The constituents of technology

Following this discussion, and in line with the above-cited purpose, our definition of technology reads:

> *Technology is one of the means by which mankind reproduces and expands its living conditions. Technology embraces a combination of four constituents: Technique, Knowledge, Organisation and Product*[1].

The four constituents are *inseparable* components of any technology. A comprehensive analysis of a particular technology therefore has to include *all* constituents *and* their interrelationships.

Each constituent or component can of course be described and analysed separately. In fact they make up the main fields of a technology analysis, each field being equally valid as an entry to such analyses. The four components can also be conceived as the main interacting *variables* of technology. They are thus all to be included when it comes, not only to analyse, but also to effect technological change.

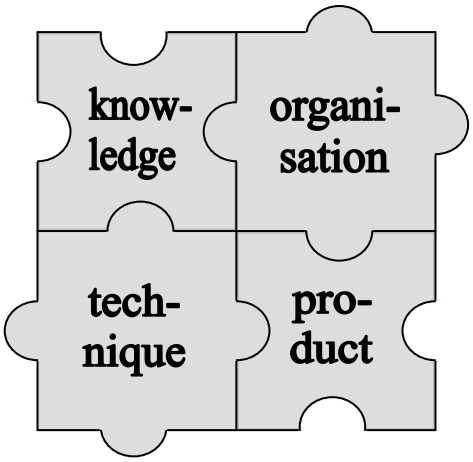


Figure 2.1: The technology concept

Our definition of technology is symbolically illustrated in Figure 2.1. All four components are depicted as pieces of a jigsaw puzzle, arguing the following thesis:

A qualitative change in any one of the components will eventually result in supplementary, compensatory and/or retaliatory change in the others. If this does not happen, *the initial change initiative will become abortive*.

This, however, is not to say that there is any one-to-one deterministic relation between the variables.

Areas of technology analysis

The definition of technology devises how to describe a given technology through its four constituting components. By such a description we derive the *structure* of any particular technology. To this comes a *process* perspective. In fact a technology can be conceived as consisting of several simultaneous and often contrasting processes.

[1] This definition was first forwarded by Müller (1973) and has proven its methodological applicability since then. For an elaborated presentation see Müller (2003).

The main structural contents, and the concurrent process features, of each of the four areas of technology analysis are as follows:

Technology as technique: The structure of technique is made up of all the physical *implements* or hard-ware involved in the technical process in question. To this come the *raw materials, components* and *energy inputs* that are transformed or consumed in the same process; in this sense the process is a transformation and consumption process. These processes are set in motion by *physical labour*; we thus have to do with a labour process as well.

Technology as knowledge: The knowledge component or soft-ware is structured according to the empirically acquired *skills, tacit knowledge* and *intuition* of the direct producers and the *scientific insight* and *creativity* of the technology designers. The processes involved are cognitive labour processes and searching-learning processes, which include all kinds of information input processing.

Technology as organisation: The internal *division of labour* and *pattern of specialisation* are central to the structure of the organisation component of technology. For argument sake, we may call this component the 'org-ware'. The counterpart to the division of labour is co-operation. This requires *management* and *co-ordination* and involves all kinds of communication processes.

A useful structural distinction is between what is termed *horizontal* as opposed to *vertical* division of labour. The former is characterised by numerous, largely unconnected, similar production processes of final products. The latter implies backward and forward linkages between production processes of components that eventually end up as finished products for consumption.

Finally, we distinguish between what we call technically determined and socially determined division of labour. The former implies that the knowledge and even the organisation components of technology are embodied the technique to such an extent that the division of labour so to speak is pre-determined. To the contrary, where the division of labour primarily is socially determined, the room of manoeuvre for alternative arrangements is much broader.

Technology as product: The product component of technology stands for the *immediate result* of the combination of all the above mentioned processes. The structure of the product takes indefinitely different kinds of shapes. Here we shall just mention a distinction between material objects and immaterial services.

We differ from most other technology conceptions by insisting on the product as an *integral* component of technology. The main arguments for doing so are:

- We aim at a holistic conception that enables us to comprehend the total *purpose*-oriented application of technology. We envision technology - including the product - as a means to satisfy needs or solve problems. The product is not an end in itself, but interacts with other societal processes. The combined choice of technique, knowledge and organisation is intimately related to the choice of product.
- The product, the result of a preceding production process, supposedly has a *use-value* that sooner or later enters a consumption process. Now, large portions of consumption processes are new production processes. The product thus bridges the gap between *consecutive* production processes.
- Most products, including service products, are also commodities: Besides the use-value, the product carries *exchange-value*. This has become a dominating purpose of application of technology and adds an economic-surplus-generation process to the process perspective of technology. Without a clear perception of the exchange-value attribute of the product, the specific formation of most technologies becomes incomprehensible.

Box 2.1 and 2.2 give an elaborated argument for including the product as an *integral* component of the technology concept. The two case boxes also illustrate that the conception held by conventional economists that any particular product can be made by use of qualitatively different combinations of technique, knowledge and organisation, is highly misleading.

In 1966, a road project in Tanzania was planned by the government to be constructed with big machines, e.g. bulldozers and excavators, the manpower to be 100 skilled and 140 unskilled labourers; the knowledge part was to be scientific engineering; and the organisation was public works. The product was specified to be 12 cm compact gravel, 6 m wide, over a length of 420 km.

However, no backup services for the machines were available, so the project almost came to a halt. Labourers were therefore hired to replace the machines. The project then employed about 50 skilled and 3800 unskilled labourers using shovels and pickaxes etc. The knowledge part turned into local engineering know-how; the works organisation did change to become of local origin; the product did not change as such. And the project got very well underway.

But for a number of reasons the Ministry did not approve of the change. The project was stopped halfway, and the rest of work handed over to a foreign contractor. He opted for a technique and knowledge similar to the original plan; the organisation was within private confines; the product remained the same. The contractor did progress well. The reason being that he could organise the backup: Almost every day an aeroplane did bring spare-parts, fuel, and even food and wine for the 120 expatriate workers. He employed 20 local labourers, but only as servants to the operators.

Heavy traffic did start - copper transport from Zambia - and it soon became clear that the road would not last long unless intensive maintenance was organised. The foreign contractor had left the area, so maintenance was organised relying on local labour. Doing so was no problem on the first part of the road length: workers - having taken part in the construction - knew the ins and outs of the road, and they had a sense of ownership to the road. But the people employed to maintain the part constructed by the contractor had neither the knowledge needed nor organisational skills, and the road was an alien structure to them.

On the first part of the road, the maintenance fared quite well. However, the last part of the road frequently broke down; and the traffic flow eventually stopped.

Thus: Two apparently identical products turned out to be socially very different! The reason being, that the two parts of the road were constructed by very different combinations of technique, knowledge and organisation. The first part did match the local conditions; the second part did not. (This is not to say that the foreign contractor could not have maintained the last part, but the cost would have been prohibitive).

Box 2.1: Two apparently similar, yet socially different products (Müller 1970)

This observation is particularly important where the social and environmental effects of two seemingly similar products are assessed. E.g. take two apparently identical shirts, A and B: Shirt A has been produced by child labour and resulting in highly polluting waste materials; whereas shirt B has been made by organised labourers under cleaner technology considerations, i.e. under healthy working conditions with ecological protective waste management arrangement. Thus, such shirts must not be considered to be identical products.

All three sandals shown in Box 2.2 were purchased in Dar es Salaam at more or less the same price or exchange value. Although the plastic sandal may look more ‘fancy’ than the others, it is impossible to repair, whereas the other two sandals can be repaired locally: the leather sandal can be repaired by the sandal maker himself or by some similarly equipped workshop; the tyre-rubber sandal can often be repaired by the owner her/himself.

The longer term use-value of the leather and the tyre-rubber sandals are therefore much higher than the plastic sandals. We may say that this is because they are *locally embedded*.

Three examples of results of sandal production are illustrated, all with more or less the same *functional* characteristics, that of foot protection with ventilation. We hold that they have the same use-value in that respect. Yet, they are different in what we could call *structural* characteristics. They have different dimensions and are made of different materials: plastic, leather, and tyre-rubber.

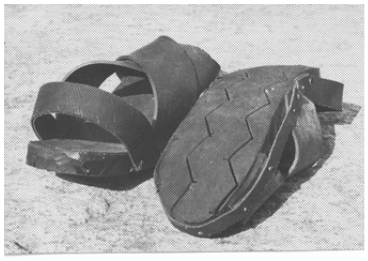
Moreover, we can easily imagine that they were produced by different machines or tools: The first by a plastic-injection moulding machine, the second by a sewing machine and the third by a knife and hammer. In other words, they were produced by different *techniques*.

The *knowledge* requirements were also different. The first requires a lot of science-based knowledge; the two others are relatively more skill-intensive, i.e. based on empirically accumulated knowledge.

Finally, the *organisation* of the production also varied substantially. The plastic sandal embodies a high degree of technically determined division of labour. The leather sandal may have been produced by one man only, but may also have been made by different workers or apprentices directed by a master sandal-maker. The tyre-rubber sandal was most likely made by one person, who acquired the tyre and also sold the finished sandal himself.

Plastic sandals

Leather sandals



Tyre-rubber sandals

Box 2.2: Similar products representing different technologies (Müller 2003)

2.2 Social conditions of technology

What actual technological changes do occur is as much dependent on the external socio-political, economic and cultural setting, i.e. the 'local conditions' mentioned in the introduction, as on the internal variables of the technology in question. This is what Schot (1991: 5) terms *co-evolution* of both the technology and the selection environment.

Examples of some of the most important external social variables that condition technological change are symbolically indicated by the jigsaw pieces in Figure 2.2.

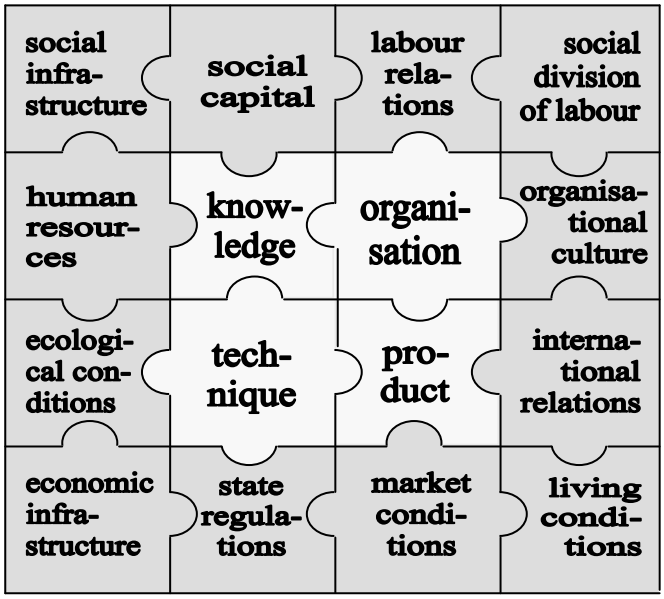


Figure 2.2: Technology and selected contextual conditions illustrated

These 'outer' pieces do not only 'stick' together with the technology jigsaw pieces, they also all 'stick' together with each other. When and if a change in e.g. the social infrastructure or say the international relations occurs, this will not only have

repercussions for most of the other 'outer' pieces or 'local conditions', it will likewise influence the technological setting of the country.

Not that there is any static concord between all the jig-saw bits and pieces, but there nevertheless will be some fit over time. In other words, technology does not have a predetermined logic of change.

2.3 International technology transfer

Perhaps the most palpable use of the model in Figure 2.2 is to apply it to the issue of international technology transfer as illustrated in Figure 2.3.

A technology package send from the North to the South is transferred from one social setting to another and does most often not fit into the latter. This problem may be solved in 3 ways:

- Option 1: The technology being supplied is fully adapted to the social setting of the receiver.
- Option 2: The social setting of the receiver is fully adapted to fit the technology supplied.
- Option 3: Both the technology supplied and the social setting of the receiver are changed or 'moved' to fit each other at some point, which hardly can be pre-determined.

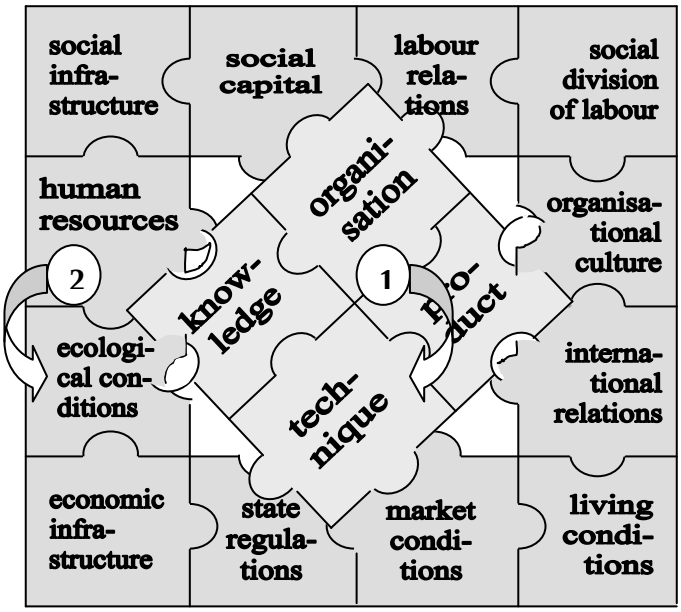


Figure 2.3: The dilemma of international technology transfer

Option 1 was a very popular prescription in the 1970´ies: The technologies transferred to developing countries should be *appropriate* to the local conditions. However, taken to its full consequence, this strategy leads nowhere, because what would be a totally appropriate technology would, most often, *already* be there (Müller 1980).

Option 2, to bring in the newest technology from a foreign and thus very different setting and then hope that the local conditions can be adapted accordingly, is obviously not feasible either. E.g. it would probably take some centuries – if at all desirable – to change, say the Tanzanian social conditions to become fully equal to the Danish.

Only by leaving the either-or notion and opting for *something of both*, i.e. option 3, where both the technology and the social setting are changed, a sustainable assimilation process may be set in motion.

This is also to say that there is no clear-cut 'recipe' for what must be done. Almost each case has to be treated separately.

2.4 Conventional history of technology

Regrettably we can only refer to conventional euro-centric conceptions of technology history. However, in Chapter 14 we attempt to draw up at picture of what we see as contemporary changes in Southern systems of production, and thus of the technology settings.

The history of technology in Europe until the industrial revolution in the 19th Century is usually told as follows. For an expanded presentation see Müller (2003). Figure 2.4 presents the 3

production systems that make up the 3 consecutive – however overlapping – production systems that conventionally describes the first phases of the technological evolution in the North.

What conventionally is called the *artisan system* [type 1] gradually turned into the so-called *putting-out system* [type 2], and then into the *manufacturing system* [type 3].

In this process the social division of labour underwent noticeable changes. Under the *artisan system*, the division of labour was very limited and not based on any noteworthy specialisation pattern. With the introduction of the *putting-out system* a significant division of labour between the producer and the distributor came into effect, gradually increasing the dependence of the producer on the distributor. The *manufacture system*: Apart from the spatial concentration of the producers, the transformation in the division of labour was mainly horizontal and quantitative in nature.

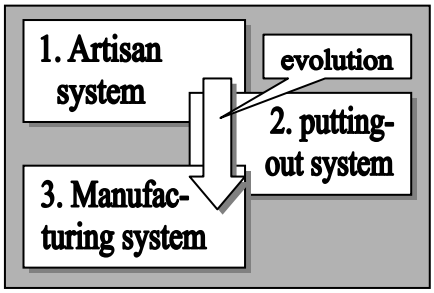


Figure 2.4: The first phases of technological evolution in the North

The emergence of mechanically powered machines in the 19th Century implied drastic transformations of the technique component of technology, which subsequently led to an unprecedented *internal* vertical division of labour. The new production system came to be known as the *fordist factory system* [type 4 in Figure 2.5].

After World War II, the previous empirically based knowledge production was replaced by a largely science based knowledge production. We see the emergence of what we term the *science based factory system* [type 5].

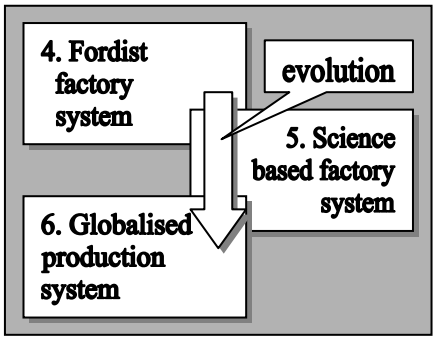


Figure 2.5: The second phases of technological evolution in the North

In the technology debate of the last three decades most authors seem to agree that dramatic changes in the productive and social structure have been underway. We are told to witness the micro-electronics revolution or the post-industrial revolution leading towards the de-industrialised information and/or service society.

After the dramatic decline of the centrally managed economies of Eastern Europe the capitalist markets are now penetrating the whole Globe. This process is termed *globalisation* (Archibugi & Michie 1997) and gives reason to term the emerging production system as the *globalised production system* [type 6].

Here we need to stress that our perspective of technological change focuses on the emergence of more and more new types of production systems. This is not to say that *all* production systems change accordingly and simultaneously. On the contrary, the different systems *co-exist*.

2.5 Innovation defined

Experience tells us that many readers using our four component model of technology get the impression of it being static, possibly because their thinking is statically embedded in classical equilibrium thinking. Our view is more in line with an evolutionary perspective, much in line with Edquist (1997: Part II). Technological transformation is viewed as taking place in incremental steps rather than in sudden 'big leaps forward'.

We therefore appeal to see the jigsaw puzzle parts as being in an ever-changing mode. Only in very short intervals of time will there be full congruence between the parts, if ever. Here we claim to have depicted a broad definition of the concept of technological innovation:

Qualitative changes in any of the 4 elements of technology that effectively leads to a transformative move and thus change of the other elements, we denote a technological innovation (Müller 2003: 54).

This definition begs the question of what a qualitative change is about. Briefly speaking it can be identified as changes in the structure-process relations within and between the different parts. NOTE: Technological innovation by our definition includes, say, organisational and product innovations, i.e. not only technical innovations[2].

Another easy definition of innovation is illustrated here: *Combination of existing bits and pieces in new ways*.

Two different innovations that combine existing bits and pieces in new ways

Phases of the innovation process

The mainstream perception of the innovation process conceive it as being made of a uni-liniar chain of events that happens in a number of different phases over time, e.g. from invention over innovation to diffusion.

We have depicted 5 of the most commonly conceived *phases* in Figure 2.6. The activities of each phase are:

- Basic *research* is performed in discovery of the ins and outs of natural and social phenomena. *Science* in a broad sense constitutes this activity.
- Then comes the *development* phase. This includes applied research, resulting in different technological development concepts for new processes and products. The main *knowledge* part of the technology is constituted. The necessary *know-why* is emerging.
- In the *formation* phase the development concept is turned into different formation *principles*. The *technique* part takes form as new processes are invented and conceived by design, prototype testing and engineering. *Know-what* is created.

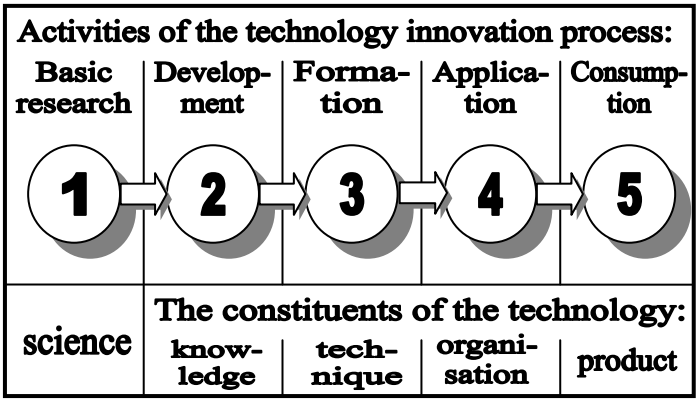


Figure 2.6: Conventional uni-liniar conception of the technological innovation process.

[2] Innovations are conventionally conceived as new creations of *economic significance*. However, we intentionally refrain from referring to the economics or otherwise of innovations. To us it suffice to talk about societal significance, if need be.

- *Application* phase: The formation principle is now innovatively applied in a particular *mode* of operation. The *organisation* part of the technology is determined. This *know-how* is then used to actually produce capital and/or consumer goods.
- As the *product* finally materialises it enters the *consumption* phase, either as input in a new production process or for final human consumption. *Know-who* in the form of consumer demand and marketing knowledge is applied in this phase.

2.6 The roads not taken

However, this simple model hides two crucial characteristics of the innovation process: the innovation process as (i) a multiple *selection* process, and (ii) a highly *iterative* process. We therefore, with reference to neo-Shumpeterian economists (Schot 1991: 4), have to supplement the model with two more models before we even begin to understand what it implies.

In Figure 2.7 the technological innovation process is symbolised as a *selection* process with an emphasis on the various choice it implies. It shows that the development phase starts by choosing one of several science areas (1), which then open up for a number of differing development concepts. One of these (2) is chosen and may subsequently be converted into *more than one* formation principles, one of which (3) is selected in the shape of a *variety* of modes of application. Technological inventions are shaped. Then a particular mode of innovative application (4) is chosen to turn out different products, one of which (5) appears to be the dominant marketed result of the entire innovation process (Müller 2003).

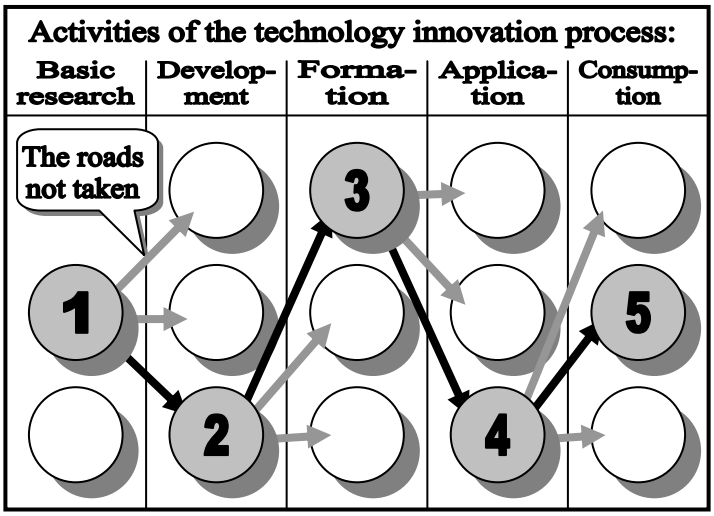


Figure 2.7: The technological development process as a zigzag selection process.

The model demonstrates the selection that takes place (the shaded circles) as well as the many potential options not chosen (the open circles), also called 'the roads not taken' (Noble 1984: 143-192). The open circles in phase 3 are also termed inventions, but only the shaded circle chosen will eventually be termed innovation. In other words, many inventions do not necessarily materialise as innovations (Rosenberg 1982). Only by over-looking or even forgetting these 'roads not taken' can the zigzag picture be drawn as the straight line presented in Figure 2.6.

The choice or 'road' taken in each case is primarily determined by the socio-economic/political and cultural setting in question. E.g. each phase is under influence of a set of consecutive regulations at work such as (1) research policy regulations, (2) regulation of information flow, (3) environmental regulations, (4) working environment regulations and (5) market regulations.

Most often these societal settings and regulations are following a particular pattern over time. We therefore experience what is called *path-dependency* (Meyer & Schubert 2007), i.e. only minor changes in the zigzag pattern of the technological development shown in Figure 2.7 are taking place. However, in different societal settings we would find technological transformations following *other* paths.

Finally, the straight uni-liniar line conception depicted in Figure 2.6 above also gives the impression that the innovation process proceeds from left to right only. Of course numerous iterative feed-backs are taking place over time. This major drawback of the model can be overcome by adding a second dimension to the model, a dimension that considers the phases as *levels* of the innovation process as shown in Figure 2.8. And it must be kept in mind that all kinds of assimilations and adaptations take place at all levels.

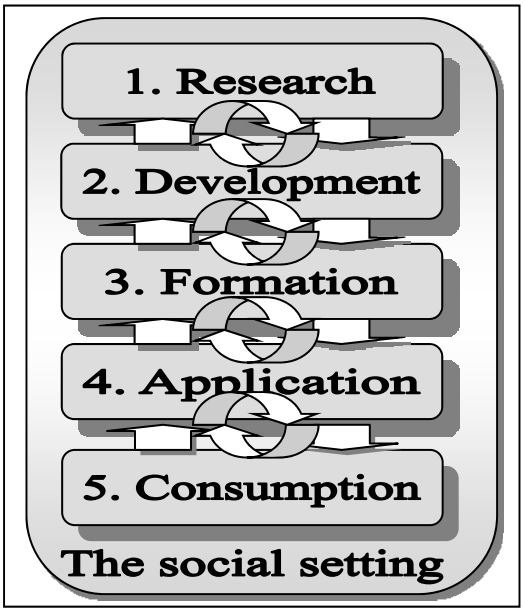


Figure 2.8: Levels of the inovation process in its social setting

2.7 Social carriers of technology

In Section 2.2 we told that technology primarily changes according to a socially determined logic. Also, the overall structure of the social setting in question makes the limits to what change may happen. Yet, as said, we do not subscribe to a rigid social determinism of technology, just as we do not take a technology deterministic standpoint.

What we see are numerous social units (e.g. households, enterprises, co-operatives, government organisations) acting within the limits of a certain, but *ever changing*, structural room of manoeuvre. These actors we call the *social carriers of technology* (Edquist & Edqvist 1979). This concept can immediately be applied to the situation where the actors are choosing amongst existing technologies. In other words, we find that the social carrier conception can open up for studies of actor-structure interrelations, which we find crucial for an understanding of technological transformation.

A particular technology may be chosen when the following 6 necessary conditions are fulfilled. The actor unit in question must have:

1. ***Interest*** in applying the technology, i.e. be motivated to obtain and operate the technology;
2. ***Power*** to materialise its interest, i.e. be in possession of the required socio-political and economic means;
3. ***Organisation*** to exert the power to establish the necessary internal conditions for applying the technology, and must be affiliated an interactive external task network.

The unit must further have:

4. ***Information*** about the technological options, i.e. be able to assess the potential alternatives in relations to the desired need fulfilment;
5. ***Access*** to the technology in question, i.e. be able to obtain and procure the hard- and software of the technology;
6. ***Knowledge*** about how to operate the technology i.e. be in possession of the capability to handle the required technique and work organisation.

When two or more different units co-operate in applying the technology we have a c*ombined* carrier of technology, e.g. in the case of a joint venture. Note: The conditions outlined above are necessary, but not always sufficient conditions.

The carrier concept can also with some elaboration be extended to include the process of technological innovation. In this case there is no ready technology ‘on the shelf’, but usually the carrier will be in command of some technology and be motivated to transform it. The innovation

process normally involves different actors at different levels. Some of these actors are R&D organizations, some are design and construction consultants, and others are actual operators of technology. Such actors are often linked together in one way or another in different task networks and make up a variety of *linked* carriers of technology.

The aggregate of single, combined and linked carriers of technology of a society make up the *technological capability* of that society. This capability has both a quantitative and a qualitative dimension. The number and size of the actor units in question give the order of magnitude of the capability. The contents, range and level of technologies carried by the units mirror the extent of technological knowledge and organisational mastery, i.e. the potential ability to satisfy human needs and solve social problems.

2.8 National systems of innovation

Technological innovations have convincingly been argued to occur within various National Systems of Innovation (NSI). The basic contention is that learning, searching, and exploring take place in practically all parts of the economy (Lundvall 1992; Johnson & Lundvall 2003).

Basic characteristics of the systems of innovation approach are: Interdisciplinary combining a *structure* and an *actor* oriented approach in a historical perspective. Institutions, understood as the 'rules of the game' or value systems and norms, are central[3]. Differences between systems relate to differing structures of production or patterns of specialisation. Emphasis is on interdependence, non-linearity and absorption of new products and processes (Edquist 1997). Wangwe (2001: 2) provides a detailed discussion of African NSIs by including all relevant parts and aspects of the economic structure and the institutional set-up in Sub-Saharan Africa.

Lindegaard (1997: 18) operationalizes the systems of innovation conception. He starts out assuring that:

> "the notion of the knowledge-based and learning economy of innovation systems is applicable for the analysis of past as well as present economies, of less-developed as well as developed countries, and of traditional manufacturing as well as of high-tech industries".

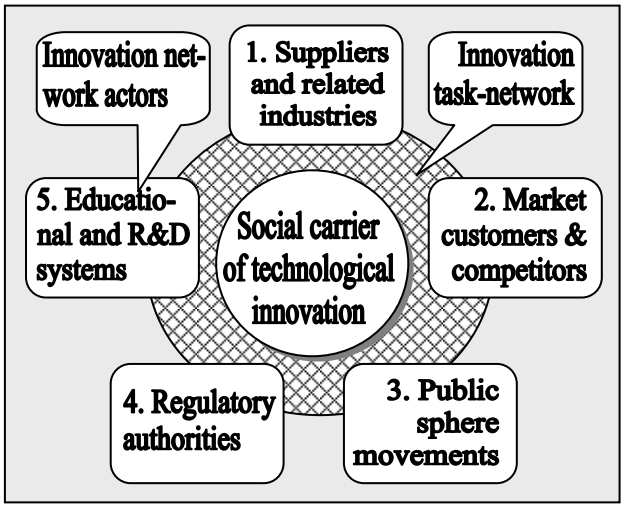


Figure 2.9: Model of an innovation system (adapted from Lindegaard (1997: 18)

The model in Figure 2.9 depicts the important external actors around the social carrier of technological innovation, where different forms of interaction transmit market and extra-market stimuli. At the same time, the external actors operate both as valuable sources for knowledge and as selection environment.

[3] The term institution is often – not here – used in a narrow sense, meaning *institutionalised organisation*, e.g. government actors. For a clarification of the taxonomy confusion see Edquist & Johnson (1997: 41-63).

3. Social relations of production

Pernille Bertelsen & Jens Müller

The focus here will be on the general social setting of many, if not most countries in the South, and in particular on the institutional and structural conditions seen in an actor oriented perspective.

We start out discussing two intriguing conceptual dichotomies that very often appear in development studies, i.e. the distinctions between (i) indigenous-endogenous-exogenous, and (ii) formal-informal. We then present an interpretation of the concepts of diversification, livelihood strategies and labour market relations, followed by a discussion of our conception of infrastructure. Finally, an overall view is provided of the theoretical framework that we use in the following empirical and analytical parts of this book.

3.1 Indigenous-endogenous-exogenous

These terms are used in a number of different analyses and discussions, however often referring to different contexts and used for varying purposes.

Indigenous people

Perhaps the most often use of the term *indigenous* refers to various groups of people in the South as defined by the International Labour Organisation (ILO 1989):

> "Peoples in independent countries are regarded as indigenous on account of their descent from populations which inhabited the country, or a geographical region to which the country belongs, at the time of conquest or colonisation, or the establishment of present state boundaries and who irrespective of their legal status, retain some or all of their own social, economic, cultural and political institutions".

The 1990's were the decade that internationally brought focus on the term indigenous in the meaning of people's rights. It contributed to create policies for, and raised awareness of, the marginalised people in almost all developing countries**.** Attention was given to people that were no longer being marginalised by colonial powers, but by their own governments or multinational companies, because they resisted to be 'developed' or 'modernised', and thus to give up their production system and culture.

However, in the search for improving the livelihood of these people, the United Nations (UN) as well as most development organisations found themselves developing a popular definition of the term indigenous. The danger that rose following that definition was the creation of a short circuit, i.e. a romantic euro-centric view on who were the right people to receive development assistance. Poor indigenous people in colourful dresses on wide plains or desserts are easily getting higher scores than dull dressed poor people from shantytowns – at least when it comes to providing a good image of what development assistance is all about.

Indigenous knowledge systems

On the other hand, at the same time as the term indigenous is used to cover the fight for marginalised people's rights, attention was created to rediscover how many of these indigenous ethnic groups practised a living different from what main-stream politicians and planners have in mind.

Researchers and Non-Government Organizations (NGO) in local agricultural and forestry sectors began to study what are being labelled *indigenous knowledge systems*. Researchers did bring focus to how multinational companies are hunting for the rights to genetic materials by

collecting and patenting local plants and micro-organisms by assistance from indigenous people all over the world who never benefit from the patents (Mugabe 1998). Recognition of biodiversity and local ways of managing 'traditional 'agricultural production systems and local ways of solving conflict over natural resources is becoming an increasingly relevant and important driving force in agricultural research (IiED 2009).

However, the focus is still on the way things were done *before* 'modernisation' made its entry into the local and vulnerable cultural systems. As Labelle (1997) tells us:

> "Most of those 'other' cultures are different from our western, science-based culture of self-proclaimed 'rationality'. Often they are limited, local cultures rooted in intimate knowledge of a particular place, and how people can live there – expressed through a language shaped by specific experience, over the ages, of the qualities of the land, the rhythm of the seasons, the mysteries of nature. These local cultures are alternative information-banks. They embody knowledge, even wisdom that we may have lost; or never had".

Thus, this revisiting of the past to discover what we 'modern' people have lost represents a particular definition and use of the term indigenous.

Originally we used the term indigenous to delineate the technology systems under study in our project. But by so doing we encountered several misunderstandings. Often we were asked if we are talking about 'traditional' systems. We found ourselves confronted by the eurocentric perceptions of modernisation theory: Societies are developing from traditional over transitional to modern stages of growth. And we disagree, as our discussion later in this book will reveal.

By using the term indigenous knowledge we were internationally and in particular among politicians and planners in the South up against a perception of indigenous as synonymous with lack of progress and innovation. Indirectly we were challenging what these politicians and planners have spent most of their lives fighting against: They have been struggling their way through the scholastic dominated education system in order to create a distance to their own culture and background. The generation born around the time of independence has been told over and over to become 'modern people' and thus to reject their cultural background. By so doing they have been taken where they are now in their modern life as developed people (Bertelsen & Müller 2003).

In particular in Latin America we have been challenged using the term indigenous in relation to technological transformation. As one local economist told us: "In Guatemala we have great problems – 72 % of the populations are indigenous peoples". All we could reply was that 92 % of the Danish population is indigenous, and this does not appear to be too big a problem.

Box 3.1: Example of conceptual confusion

Nevertheless, the term indigenous is often used in relation to the process of national technology transformation through international transfer, i.e. this process is sometimes called "indigenisation" (King 1996: 172; Göransson 1993). It is also used in a much wider sense by Hart (2007: 21) where he advise multinational companies

> "to become indigenous to the places in which they operate ... It will entail the development of new native capabilities that enable the company to develop fully contextualized solutions to real problems in ways that respect local culture and natural diversity".

Endogenous knowledge

Because of many of these misunderstandings we decided to use the term *endogenous* inspired by Fals-Borda & Mora-Osejo (2003) who argue that this originally is a biological term meaning 'growth from within'.

It is important for us to stress that our use of the term endogenous knowledge systems or technology should not be understood as a call for a return to, or glorification of a static past. What we advocate is an active engagement with the present and future situation, and the formulation of critical alternatives to the hegemonic trends of the prevailing modernisation ideology and euro-centric development discourse.

Briefly speaking, our interpretation of endogenous is 'locally embedded' or 'of local origin', in contrast to what has *not* been 'endogenised', i.e. is exogenous or 'of foreign origin'.

We also forthwith choose to define endogenous knowledge as 'local time and place knowledge' as presented in Figure 3.1. It consists of cultural inherited knowledge *and* includes all such recent and contemporary exogenous knowledge elements that gradually have been endogenized (Bertelsen & Müller 2001).

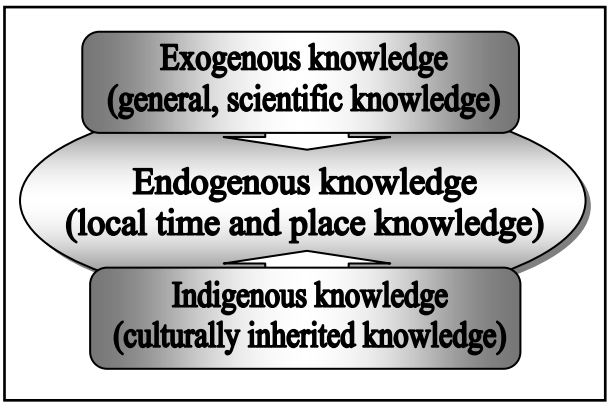


Figure 3.1: Salient components of endogenous knowledge

Thus, endogenous technology refers to a technology that is being produced, used and reproduced in a structurally confined production system. The knowledge needed is locally available and disseminated in the society; and the organisation of the production is embedded in the local institutional setting. Therefore, the term endogenous technology covers technologies ranging from potters in Africa to the telecommunication industry in India (Jain 2000).

The term endogenous is used without reference to a historical perspective. It has to do with local control over and accessibility to a knowledge system that enables people to use, reproduce and innovate their technology; using their own creative ideas and available resources to be inspired to mix the local with external knowledge at different levels of society; and by so doing, constantly reproducing and transforming the endogenous technology.

Technological innovations in established enterprises primarily come about incrementally and basically emanate from the existing or *endogenous* technology of the enterprises. However, innovation processes are usually facilitated by infusion and assimilation of external or *exogenous* technologies (Bell 1997). The success of such infusion depends at least on three conditions: (1) the technological capabilities of the enterprises in question; (2) the extent and quality of the task-network of the enterprises; and (3) the institutional and structural room of manoeuvre of these enterprises.

The same is true for the meso level of sectorial technology systems and for the macro level of national technology systems. Only if technologies thus transferred enter into a dynamic process of *endogenisation* will the transfer be instrumental for viable transformation of the national technology systems. This also goes to show that, unless the endogenous technological capabilities of enterprises, sectors, and the society at large are *recognized* and *maintained* at all levels, endogenisation of exogenous technologies will stagger.

3.2 Formal-informal

For several decades researchers and practitioners have been occupied with the intriguing distinction between the formal and the informal sector. An International Labour Organization (ILO) employment mission to Kenya introduced the term 'informal sector' by observing that

- "the bulk of employment in the informal sector, far from being only marginally productive, is economically efficient and profit-making…" and "there exists considerable evidence of technical change…" (ILO 1972: 5).
- "informal activities are the way of doing things, characterised by (a) ease of entry; (b) reliance on indigenous resources; (c) family ownership of enterprises; (d) small scale of operation; (e) labour-intensive and adapted technology; (f) skills acquired outside the formal school system; and (g) unregulated and competitive markets" (ibid: 6).
- "the designation [formal and informal] is not intended to contribute to an academic proliferation of labels; we merely seek an analytical terminology to describe a duality that avoids the bias against the low-incomes sector inherent in the traditional-modern dichotomy. Both sectors are modern…" (ibid: 503).

A recent working explanation of the informal sector[1] in Tanzania reads as follows:

> "The informal sector is regarded as a group of production units which form part of the household sector. Household enterprises are units engaged in the production of goods and services, which are not constituted as separate legal entities independently of the household or household members that own them" (ILO-UNIDO-UNDP 2002: 16).

Nevertheless, over the years many policy makers and researchers have been more occupied by how else to define and label the informal sector (e.g. the hidden, underground, shadow, black, invisible, parallel, subterranean, or extra-legal economy) rather than trying to understand in depth – let alone to recognize – what the activities in the sector signify. It is most often defined by what it is not, or what it is lacking. Latouche (1993: 132) explains this in the following statement:

> "The historical emergence of the informal and its 'discovery' in the 1970s is due primarily to the failure of development – a failure which constitutes the specific form taken by the crisis of the *formal* in the Periphery".

However, the definitional confusion also comes about because of the vastly different activities within the informal economy. Taken as a whole, it – apart from genuine productive ventures – includes all kinds of more or less criminal endeavours, semi-legal hagglers, hawkers, or huskers (Casanovas 1992).

Informal becoming the normal

Another reason for the relative neglect of dealing with the informal sector is the original belief that it would fade away, i.e. that the micro and small-scale enterprises (MSEs) would gradually become small- and medium-scale enterprises (SMEs), and some eventually even large-scale firms (Maliyamkono & Bagachwa 1990: 30).

However, as already indicated, the opposite has happened in most parts of the South, i.e. the MSEs have expanded, and the SMEs have diminished in number. But many SMEs in the formal sector have only disappeared from the national statistics and merged with the MSEs in the informal sector (Peattie 1996). This movement has created the problem of 'the missing middle', which is one palpable expression of the national technological divide (Ferrand 1997).

[1] In 2002 ILO decided to use the term informal 'economy' (ILO 2002). However, in this book the old 'sector' term is applied since it is still the most commonly used. The 'sector' notion is used as analytical paradigm only.

Studies from Africa show that the share of the informal economy generally exceeds 60% of total employment. It accommodated about 75% of the new entrants into the labour force during the 1980'es (Hope 2001). A diagnostic report commissioned by the Government of Tanzania in 2004/2005 revealed that 89% of real property and 98% of all business in Tanzania are extra-legal (Program Management Unit 2007: 1). See also Section 10.1.

According to ILO (2002), 40 per cent of Latin American workers are informally employed, and individuals working in micro enterprises produce from 10 to 50 per cent of the GDP of Latin American countries. It is estimated that 60 per cent of the population live off the informal sector. A study of the labour market in Nicaragua records that between 75 and 85 per cent of the working population are working in the informal sector (Pisani 2000).

Most authors deal with the urban informal setting. E.g., McGee (1996) notes that the level of urbanization in Latin America is close to that of the North with 80 per cent of GDP stemming from urban areas in contrast to 50 per cent in Africa. However, since the rural-urban interface is crucial to bear in mind, the rural setting is just as important to look at. Informal sector enterprises in rural areas are often referred to as 'non-farm employment activities'.

Urban settings

De Soto (1989: 3) observes:

> "A steady stream of small craft workers, tools under their arms, expands the range of activities carried out in the city. Indigenous local adaptations add to the production of essential goods and services, dramatically transforming certain areas of manufacturing, retail distribution, building and transportation."

At the turn of the millennium, Africa's cities were driven predominantly by informal practices in such vital areas as work, shelter, land use, transportation, and a variety of social services. In some cities, up to 90 per cent of the new housing stock has been provided informally and more than half of the adult population is in unregistered employment (Hansen & Vaa 2004).

Rural settings

Statistics of informal rural non-farm activities in Africa are scarce, but we may quote Maliyamkono & Bagachwa (1990: 42):

> "Some farmers seeing their agricultural incomes shrinking day after day respond by seeking part-time employment in non-farm activities. In some instances this meant a revival of traditional skills".

King (1996: 194) records that in the case of Kenya, 78 per cent of employment and of enterprises in the MSE sector is to be found in the rural areas. Lanjouw (2001: 3) records that 47 per cent of the labour force in rural settlements and rural towns in Latin America are employed in non-farm activities. In El Salvador this rate is 36 per cent, and nearly 30 per cent of these are engaged in some form of manufacturing activities (ibid: 6). Non-farm activities are likely to employ labour beyond the marginal product of labour of the prevailing average agricultural and urban wage.

The majority of rural non-farm employment is informally embedded and is often of part time or seasonal nature; much of it is manufacturing related to agricultural production such as processing crops or making farm tools. Reardon et al. (2001: 3) describe this as household 'multiactivity' and estimate that between 30 and 50 per cent of rural income in Latin America stem from it.

In sum, the situation appears to be as De Soto (2000: 27) notes that *"extralegality has become the norm – it is legality that is marginal."*

3.3 Diversification and livelihood strategies

In order to grasp some of the driving forces that shape the structures and institutions recorded in the previous sections, we need to draw on an actor-oriented perspective with reference to relevant studies in political science and anthropology. Below only a few such studies are mentioned that immediately appear to be relevant. Central notions in this respect are diversification and livelihood strategies, which we also view from a labour market perspective.

With regard to diversification, the active livelihood strategies of the actors in question are decisive, i.e. how they apply a multitude of economic means, social arrangements, and cultural orientations in different directions simultaneously. Together the different elements compose a strategic combination in which they complement each other (Ellis 2000).

Thus, before proceeding with samples of our empirical findings in Part II we need to provide a notion of the changes in the overall social context that have taken, and are presently taking place. The so-called process of globalization needs of course to be kept in mind, however Mittelman (2000: 226) reminds us that:

> "globalization is a partial process that pertains only to those entities, individual and corporate, that interact with global structures. There are many phenomena, especially on a local level, that are either outside globalization or mingle only indirectly with global processes".

And we accord with Llambi (2000: 178) that we should see:

> "the globalization process as a socially and politically contested terrain rather than as a uniliniar process endowed with an underlying logic of development".

Nevertheless, we primarily restrict us to deal with the social scene apparently prevailing in the locations of our main empirical research, i.e. rural Tanzania over the last two decades.

As far as we can make it, the analysis and theoretical scope of Seppälä (1998) as reproduced in Figure 3.2 below is providing us with a useful overall analytical framework. It provides the basic structural features characteristic of the horizontal division of labour (points 17 to 26), the focal issues of the process of diversification (points 11 to 16), and the structural effects leading to differentiation (points 1 to 10).

On two issues we divert from Seppälä: Point 4 where he claims "lack of technological development". Here we disagree and venture to use the concept technological convolution (to be explained later in Chapter 14). And we have added point 24 to his notions of structural features, i.e. the point on rudimentary infrastructure. However, for our purpose point 12 (small production units) and point 14 (flexible specialisation) are the focal issues and central to our analysis. Our analysis is moreover in line with Havnevik (1993) and McCormick & Pedersen (1996). On a more general line of recent theoretical discourses we refer to Bryceson (2002).

Bryceson (1996) inter alia points out, that what we hitherto have called 'rural small scale industrialisation' or 'non-agricultural income generating activities' can be conceived as part of the local *service* sector. This sector should not be regarded as a residual something just because it neither can be included in the industrial nor in the agricultural sectors. We very much agree with the usefulness of the following explanation, and thus prefer to quote directly:

> "Services are defined restrictively as value-added production of goods and activities provisioned by either public or private agents. In the private sector, this refers to goods and services which meet an individualized (as opposed to industrial mass product) demand involving customized supply, largely contingent on specific delivery locations and timing… Above all, the distinguishing feature of the service sector is not any disassociation from agriculture or industry per se, but its delivery characteristic, i.e. ready accessibility of goods and services tailored to the mobility and time constraints of clients." (Ibid: 99).

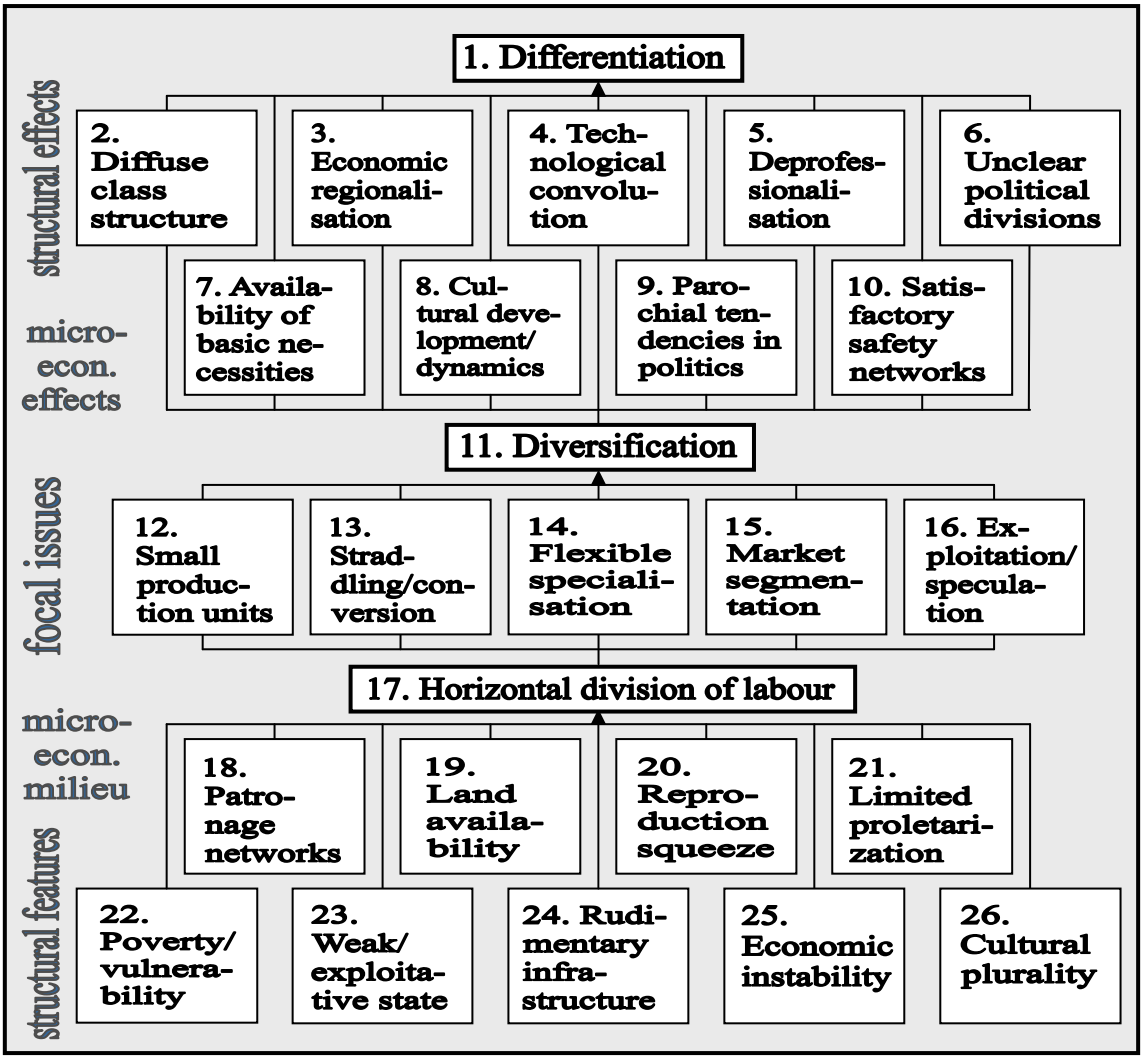


Figure 3.2: Diversification in the Tanzanian rural economy (Seppälä 1998: 197)

Bryceson's reasoning for presenting this explicit conceptualisation of service production is that many parts of African rural areas are undergoing a process which she denotes *deagrarianization*, i.e. the agricultural production undergoes a relative decline in significance in respect of the primary occupation of the total population. This process has been observable for some time (Pedersen et al. 1994). Lerise (1991) has provided another concept which embraces the same trend where he talks about *urban functions* at village level, especially about the lack of such functions.

The argument for an explicit conceptualisation of this process is that it facilitates an understanding of the many mechanisms at work, which not only provide an income for an increasing proportion of the rural population, but also a social 'meaning' and occupational identity.

A salient feature of the diversification issue is that not only do we find numerous examples of horizontal diversification between the production units; diversification of productive activities also increases within the single household units. Even the individual craftspeople are taking up a number of different lines of production, as will be demonstrated in the following chapters.

By the way, it is interesting to note that it has almost become a standard proposition by national and international politicians and planners to claim that there is an urgent need for the economies in the South to diversify. This is probably true under the current processes of glob-

alisation. However we cannot help noting, that a noteworthy process of diversification already has been under way for quite some time in the informal sector.

Using a household perception, Benería (1991: 179) infers from studies of urban Mexico:

> "Most families so far have survived the crisis through a heroic effort, in which all members participate through new combinations of work for self-consumption and work income."

Looking at the informal enterprises as agents, Parrilli (2001) provides a highly heterogeneous picture of strategies from a survey of the Nicaraguan informal furniture sector. He reports of 'survival producers', the rationality of whom is oriented towards obtaining a regular consumption pattern in order to avoid variations that could jeopardize the survival of the family. Risk aversion is central to the strategy. The greater majority of enterprises, which he calls 'traditional producers', prioritizes an increase of the family consumption pattern, i.e. eating more meat, paying for the children's school, or more and better medicine. Only in the case of what he terms 'exploring producers' do we find a real accumulation process.

Like Parilli, Seppälä (1998) and Jansen (2000: 195) identify three livelihood strategies pursued in the rural setting, and they relate these to changes in the social division of labour. The point is that the conventional perception that *either* the rural population is desperately trying just to survive, *or* they are accumulating physical capital and reinvesting in expansion of their businesses is too simplistic. In between we find many micro enterprises and households that are primarily occupied with reproducing their livelihood; investing whatever surplus they generate as much in social as in physical capital as also explicated by Hydén (1983) in his notion of 'the economy of affection'. With reference to more recent studies in Africa, Hydén (2006: 1) concludes that:

> "the informal institutions and practices that are associated with a moral or affective economy continue to be a vital part of social and economic life in Africa. Indigenous concepts and practices are, if not reinvented, at least continuously adapted to changing circumstances"

A very important point to note is that the enterprises within the reproduction livelihood strategy segment are constantly changing and innovating their technology in step with the ever-changing socio-economic and political conditions. If they did not, they would soon be out of business. And we agree with the view of Biller & Quintero (1995: 7) arguing that "the poverty argument is often overused by the informal industry lobby."

Livelihood strategy	Mode of production	Social division of labour
Survival	Subsistence	Rudimentary diversification
Reproduction	Petty commodity	Horizontal diversification
Accumulation	Capitalist	Vertical diversification

Table 3.1: Variation of livelihood strategies.

Table 3.1 adds a mode of production[2] and a social division of labour perspective to Seppälä and Parrilli's schematics.

[2] The overarching mode of production in the South is capitalism. However, we find a co-existing mix of structures. The distinctions among modes of production are used here for analytical purposes only.

3.4 Concomitant labour market relations

Much of what has been said about livelihood strategies is intimately related to the question of labour market relations. The central characteristic of urban labour markets is that they are comprised of a heterogeneous collection of subordinate relations, which, while they coexist and overlap, cannot be effectively integrated (Weeks 1991).

Standing (1991: 36) states that:

> "the enormous growth in so-called informal economic activities in most parts of the world cannot be divorced from the question of labour regulations. The unemployed have taken up small-scale employment, family enterprise production and the like, or those whose formal employment earnings have fallen have supplemented them with secondary activities […] [and this] raises doubts about assumptions that the informal sector is a producer of non-tradable goods and uses only unskilled labour."

Kongstad (1986) provides a detailed overview of what this implies in terms of shifting modes of employment under petty commodity production. Figure 3.3 supplements Table 3.1 by providing a model that summarizes his points of view.

Types & forms of reproduction	Self em-ployment	Dependent wage work	Disguised wage work	Irregular wage work	Stable em-ployment
Subsistence production					
Petty commodity production					
Capitalist production					

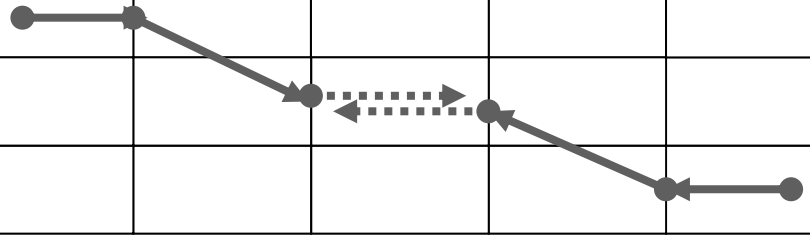


Figure 3.3: Trends of transformation in labour relations (Kongstad 1986)

It must also be said that formal sector firms cut labour costs by using home workers, sweat-shops, street vendors, neighbouring shopkeepers, and others in the informal sector. While nominally self-employed, they are actually 'disguised workers' with none of the benefits or safeguards of formal employment. Current adjustment policies seek to 'flexibilize' labour. In practice, this means cracking down on trade unions and making it easier for managers to hire and fire employees (Green 1999).

Calderón-Madrid (2000: 26) describes the situation in this way:

> "A person may start being an unpaid worker, move to self-employment, then to the informal sector before entering the formal sector. Moreover, once in the formal sector some move back to the informal sector, only to go back to the formal sector again and finally move to self-employment, with some periods of unemployment."

In sum, the work process is organized in different manners within the informal units. Labour relations are not subject to formal contracts; working hours and remuneration are flexible, and ad hoc payment arrangements exist.

3.5 Infrastructure: The other side of the coin

As indicated in Figure 3.2 (point 24) we hold that one of our study assumptions will be about 'rudimentary' infrastructure facilities; and we can add that experience from our recent cross-country blacksmith survey in Tanzania confirms that what we usually conceive as the rural infrastructure certainly is undergoing a progressive down-grading process of change in many

areas (see Chapter 11). However, new infrastructural facilities are emerging in the communication sections, i.e. mobile phone installations, something we explicate in detail in Chapter 12.

The reason for waiting till now to introduce the infrastructure issue is that it would be more or less meaningless without prior reference to current changes in the structure of production or social division of labour. The point is that we regard the structure of production as the front side of the 'coin', and the infrastructure as the other side of the 'coin', the 'coin' itself being the entire productive and reproductive capacity or forces of production of a country.

Thus, having highlighted the dynamic diversification process with its concomitant horizontal division of labour we now try to turn the 'coin' around to see what is on the other side. What infrastructure is in effect facilitating the diversification observed? Apparently not the decaying infrastructure we have been looking at so far.

The point we are trying to make is that the conventional conception of infrastructure is too narrow to grasp what takes place.

Infrastructure defined

Originally infrastructure was a military expression to denote all those physical installations necessary for warfare, but which were not directly used in the active war process. It included such installations as barracks, runways, radar utilities etc. Later the concept was transferred to the civil spheres to embrace all such installations and utilities, primarily publicly owned, which are necessary for the social production, but which are not directly used in the production processes. An expression that is sometimes used synonymously to infrastructure is *the common conditions of production* (Müller 2003).

Whilst public ownership initially was one of the characteristics of infrastructure, this has changed. The neo-liberal trends during the 1980´es and the structural adjustment interventions in the 1990'es allowed privatisation of much infrastructure to become one of the policy aims of many states.

Infrastructure is normally understood as including roads, railways, communication installations and electricity utilities, which are often referred to as physical infrastructure or *economic infrastructure* since these are instrumental in facilitating the direct production processes in society. But the concept also includes educational organisations, health facilities, recreational installations etc. As such these facilities are certainly also physical in some sense, but often referred to as *social infrastructure* since their primary purpose is to cater for the reproduction of the labour force of society.

It should be clear by now that we have to do with a multi-facetted phenomenon. The question is whether we are able to identify a common denominator for the infrastructure concept. A closer look reveals that one of the basic functions of infrastructure is that of *connecting* or 'tying together' what is territorially disjointed or divided. Roads and communication systems connect separated points; hospitals bring together sick citizens under one roof, sewer systems connect households with wastewater treatment plants etc. The more the social production and reproduction is specialised and concentrated, the more it is split up territorially, and the more the various production and reproduction sites need to be connected, regionally, nationally and internationally.

Infrastructure can thus be conceived as technological systems, the products of which are connection and assembly facilitation. The common characteristic of these products is that they are *service products* that, by and large, are consumed the moment they are produced.

We define infrastructure as follows (Müller 2003: 38):

> *Infrastructure is the technological system that facilitates the material and institutional exchange and transaction processes, which connect the socially divided labour processes.*

In the South we find that many public infrastructures are reminiscence of the pre-independent period and established with the purpose of export facilitation, administration, strategic control and ultimately exploitation. These purposes have also been prominent after independence, and are to some extent still so.

In particular the roads and transport facilities are important as told by Wilson (2004: 528):

> "Assessment of roads appear to be coloured by an either/or position on the part of the observer; roads are seen to lead either to advancement and development through breakdown of isolation, or to threat and impoverishment through the breakdown of autonomy".

However, when the infrastructure deteriorates, relatively little appears to happen immediately in relation to artisanal activities, food production and processing for local consumption; the reason being the existence of numerous informal infrastructures. This point will be elaborated in Chapter 11.

3.6 Socio-technological formations

Returning once again to the general model in Figure 2.2, we can now pin down two opposing notions of the relations between technology and society.

Technological construction of society

The most common understanding is that it is primarily technological change and innovation that drives the socio-economic developments of society, i.e. that it is the four inner jig-saw puzzle pieces that drive and turn the picture. Science (most often understood as natural science) centres are the knowledge intensifying engines and back-bone incubators of technique and product innovations that again leads to new organisational settings in the production systems.

These moves change inter alia the market conditions, the international relations and the social division or labour, which again necessitate changes in the economic infrastructure, and so on in order to fit the new technology. If this does not happen, the technological innovation becomes obsolete.

In other words, society is *technologically* constructed. We find numerous so-called technology assessment analyses, being analyses of the *social consequences* of technological change.

Social construction of technology

The other notion has been forwarded and promoted over the last two to three decades: It is the social conditions of production that shapes whatever technology is being developed. I.e. it is the ever changing 'outer' jigsaw puzzles that force the technology pieces to follow suit in order that they eventually fit.

This is also to say that technology is *socially* constructed as argued by Bijker et al. (1987), and elaborated inter alia by Müller (2003). This view calls for analysing the *technological consequences* of societal change.

This is in line with Hill (1988: 27):

> "The particular forms of technology that develop and bed into society are shaped by cultural meanings and social negotiations. Equally, the experience of technology and its impact on everyday life are shaped according to cultural meanings that reside within the wider society".

Oduol (1995: 303) follow this line of argument in her study of Kenyan farmers' adaptive responses to modern technology by arguing:

> "Technologies are created, adapted, and adopted according to human needs and conditions at the time. These needs are developed and shaped according to cultural meanings and social negotiations…..Just as technology influences human life; therefore, human beings influence the creation and development of technology".

A useful supplementary method to get to grips with and operationalize the social construction of technology approach is the National Systems of Innovation (NSI) introduced in Section 2.8. Societal structures and institutions are also here regarded as key determinants of whatever innovative transformations may take place in technique, knowledge or organisation and thus products.

Summing up

Thus, arguments for both the technological construction of society and the social construction of technology can be forwarded. However, the most important thing to consider is a *dialectical* outlook. It may be seen as the chicken-or-egg discussion; but in the final analysis we consider that the social construction of technology conception is the primal determinant. Its application will be argued and demonstrated in the analyses provided in Part IV.

We are now able to present an overall view of our theoretical framework. Central concepts have been illustrated and gradually combined with reference to relevant literature within the field of technology-society studies.

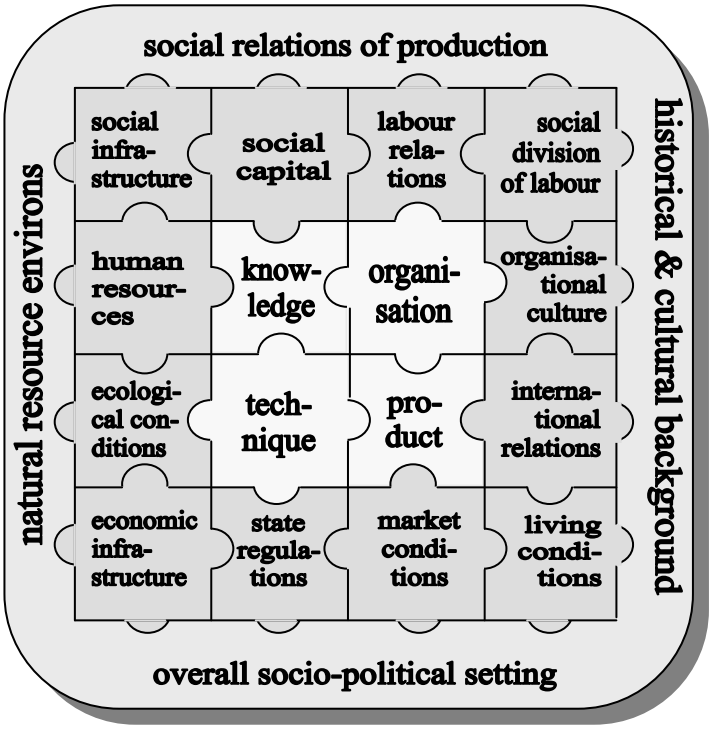


Figure 3.4: Technology with immediate and overall societal contextual conditions

To complete the model introduced in Figure 2.2 we therefore wind up with Figure 3.4, where the original jigsaw puzzle is shown in its major framework of the social relations of production, the overall socio-political setting, the natural resource environs and the historical & cultural background. And we need to note that the contents of this framework drastically differ from place to place around the world.

Part II: Empirical records

This part provides the empirical background of the study with reference to past and contemporary recordings. The focus is set to our concrete case studies, mainly from the rural artisan sector in Tanzania. In depth case recordings are in particular provided of the changes that have been observed of the village blacksmith segment, the tool making of which to a large extent forms the backbone of most artisan operations. Then further case studies of local boat building and pottery are presented, followed by recordings from a survey of user-producer commodity relations. Finally, additional case studies of individual endogenous technology inventors are presented.

4. Historical overview of Tanzania

Eginald Mihanjo

As argued in Part I, the history of society and its dynamic transformations explain the nature of its technology and technological changes. Therefore, in order to appreciate the background of the case studies presented in this Part II, the following brief overview of the history of Tanzania is forwarded, divided into the pre-colonial period, the colonial phase and the post- independent period.

Pre-colonial period

The history of Tanzania since pre-colonial times provides us with a picture of the relationships between the socio-political settings and the socio-technological transformations during times of minimal external influence on local technological initiatives. African societies were largely influenced by indigenous and local environmental conditions and relations in their organization of production and reproduction. For Tanzania this period, where local roots played a significant part in technology changes, extents up to late 19th Century. In this period Tanzania was organized in diverse social, political and economic structures. The predominant systems were the communal and state formation. With exception of South-East Tanzania, which was dominated by the matrilineal system, the larger part of the country was under the communal patrilineal kinship system. Among the pastoral societies the kinship structure had an additional set-up; the age set system, which developed as a result of the needs of the economy and its protection. In addition, the Western section of Tanzania was organized under the Ntemi Chiefdoms, a sophisticated development beyond the kinship ties. To the North and the North Western areas of Tanzania the pressure of population as well as availability of food supply led to emergence of centralized state systems. In a small section of central Tanzania, the Hadzabe were still practising hunting and gathering systems.

These differences in social formation were also reflected in the economic activities. In all cases the tool makers, especially the blacksmiths, had a special role in society. These were regarded not simply as innovators, but also as the protectors of society's livelihood and fertility and the engine of society welfare. In philosophical sense, they provided the metaphysical explanations (ontological and cosmological) and epistemological grounding as well as the axiological underpinnings (ethics and aesthetics). Beside inventing and making tools for themselves, for the farmers, fishers, pastoralists and the hunters, they also shaped the values of the natural and social relations.

Colonial phase 1884-1960

With the German conquest and colonial integration, things started to change – from a multi-faceted width into a mono-faceted view – the colonial view. This advocated against the local

knowledge system, which was degraded as uncivilized knowledge. Due to resistance against colonial rule, the blacksmith innovators and the medicine men were the first to be confronted by colonialism – they were attacked by law, state and as well the church. These were the iron makers, gun makers and mobilizers of the people. Instead, the colonial state brought in imported hoes so as to address colonial economy needs. They also introduced new technical skills as well as literacy skills mostly favouring the Western model of industrialization, consequently uprooting the African tool makers from production processes, and uplifting them from ground and linking them with the European market. This situation was perpetuated during the British period. Indeed technological dependence was more enshrined during this period and through the import substitution strategy after the World War II. To solve their critical needs of resources, the British had to open up colonies to help the Empire revive her economy.

Post independent period – 1961 and after

After independence in 1961, colonial policies on traditional knowledge and technology system were largely retained and so far remain unresolved. Although the country aspired for modernization as a kick to economic development, policies designed were unfriendly to local technologists and encouraged foreign technology and an import substitution strategy. Research institutions and universities et al., all favoured Northern technology and experts, and had the colonial notion of African technology as being inferior, primitive and out-dated as well as unsustainable. The first three year development plan was largely a product of World Bank intervention and aimed at modernization drive through foreign aid and classical Western based approach to industrialization. This did not materialize since foreign aid was not forthcoming because Tanzania supported the liberation struggle against colonialism and the apartheid regime in Southern Africa, consequently clashing with the Western powers, USA, Britain and Germany being the major sources of aid. Henceforth industrialization did not take place and local indigenous technology initiatives were retarded.

Tanzania decided to look for a national based alterative by adapting a socialist stance through the Arusha Declaration in 1967. It nationalized basic means of production – industries, banks, transport systems, and administered a centralized state approach of industrialization by establishing public enterprises and a coordinating organ, the National Development Corporation. Through this framework it sought for a national-based independent root of capitalization, technological development and industrialization. In addition a small scale root for development of industry was designed through formation of the Small Industries Development Organization (SIDO).This route was well supported by education policy – Education for Self Reliance (ESR) and Functional Education, which aimed at linking education with preparing the youth with future life. This had significant impact on exploring indigenous knowledge systems and its application to life. This encouragement also stimulated opening up of the Vocational Education Training Authority (VETA), which established vocational skill oriented training centres. This new wave of exploring and exploiting indigenous roots and vocational skills for the development process also persuaded the late Prime Minister Edward Sokoine, inter alia, to encourage the recruitment of skilled gun making local blacksmiths by the Police Force in early 1980's – before his death in 1984.

However, this focus disintegrated by the mid 1980's due to the economic crisis that faced the country, and the International Monetary Fund and World Bank economic reforms between 1986 and 1995, as well as the deindustrialization process that followed due to non-performance of the public sector. The ensuring policy confusion characteristic of the open market and liberal economy had direct consequence on local innovators as the state lost hold of both industrialization process and economic drive. This was replaced by an individualist

‘good for us all’ approach that placed the country in an uncoordinated framework. Among others the ESR, SIDO, VETA and the Ministries responsible for Education, Industries, Science and Education all suffered serious problems of resources as well as coordination. The gains of the 1970’s were lost and liberalism took hold.

It was only in the post mid 1990s – in the aftermath of the privatization drive – in particular after the inception of the Vision 2025 Declaration in 1999 and other follow up policy initiatives (detailed in Chapter 10) designed to encourage people’s empowerment and entrepreneurship that local initiative took new hold. Discussions as regards empowerment and the indigenous knowledge systems became dominant and therefore a renaissance of the nationalist drive toward technological development and industrialization. In the last ten years 2000-2010 and in the new ruling party Chama Cha Mapinduzi (CCM) policy frame 2010-2020 and its Election Manifesto 2010-2015 (CCM July 2010) local initiative, a nationalist drive to economic development, Agricultural or Green Revolution as well as an industrialization drive has been given a central role. This approach encourages not only an empowerment policy, but also indigenous technologists and a national system of innovation, scientific and technological path.

However its success would depend on this long history of the indigenous/endogenous knowledge as well as its technological system that for long time has not been paid attention. For this reason, an attempt to make a critical analysis about what it entails, an understanding about it, as well highlighting its strategic importance, in particular the potentiality on its untapped ability to transform rural production and livelihood is highly needed. It is the aim of this book to make an attempt in this direction.

5. Village blacksmiths

Jens Müller

This chapter gives an empirical record of our study of village blacksmiths, primarily in Tanzania. Between 1974 and 2009 we have visited and revisited more than 100 groups, primarily in the following 7 regions: 3 regions in Northern Tanzania, i.e. Kagera, Mwanza and Mara, and 4 regions in Southern Tanzania, i.e. Lindi, Mtwara, Ruvuma and Iringa[1].

The surveys took place in 4 consecutive periods:

1. Between 1974-77 in all 7 regions;
2. Between 1994-95 in Kagera region;
3. Between 1998-2003 in all 7 regions;
4. Between 2005-09 in selected regions.

Figure 5.1 provides an overview of the areas where the surveys mainly took place. Occasional other groups were also included from time to time while we were 'on the road'.

Box 5.1 and 5.2 below give some impression of our experience as we were trying to get to grips with the locally embedded knowledge of the blacksmiths.

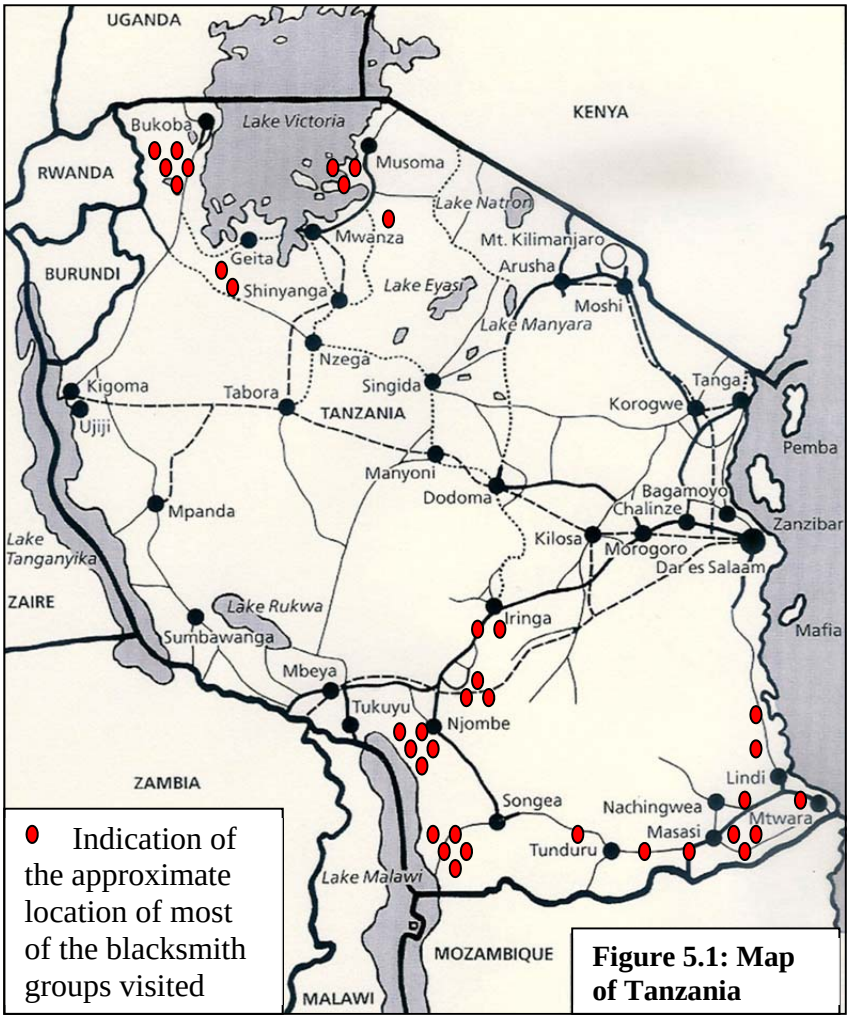


Figure 5.1: Map of Tanzania

"If we go on strike, hunger will happen!"
This message was given to us in 1999 by one of the village blacksmiths in Ngindo Village, Mbinga district, at the end of a long interview. He had, till then, patiently told and demonstrated what tools his group are using, from where they obtain the raw materials, how they acquired their skills, how the group is organised, what products - including a lot of noteworthy repairs - they are making to what customers, and finally what network relations the group has to other agents in the area. But as we kept questioning him he got a bit frustrated; to him, the social significance of his trade is so obvious that ***our*** 'ignorance' appeared overwhelming to him: why all these questions?

Box 5.1: Important message (Nsana et al. 2002)

[1] Details of the surveys are reported in Müller (1980), Mkwawa & Müller (1998), Müller (2001), Nsana et al. (2002), Bertelsen & Müller (2001 and 2003), Diyamett et al. (2005) and Mwanyika & Müller (2008).

Three pieces of scrap iron were cut up at a garage in town so their origin was not immediately obvious. These pieces were then brought to an old blacksmith and he was asked to tell what ***types*** of iron were at hand. One by one he placed the pieces into the charcoal fire and systematically hammered them. During this operation the blacksmith did talk, and when asked about what he was saying, he told that he asked our question to the iron itself. The answer, he later said, came through his eyes (what colour), his nose (what smell), his ears (what sound), and most importantly through his arm and shoulder. After two hours he concluded: "This piece is good for a hoe or axe; this may make a reasonable knife; this piece is really useless".

However, this was not what we had asked him about. So, samples of the same iron were later send to the Danish Technological Institute. The answer came two weeks later in the form of three small reports describing - in tables and diagrams - the percentage of carbon and other ingredients, penetration strength, bending properties etc. This information we would have had to bring to some manufacturer to be told what good use could be made of these iron types. We did not do so: ***the village blacksmith had already told us!***

Box 5.2: Ingenuity of an endogenous craftsman (Müller 1980)

But where do these craftsmen come from? How can their present technology be characterised? How have their technology been transformed under the ever-changing contextual conditions?

5.1 Historical recordings

Investigations and tests indicate that iron was excavated, smelted and forged in North Western Tanzania as far back as 500 B.C. (Schmidt & Avery 1978). However, whether 500 B.C. or A.C., blacksmiths have been at work before Arab and European intrusion (Schmidt 1996). Early European explorers of East Africa tell of powerful and prosperous kingdoms where much of the reason for this power and wealth was their mastery of iron works technology (Koponen 1988). A German lieutenant reported in 1892 that he estimated the number of hoes annually traded at Tabora market, the main centre for inland trading by then, to be 150.000 (Kjekshus 1996). In Mara region we were told that young men wanting to marry had to canoe all the way on Lake Victoria to Geita to bring back 2 special hoes as part of the bride price.

However, the German and later the British colonial authorities forbade the blacksmiths' trade in many districts. In case the smiths defied the ban their tools were confiscated. From own interviews in Mwanza region it was confirmed that in some cases the defiant smith was taken to court and had his arm amputated. Many reasons can be cited for this ban; one may have been that some of the blacksmiths were able to make guns. But these, largely administrative measures to sabotage the blacksmiths were only partly successful. The smiths withdrew into hiding in the forests and swamps.

At independence the blacksmiths were ostensibly legalised. But as was the case with other rural non-agricultural activities, the blacksmiths were neither explicitly recognised nor registered. Another thing is that their much specialised skills did not fit into the code for skilled labour inherited from the British, e.g. a master smith cannot yet pass a formal trade test even of the lowest grades. The smiths are thus still regarded as unskilled by the formal system.

The hoe was and is the most common agricultural tool in Tanzania. Until 1970 the demand for new hoes was met by the local blacksmiths and through imports. An attempt was then made to substitute the import with hoes produced at the state owned farm implement factory, Ubungo Farm Implement (UFI), provided by China in the mid 1970'ies. However, the factory had many problems in getting started, and did probably never reach at more than 50% of its output capaci-

ty[2]. This loss of projected output was not compensated by additional imports. Instead, the distribution of hoes was rationed.

The demand for the hoes made by the village blacksmiths thus increased considerably. These hoes were also preferred by the peasants because they were fully adapted to the local soil conditions and crops. Often the blacksmiths were asked to modify and reinforce the factory produced hoes, or to repair these when they, too often, broke. Moreover, the blacksmiths made a large number of special tools which are not mass produced anywhere.

Village blacksmith visited in Bukoba District - 1974

In spite of the increasing demand, the production by the blacksmiths declined in the whole country. Many explanations for this, the most important of which can be summarised from the 1974-77 survey (Müller 1980) as follows:

1. The attempts by the government to modernise the society by means of central directives implied active impediment of existing local institutions and organisation of production and distribution; inter alia, enterprises owned by single persons were obstructed. Moreover, the old system whereby local markets were rotated according to fixed weekdays amongst the small trading centres in a district was forbidden. Shipment of products between districts was also explicitly hindered. Not only did this obstruct the distribution of the products of the blacksmiths, it also made the collection of raw materials, i.e. scrap iron and charcoal, much more cumbersome.
2. The acquisition of raw materials in the form of scrap iron was frustrated by government restrictions: Having invested in a scrap melting plant, the state had ordered all scrap metal from public enterprises to be sent to that plant. The regions were virtually 'vacuum cleaned' for iron.
3. A declared policy to promote small scale industrial production in the rural areas was carried by the state agent Small Industries Development Organisation (SIDO) with an arrogant attitude towards the 'clients'. The endogenous technologists, if recognised at all, were referred to as being backward, lazy and crazy – ignorant. The same attitude was very common amongst the Tanzanian civil servants, politicians and academics interviewed during the research project.
4. The efforts to develop economic infrastructure were primarily geared towards the needs of large industries on the implicit expense of the rural areas. E.g. improved transport and communication facilities at district level were not forthcoming and existing facilities were not maintained resulting in accelerating decay.

However, as said in the introduction, the 1974-77 survey demonstrated that the village blacksmiths certainly were neither backward, nor lazy nor crazy. On the contrary, *they were skilled, industrious and sane*, but their conditions of production were deteriorating to such an extent that we could only predict their early liquidation:

> "What the colonial state couldn't achieve by direct administrative means, viz. the liquidation of the smiths, the present independent state is on the point of accomplishing by indirect economic means" (Müller 1980: 195).

[2] UFI distributed in the range of 1.1-1.6 million hand hoes annually from 1980 to 1983, compared to an estimated demand of about 3 million hoes for 1983/84 (Mothander et al. 1989: 113).

5.2 A transition period 1985-95

As indicated in the introduction, we did a follow up study in 1994-95 in Bukoba District where the first study was initiated. Now the Bukoba Town market was bursting with goods and food of all kinds, including a wide range of products made by the local village blacksmiths.

A number of blacksmith's groups from the 1974-77 survey were revisited, in order to find an explanation for what had happened and what features the previous study did miss out. The following are the main impressions from interviews with some of the blacksmith groups visited in Bukoba District late 1995 (Müller 2001). 4 out of 12 interviews are recorded here.

1. Nyungwe-Kanyigo group (38 km North of Bukoba Town)

The old blacksmith *mzee*[3] Bernard, who made the starting point for the 1974-77 survey, died in 1989 at the age of 78. His sons had not been "interested" in the trade of their farther, but had gone to school in order eventually "to get dressed in white shirts and tie".

But Bernard's younger brother *mzee* Justace (now 75 years old) had taken over the master title *fundi*[4]. Justace had moved the workshop to his compound and continued the blacksmith trade with assistance of three of his sons, i.e. those who had been apprentices of Bernard. However, two of these sons had recently died, possibly of AIDS. This was probably the immediate reason why Justace now had given up the trade and torn down the open, thatched workshop shed.

His youngest son, who otherwise would have taken over the *fundi* title, was also present. He explained that his children were too young to help him, and that the remaining family members were fully occupied with farming tasks (coffee, bananas, beans etc.). The work to obtain the raw materials for the blacksmith production had also become too difficult and the price too high.

His father ended the interview by saying "...it is a big loss for our clan (sic!) that we had to stop our trade, and we are very unhappy". He was referring to the fact that the family belongs to the Banyuna clan, one of the five blacksmith clans of the Haya tribe living in the district.

2. Kikukwe-Ibanga group (43 km North of Bukoba Town)

Justace could not refer us to other groups of the Banyuna clan who were active in blacksmithing in the area. But he took us to the blacksmith workshop of *fundi* Swaib. This looked completely as the workshop visited 20 years earlier: The same tools (stone anvil, self-made hammers, tongs and goatskin bellow); the same raw materials (scrap iron e.g. steel springs from cars, and charcoal); and the same products (hoes, axes, planting spears, knives etc.).

Swaib told us that his clan, the Bashasha clan, had moved into the area about 200 years ago. Now he worked daily with 8 apprentices and assistants, all members of the clan. None of this group of youngsters went to school any longer: "Our school has been closed for more than a year, because we now have to pay school fee ... but *this* is their school" Swaib said and pointed at the workshop.

Swaib moreover mentioned that his group had been negotiating with Justace to work together and establish a workshop next to the road, i.e. a joint Banyuna and Bashasha clan venture.

[3] *Mzee* is the respectful form of address to an elder, more experienced man. In the family institutional set-up it is the oldest man who is called mzee, and the title has thus an extended social meaning.
[4] *Fundi* means craftsman in Kiswahili. But in the Haya tribe it is only the master who is called fundi. This 'title' gives him extended power of command. All the apprentices and other assistants have to obey his instructions unquestioned.

3. Itahwa group (1) (8 km South West of Bukoba town).

According to our research assistant, it was necessary to ask permission from the *Omukama*[5] Rukamba the Second of Kyamtwara, before we went out to visit the two blacksmith groups in his area. We had to explain to him what we were doing, and only when he was satisfied, he gave us his consent to visit "his" (sic!) groups.

The first group was headed by *fundi* Daniel from the Mugila clan, which he can trace back for sixteen generations! He worked with two brothers. The youngest was not trained as blacksmith, but as book keeper, and he worked as the cashier of the group. He had been government employed, but was recently retrenched like so many others following the policy of slimming the public sector.

Daniel had moreover ten young men working as apprentices. Two of these were his sons; but more noteworthy, three of them did not belong to any of the blacksmith clans. As an explanation, Daniel told us that these boys had nothing else to do, and that the *omukama* had ordered him to take them in. Apparently it was the intention that they should work with Daniel for two years and then establish themselves elsewhere. By then Daniel reckoned to take in other apprentices.

The workshop of Ithawa group (1) - 1995

The workshop of the group was extraordinarily well equipped and arranged. Work was done under a large iron roof placed on iron rafters bolted to solid iron poles. The tools were a 'modern' steel anvil, two steel vices and a large number of different hammers and tongs; and a large bellow of German design. Some of these tools had, according to Daniel, been donated by various NGOs through SIDO.

It was very important to Daniel that we saw a certificate, which he had obtained for a three weeks course at a vocational training school in Tabora. He was one of the first traditional blacksmiths from the Haya tribe to have his skills and craftsmanship formally acknowledged. Yet, he was still regarded as unskilled, because the Tabora certificate was not an officially recognized trade test certificate.

As regards the organisation of the work of the group, there were constantly two production lines in action, whereby the forge and the anvil were optimally utilized. Doing this required a relatively complex internal division of tasks. Each part of the work was delegated to the individuals in a way which we had not seen before at other village workshops. Part of the explanation was that Daniel not only looked upon his work as a production enterprise, but also as a vocational training school. It was important to him that each person would learn all functions well.

Selected tools made by Ithawa group (1)

The products were by and large the same as those made by the other Haya blacksmiths' clans. The raw materials were also the same. But the products of the group had a better

[5] *Omukama* is mostly translated by 'chief'. The chief of Kyamtwara was according to himself the only remaining in the area who maintains his traditional authority.

finish; inter alia they were grinded and painted with black paint. The most amazing was that the group was able to make a ring on the hoe for the hoe shaft instead of the pronged hoe, which is what the traditional blacksmiths used to be able to make.

During our prolonged stays at the workshop, every now and then a local tradesman turned up on his bike to order or collect particular finished farm implements. Referring to this, Daniel told us of his plans to move his workshop to the roadside to ease the contact to the costumers and also the raw material suppliers. But he had no intention to have his workshop registered anywhere; he obviously preferred to work informally.

4. Itahwa group (2) (6 km south West of Bukoba town).

This Itahwa blacksmith group turned out to be the trade marking *SUPER*-group (referred to in the introduction). The group had recently been established and the *fundi* was not a member of any of the blacksmith clans, but was the brother in law of Daniel. After having worked for five years as apprentice he had started his own workshop. He was also using a steel anvil and a large bellow. The group worked every day, and was smaller than the other group. It primarily sold the products through a middleman at the Bukoba Town market where we first found them. The middleman told us that he, besides selling the products piece by piece, also sold bundles to the neighbouring districts. He even sometimes exported such bundles to Uganda, this being one of the reasons for the trade markings.

The two Ithawa groups had not only managed to keep up their trade, but had also changed the technology in a progressive way, increasing productivity and quality. They had also broken the relatively closed craftsmen's clan system. They had benefited from the back up of both the traditional authority and the official support agency, SIDO.

Changing conditions of production

In brief, the findings of this survey gave rise to the following main hypotheses (Müller 2001).

The combined outcome of the societal changes over the last ten years have been effectual for the sustenance of the village blacksmiths and provided conditions for the eventual transformation of their technology.

Decline of state control: An immediate explanation would be that the authoritarian means of the government and the ruling party (CCM), with which their modernisation policy had been executed, were either given up or considerably weakened. These means had often the form of centrally or regionally issued directives (Lerise 1991; Havnevik 1993). Other authors have claimed that the reaction of the peasants or craftsmen to these directives had just been to "elude the state".

To what extent the directives had actually been withdrawn or just not been enforced we were not in the position to tell. But the blacksmiths seemed in any case not to be up against administrative restrictions any more as regards procurement or marketing. Moreover, the village craftsmen were not any longer economically or socially illegal, even if they were not regarded as part of the registered formal sector (Maliyamkono & Bagachwa 1990).

The lift of the restrictions on commodity trade and performance of craft production have resulted in an increased room of manoeuvre for the unfolding of the technological capability of the village blacksmiths.

The effects of structural adjustment: The general impact of the structural adjustment policies after 1986 when these were imposed on a large scale in Tanzania have been detailed by Gibbon & Raikes (1995). As regards the village blacksmiths the structural adjustments seem to have had the following effects:

The intended increase in agricultural production, which primarily had occurred for food crops, must generally have increased the demand for agricultural implements, including hoes. In the years before 1986 the hoes from UFI or imports were on the government's list of rationed and subsidised items. According to Mothander et al. (1989) and Maliyamkono & Bagachwa (1990) hoes were among the common black market and smuggling products. The competition with imported hoes may by then have been eased as a consequence of the devaluation of the shilling (Gibbon & Raikes 1995).

The complaint from the village blacksmiths interviewed was not in respect of their customers' demand, but concerning their purchasing ability: "Before people had money, but few commodities were available ... now it is the other way round".

The structural adjustment policies have not had noteworthy direct effects on the earning conditions of the village blacksmiths. However, all aspects considered the effects seemed to point in a positive direction.

Ideological dissolution: There appeared to be signs of dissolution within the government and the party of the ideological attitudes in respect of endogenous technology in general and of the village crafts people in particular.

Most directly we came across this in interviews with SIDO officers in Kagera Region. Not only did they tell us that a bottom up development of village crafts was needed. They were also in practice involved with apparently sensible support endeavours. The assistance to the Itahwa-Kyamtwara group (1) was not the only example to indicate that the previous backward-lazy-crazy attitude had changed.

On the other hand, when technology policy was discussed in academic circles in Dar es Salaam it was only beginning to be recognised that the technological capability of village craftsmen was worth discussing (Wangwe 1994). The general trend was to point towards South East Asia for industrialisation models.

A noteworthy dissolution of the modernisation ideology of the ruling elite has taken place. Although this is probably happening from virtue-of-necessity considerations, the endogenous technology of village craftsmen is now beginning somehow to be considered an asset for the development of the country.

The role of infrastructure: As regards the Kagera Region the only positive infrastructural development that had happened was improvement of *inter*regional transport connections. The boat traffic on Lake Victoria had increased and stabilized. Moreover, the road and bridge connection to Uganda was about to become of all-weather standard.

On the other hand, the *intra*regional road network was in an even worse condition than twenty years ago. Communication and market facilities were still very poorly developed. According to Lerise (1991), this situation was no exception compared to the rest of the country.

Of the social infrastructure, only the school system will be mentioned. The public schools in Tanzania had been deteriorating for long (Galabawa 1994). Not only had the primary school intake fallen, but the quality of the teaching was also declining, and there had been a clear tendency to disdain the work of the hands in favour of the work of the heads. In respect of vocational training of craftspeople and technicians the situation was apparently even worse, in spite of an immense need for such educations (Ishumi 1994). However, as was evidenced from our mini-case studies, this situation had in effect favoured the village blacksmiths in that more youngsters had been taken in as apprentices, alongside with an increased social recognition of craftsmanship as such.

The village blacksmiths have apparently not been very frustrated by the slack upkeep of the economic and social infrastructure. On the contrary, they seem temporarily to have benefited from at least the decline in the public schooling system.

The labour supply situation: Tanzania had experienced stagnation in the migration from the rural areas to the towns. This was probably caused by a relative deteriorating situation for town dwellers compared to the living conditions in the rural areas. The socially deplorable retrenchment of publicly or semi-publicly employed that took place seemed moreover to result in some noteworthy repopulation of the rural areas with relatively higher educated persons than before.

This trend increased the labour supply in the rural areas and did to some extent ease the previous difficulties for the rural craftsmen to enlist an adequate number of apprentices and assistants.

The labour supply to the village blacksmiths has increased. As long as the technology of the blacksmiths remains as labour intensive as it is, this increase may further the chances of survival of their trade.

Ecological deterioration: Here we only mention that an expansion of the activities of the village blacksmiths with their particular forging technology must be regarded as very controversial. It would result in an increased consumption of charcoal in competition with the demand from the households. The blacksmiths complained that they are up against rising prices for increasingly poorer quality charcoal.

The village blacksmiths will be forced to economise their use of charcoal and eventually be compelled to find alternative, improved methods of heating arrangements of their forges.

Resources of civil society: Development research did originally make a mistake by defining the informal sector residually, i.e. as comprising all activities which could not be included in the formal sector. In the same way, we will miss a real understanding of how the African societies are sustained and transformed if we continue to conceive the civil society residually, i.e. as all such phenomenon that cannot be referred to the state or the market (Hadenius & Uggla 1996).

Most of the recent studies of the civil society have tended to focus on assessing what counter power can be found in new social movements against the established ruling classes. In other words, these have been politically oriented investigations (Gibbon 1993). Brett (1992), in his study of how the Ugandan society is emerging after decades of extreme authoritarian rule, moves a step further and points at the crucial resources for survival, which do exist in the civil society.

Moreover, the blacksmiths produce other items than productively useful tools and services. Thus, they enjoy an a priori cultural esteem, which seems to be one of the explanations for their comeback each time they were suppressed by external forces. In particular in places where the traditional institutions like the chiefdom still exist we can expect a persistent moral support.

The clan system had hitherto been relatively closed as one of the means to preserve, but also restrict it. On the other hand, our observations indicated that the system can be changed under pressure and eventually become a progressive feature in the present societal transformation processes. In apprehension for the survival of the tribe, the clans seem to be capable of opening up, partly to establish cooperation between the clans, partly to introduce non blacksmith clan members to the craftsmanship.

The cultural values and norms of the local society render the village blacksmiths with a particular identity and give their technological capability a social "meaning" that transcends the modernisation paradigm on which they were assessed in most development planning in the past.

The endogenous technology of the village blacksmiths is embedded in the culturally conditioned division of labour of the civil society, and this seems to be one of the main explanations for the comeback of their products on the local market.

5.3 Different production systems

As already indicated, a follow up research project was carried out 1998-2003. As regards the blacksmith survey part of the project we took point of departure in the above given hypotheses. We did concentrate the field visits more or less to the same districts and regions, which we had visited during the 1974-77 survey. Quite a number of previous surveyed blacksmith groups were revisited, which gave reason to observe the changes in their activities in general and their technology in particular.

We can confidently state that the number of active and visible smiths had increased since the 1974-77 survey. The best guesstimate from that survey was that the numbers was in the range of 30.000 out of a rural population of 14 million (Müller 1980:114).

It needs to be said, however, that the blacksmiths were previously invisible and hiding more from the authorities and researchers than they do today. For a case in point see Box 5.3.

During 1974 I had visited a relatively well equipped workshop in a particular village. Trying to revisit it in 1977 turned out to be difficult, but finally found the blacksmith in a very shabby place with only few tools. The blacksmith threw up his arms and complained how badly his business had been run down. But then he suddenly recognized me, laughed and off we went down the hill to his real – but hidden – workshop. This looked as neat and busy as the previous place I had seen before. He confided to me that he had always kept away from "government" as much as possible.

Box 5.3: A case of blacksmith survey intricacy (Müller 1980)

Although we are not able to quantify the present village blacksmith enterprises very exactly, we have reason to suggest that while the population has more or less doubled between 1970 and 2000, the number of active and visible blacksmiths appears to have tripled during the same period.

Table 5.1 and Figure 5.2 give some quantitative indication from various relevant surveys.

Location	Timing of survey	Number of groups	Number of smiths	Reference
Lindi and Mtwara Regions (see Figure 5.2)	1991	140	698	RIPS (1998)
Mbinga District, Ruvuma Region	1990	58	73	Kapinga (1990)
Makete and Ludewa Districts, Iringa Region	2000	30	80	Nsana et al. (2002)

Table 5.1: Number of blacksmiths in selected areas of Southern Tanzania

More important in the context of this book is however to record the current variations of the internal and external division of labour within the blacksmith enterprises. For this purpose we - for lack of better conceptions - have to use the archetype systems descriptions taken from early European technology history recorded in Section 2.4.

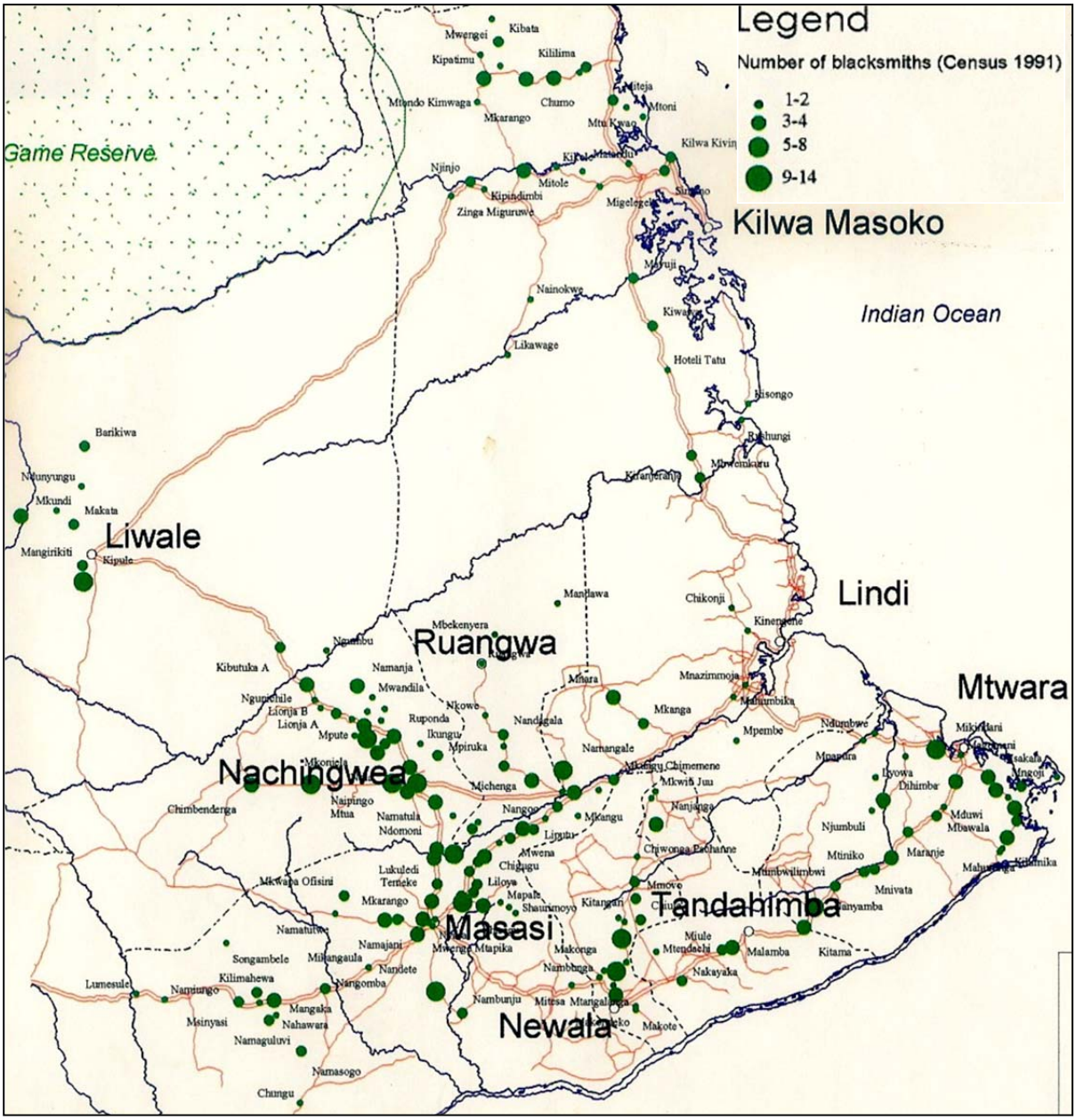


Figure 5.2: Location of blacksmiths surveyed 1991 (RIPS 1998)

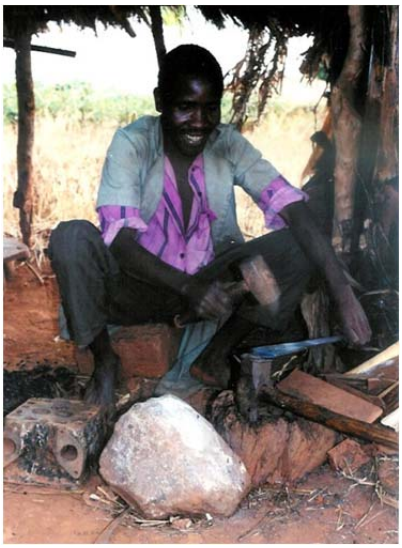
In what follows we present a brief characteristic of the different production systems that we observed during our survey of the activities of the village blacksmiths. A selected case record illustrates each system. For further case records see Nsana et al. (2002).

Simple artisan system

The master smith works with 1-3 apprentices or assistants, to a large extent using 'home made' tools. The group often makes its own charcoal and collects the raw materials, i.e. scrap iron like broken steel springs from trucks. Ordinary agricultural hand tools and other implements are produced and repaired. These are traded at the doorstep of the workshop, sometimes as simple barter exchange. A particular exchange system called the nusu-nusu (half-half) system is used in several places: The customer may bring a steel spring of which the smith makes two hoes, one for the customer and one for himself for further exchange (Mkwawa & Müller 1998).

Case record 1:

- *Place:* Kingerekiti village - Mbinga district.
- *Name:* Garus Mbunda.
- *History:* Garus joined his father as apprentice in 1976 when he was still at school. He ‘graduated’ as blacksmith the same year he finished his primary education. He has his brother's son as apprentice. His son is helping out after school. Garus' father, like other old smiths in the district, took previously part in iron excavation and smelting.



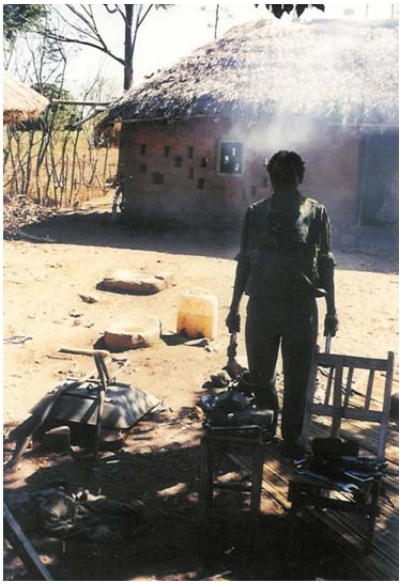
- *Technique:* The workshop is placed under a low hanging thatched roof on poles with no walls. The main tools are a double stick operated goat skin bellow for the charcoal fired forging hearth, locally modified anvil, and hammers - some bought from shops some self-made. Quenching (hardening) is occasionally done in water.
- *Knowledge:* Acquired via apprenticeship under his father, continued experiential learning, and recurrent interaction with his customers.
- *Organisation:* Most operations, except driving the bellow, are done by the master.
- *Products and market:* Mainly hoes, axes, knives and spears, and repairs of the same. Marketing through barter exchange in addition to money transactions. Chickens are the main form of barter. Labouring on the smith’s farm is another form of barter.

Complex artisan system

As above, but supplemented by the use of various imported tools, e.g. anvils, blocks or vices. Some operations, e.g. welding jobs, may be sub-contracted to nearby workshops with access to electricity. Apart from the conventional implements, the smith makes and repairs perhaps ploughs or carts as well as spare parts for maize mills or simple windmills. Some of such items, which were originally handed in for repair, the smith may subsequently imitate, i.e. performing so-called reverse engineering.

Case record 2:

- *Place:* Buanga village, Musoma Rural district.
- *Name:* Mafuru Mbuya.
- *History:* Mafuru is 63 years old. His mother's father was a well-known carpenter and canoe builder. As teenager he used to offer a helping hand in various small workshops in Musoma town, without payment – just to learn. He also went with local loggers and acquired knowledge of truck repairing. He started in 1945 as bicycle repairer, but moved to the village in 1966 to do more ‘general engineering’ jobs.



- *Technique:* He uses a self-made bicycle driven air-blowing fan for the hearth, a broken engine block as anvil, various hammers and tongs, and a wide variety of other metal working tools. Materials are not only broken steel springs, but also old truck chassis and other similar parts. He uses ‘salted’ water for quenching. He brings welding jobs to the nearby town when needed.

- *Knowledge:* Apart from basic blacksmith skills, Mafuru is intimately conversant with general mechanics.
- *Organisation:* Works alone with occasional help from his sons and other family members. Sometimes customers are giving a helping hand as well.
- *Products:* Mainly ox- or donkey-carts, ox-ploughs (mainly repairs, but he can make 'new' ones), and wheelbarrows.

Simple putting-out system

The blacksmith group works systematically with one or more middlemen who mediate orders from distant customers, and who perhaps bring raw materials as well. Sometimes a middleman takes part in the production process, e.g. by helping operate the furnace bellows. The middleman undertakes round trips to local markets that in many areas are arranged according to a rotating weekly schedule. Sometimes the smith himself does such trips and often brings ideas back home about new product designs.

Case record 3:

- *Place:* Nanyamba Village, Mtwara Rural District.
- *Names:* Dadi Athuman and Abdalla Salum Nkumbulwa.
- *History:* Both smiths, who are cousins, posed as master blacksmiths and mentors. They were aware that about 16 people, who are related through kinship, are also blacksmiths. Dadi and Abdalla trained the rest. Blacksmithing was considered a clan craft that each boy born in the family had to acquire; from one generation to the other. It was the reserve of the males though, as female members were not allowed to join in the trade. The workshop was established in 1966 by their grandfather.

- *Technique:* Production was based on anvil and hammer using charcoal as the main source of power. The production was assisted by bellows made from canvas that was initially provided by RIPS[6]. The hearth is on the ground (i.e. not raised). Special types of charcoal were mentioned mainly 'nkaa', known as being the best, and could be identified by the smiths even in a heap of other types.
- *Knowledge:* Acquired through apprenticeship system that followed the kinship chain, and by some training at the Folk Development College (FDC) at Chilala in Lindi District.
- *Organisation:* The two cousins are the master blacksmiths and mentors. They own the workshop in a form of partnership. They are regularly assisted in the bellow operation by someone from a neighbouring village. This person also acts as a *middleman*. He solicits jobs from his village and other villages and brings the orders together with scarp iron and charcoal. They share the proceeds.
- *Product and production capacity:* Main products are hoes, axes, knives and mundus. They occasionally also make saw blades for the nearby carpenters. The workshop can make as many as 500 hoes as a minimum in two months, about 12 hoes a day, depending on inputs of charcoal and scrap metal leaf springs.

[6] RIPS stands for the Rural Integrated Project Support programme in Lindi and Mtwara Regions. See more about this programme in Chapter 11.

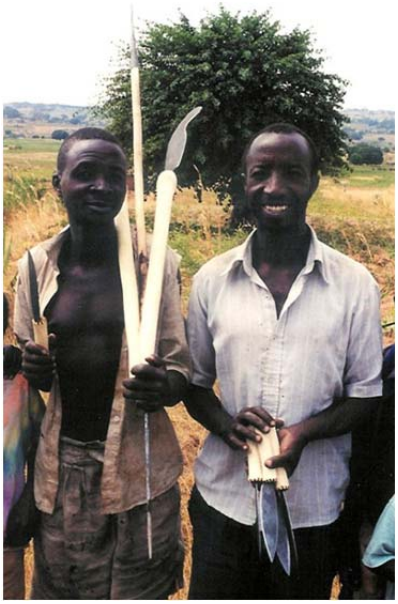
- *Market:* The smiths have ready market contact persons for their products, and they were not afraid of competition even from imported hoes. The types of soil and agriculture technology in the area allow for the kinds of hoe that they make.

Complex putting-out system

Besides ordinary production to order, the group performs modest mass production of products in high demand, e.g. kitchen knives. The group is usually larger than the others and some apprentices or assistants take relatively independently part in the production process. The finished products can be given a trademark, e.g. a particular star or name of the group is stamped into them by a rough chisel. A buyer comes regularly and collects the products and brings indications of what types or designs that sells well for the time being. He may bring scrap iron on a regular basis.

Case record 4:

- *Place*: Makojo village, Musoma Rural district.
- *Name:* Bureki Rugola.
- *History:* Bureki's grandfathers came from the Bukoba area in the 18th century. He counts 6 'fathers'. They came by walking via Geita. Some went to other places, but they all consider being member of one clan of what today is called the Wajita tripe. Bureki was born in 1921.
- *Technique:* Two forging hearths, each with a set of stick operated goatskin bellows. Steel piece from old goldmine for anvil plus various big stones. All kinds of hammers bought in shop. Homemade tongs and chisels. Some finished products are smeared with cow horn to protect against rust and to give black colour. For quenching they use water with crushed lime and ashes having impurities from previous iron works. They prefer to make their own charcoal.



- *Knowledge:* All members of the group had primary school education; one had been to secondary school. Otherwise their fathers trained them.
- *Organisation:* The group has 10 members. When a son 'graduates' as blacksmith, the father may allow him to 'take his own orders' – provided he is married. Working daily and in very close co-operation with a neighbouring group.
- *Products and market:* Machetes, hoes, axes, spears, arrows, knives, masons spoon, carpenters blades, hammers, pick axes; also axes for boat builders, fishing hooks, anchors, nails and rings for boat construction; bicycle carriers. Repairing and reshaping, in particular factory made hoes. They *trademark* some of the products 'R 1997 R' stamped with a small chisel. Knives are brought to the market in bundles of up to 100 – some to the larger regional towns. They have orders from a nearby mine for pick-axes. Traders come from far away with orders; this is also how the blacksmiths are informed about the widespread and much diversified demand for their products.

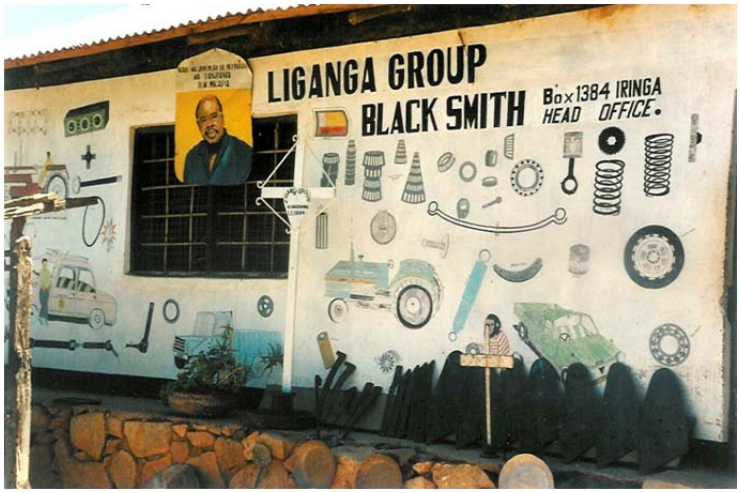
Simple manufacturing system

Several master smiths have grouped together and work usually in a line under the same roof, each with their particular apprentices/assistants. Each is however completing their own jobs, i.e. the internal division of labour of the group is minimal. The group is often directed by a former middleman that over time has picked up the blacksmithing skills. Some of the group members are usually marketing the products, e.g. from the Southern Highlands to Dar es Sa-

laam where it may have contacts to special retailers. Such groups sometimes define themselves as a co-operative and may have a joint bank account towards which each member is contributing on a monthly basis.

Case record 5:

- *Place:* Kihesa, Iringa town.
- *Name:* Liganga Blacksmith Group.
- *History:* The group started in 1994 and is organized as a partnership under the chairmanship of Romanus Mlolwa. He started by opening a small workshop mainly in car puncture repair. He rented the place from an Indian who agreed to be paid out of Romanus' business proceedings. He then developed effective networks and within one year he already had won contracts with government offices that brought him jobs in terms of puncture repair and other minor repairs. He eventually bought himself two second hand cars that he operated as taxis. He ran the business for two years; then he scraped them and started the Liganga group.



- *Technique:* Numerous basic metal working tools using electricity or gas for cutting or welding in many different operations. The scrap is particularly expensive as it has to be collected from distant places in other districts like Mufindi or Njombe. They also get access to TAZARA railway scraps, e.g. wagon pieces thrown away by the authority after accidents.
- *Knowledge:* Romanus acquired the blacksmith skill from an old *fundi* in his home place in Rudewa District. Within a short period of time he was able to make many products including oxen plough parts. He then moved to Tanga town where he joined his uncle who encouraged him to join Tanga driving and mechanical school. Here he acquired some the theoretical knowledge in car mechanics and elementary driving. He was eventually tested and got a class III driving licence before moving back to Iringa town.
- *Organization:* The group works jointly; however the blacksmiths are more or less finishing the jobs that they are assigned, shifting from the various tools and machines that are placed inside and outside the workshop building. The group has a subsidiary at Ilula some 50 km away that supplements the capacity especially during peak seasons. Demand for farm implements peaks around the months of October to December in preparation for the January farming. One of the old blacksmiths is part time consultant and mentor to this group.
- *Products and market:* All kinds of implements: hoes, bill hooks, bicycle carriers, mason chip spoons, mason chisels, aluminium pots and pails. A particular production line is for ox plough parts: lines, scissors, knives, wheels, soil movers, upper and lower handles. In addition to the usual blacksmith products, the group also makes pottery products that are specialised by five women members. As matter of fact, Liganga group is the only one among the rural MSEs visited that were gender sensitive. According to Romanus, the group's products are competitive in Iringa town and the surrounding villages. In the case of plough parts, they almost have a monopoly of the market as they suit the ecology of Iringa very well. Customers prefer the group's products to imported ones or those made by the national farm implement factories, such as UFI and Mbeya Farm Implements factory.

Complex manufacturing system

The master smith is production leader for a number of more or less "graduated" smiths. More than one furnace and other work places are in use at the same time, since the relatively large assortment of products requires different work processes. Still, each individual is responsible for finishing each product part and thus moves around in the workshop to the different work places. The parts are finally put together under supervision of the master smith who also takes an active part in the production processes, partly because he may have acquired the role as informal vocational training instructor. A number of products are produced to stock; others are exhibited as prototypes to tempt occasional customers. Such products are often complicated devices for food processing, pesticide sprayers or fertiliser distributors.

Case record 6:

- *Place:* Njombe town.
- *Name:* Kisangani Iron Smithy Group.
- *History:* The leader of the group, Reuben Kisangani Mtitu, is 30 years and one of the most enterprising blacksmiths we have met. His workshop combines blacksmithing with welding and metalworking. He learnt the trade from his grandfather Lika Mwakigile Mtitu in their home village Mkiu. His father was also a blacksmith.
- *Technique:* 'European' type anvil, a bicycle wheel driven fan for the charcoal hearth and very many other iron working tools. Most exceptional is the electric welding and drilling equipment (the workshop is connected to the town grid).
- *Knowledge:* In addition to the basic blacksmithing training mentioned above, Reuben has been at some SIDO courses, including welding.
- *Organisation:* The multipurpose tools are organised in a flexible way, with 4 more or less permanent metal workers and some extra assistants when required. The City Council has provided the workshop plot at the roadside premises without rent, and no business licence fee is charged either. Thus the workshop is recognised and is at some kind of entry to 'formal sector operations'. Part of the work is sub-contracted to other blacksmith groups, some across the road, and others in neighbouring villages. On the roof of the workshop there is an 'exhibition' of the tools for sale at the workshop.
- *Products and market:* A good number of ordinary agricultural implements. But more significantly, various specialised farm tools, hand operated insecticide sprayers, coffee grinders etc. In addition he is producing a proto-type of blacksmiths' bicycle wheel operated fans.

Proto-type bicycle wheel operated fan

5.4 Innovative transformations

Having thus 'visited' a few selected blacksmith enterprises we may now sum up as follows: Although the core technique of the blacksmiths in Tanzania essentially has remained the same

for thousand years, that of shaping red-hot iron by hammering, the tools and auxiliary instruments of labour have undergone recurrent innovations throughout.

A dramatic change did occur when scrap metal from cars, the mining sector and other industries did replace the smiths' own iron excavation and smelting. The change from iron ore smelting to the use of scrap metal appears to have happened during the 1930's and 1940's. The latest changeover we have recorded is about 1949 in Ngindo village, Mbinga District (Nsana et al. 2002).

Another example is that the heating of the charcoal-fired forging hearths is presently being changed from various types of goatskin driven bellows to the use of the labour saving bicycle wheel operated fans (See Case 6, Section 5.3).

Old iron smelting site near Ngindo, Mbinga District, visited 2000

Anther observation is that none of the blacksmiths had been trained at formal vocational training schools. One, case 3, had received extra and useful training through a donor funded project connected to a formal vocational training provider, i.e. the Folk Development College (FDC) at Chilala in Lindi District. A few, as in case 6, have had valuable contact to SIDO; but these were exceptions. On the other hand, we see these cases as encouraging signs of a changed ideological attitude on the part of the government. See Chapter 10.

Very clear qualitative changes in the organizational set ups have also taken place over the period of our research visits. More and more groups are expanding, cooperating and arranging themselves accordingly. We are however still in the dark identifying a pattern in organisational changes according to geographical location. Regrettably we are also not able to quantify to what extent this has happened, but it appears to some extent to be conditioned by the varying infrastructural settings. The point to make is that the single micro-enterprises do change set-up from time to time, responding to changing socio-economic circumstances. One year we may find an advanced manufacturing system, next year the same enterprise may have changed to a simple putting-out system of organisation.

Evidence of product innovations is numerous, and the repair services of the blacksmiths are also undergoing ever-increasing diversification and sophistication. The main reason for the smiths to keep making hand-operated farm implements is that the main demand is for such products (Poston 1994). In areas where animal-operated implements are in use, the smiths take up making parts and vital repairs, but also sometimes making these implements from scratch.

Our findings tend to concur with Boserup (1993) where she demonstrates the capability of local technological innovation. However she claims that innovations are unlikely to take place in agriculture unless the community concerned is exposed to the pressure of population growth.

We hold that a similar contention is true for the village blacksmiths. Firstly, they are the back stoppers precisely of the innovations in agricultural technology observed by Boserup; secondly, as populations are increasing in numbers, so are the diversifications of all kinds of other

productive activities. This gives rise to an increase in the demand for tools made by the blacksmiths as shown in most of the cases cited above.

The blacksmiths are thus expanding their product diversification in close interaction with an increasing number of other craftspeople. They relate very closely not only to the farmers, but to the local timber & log maker, boat builder, carpenter, mason, wooden grinder maker, cattle owner and bicycle repairer. See also Chapter 8.

Selected cases of innovations

As said, a number of the blacksmith groups were visited more than once to provide a picture of possible changes in technology over time. In most places we were being very welcomed, also because we brought pictures from the previous visit and even sometimes scrap iron or charcoal from towns. It also appeared useful to show pictures from some of the other workshops visited, which did show different technical setups, e.g. pictures of the bicycle driven furnace blower.

Quite many had done some interesting changes in their workshop setups, most of them by own initiative, others – as already recorded – with some external support.

Admittedly, the following cases are exceptional in the sense that they were chosen in 2008 amongst blacksmith groups, which were reported to us by a local NGO – Nature Conversation Foundation (NACO) in Njombe, Iringa Region – as the most progressive in the area (Mwanyika & Müller 2008).

Case record 7:
Place: Mkiu village – Ludewa District.
Name: Kiyombo Cluster. Agricultural Tools Making and Youth Training Centre.

The group was first visited by us in 1999. The group has now fundis and apprentices of all gender. The group has moved from its previous old thatched roofed workshop at the outskirts of the village to a reliable and extensive premise in the village after funding from an Irish NGO facilitated by NACO in 2005. They are attending trade fairs invited by SIDO and co-operate with Kisangani Smith Group (see next case record). The group is not registered. Like many other groups it deals with the making of farm tools such as: Traps, bill hooks, hoes, racks, environmentally friendly cooking stoves, etc.

Case record 8:
Place: Njombe Town.
Name: Kisangani Smith Group.

The group was also visited by us in 1999 (Case record 6, Section 5.3). By then it was situated at the outskirts of the town. Now it had moved to a much larger compound in the town centre.

The group consists of 12 fundis and 5 apprentices under the leadership of Roben Mtitu. The group is the only formally registered blacksmiths enterprise we came about, i.e. it has moved out of the informal

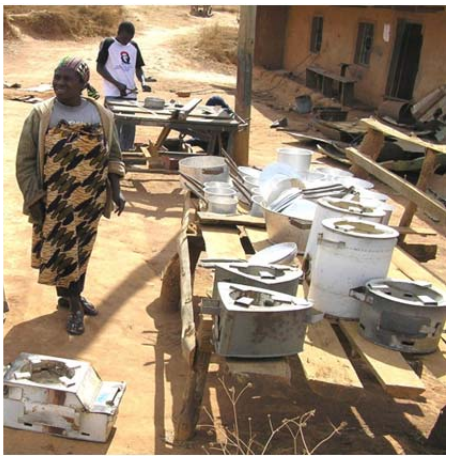
sector. It is the most recognized blacksmith group in Iringa region and has received the largest amount of resources from the Donor Communities from within and outside of Tanzania, some of which were facilitated by NACO.

It deals in fabrication and repair of a variety of special implements like rope water pumps based on a Dutch technology, mini hydropower plants, small scale farm machinery, apart from all kinds of farm tools like hoes, axes, pangas as well as environmental friendly and charcoal saving and also sawdust fired cooking stoves.

Case record 9:
Place: Ramadhani – Njombe Town.
Name: Rahel Blacksmiths Group.

Rahel is the leader of the group and is the only female blacksmith in the area. She learned from a blacksmith who has a workshop in the same Ramadhani area. In her workshop there are 3 fundis and one apprentice. The group cooperates with other groups and works closely with SIDO. The group is not registered although the Tanzania Revenue Authority and village government authorities collect some revenue.

The group works on farm tools and domestic utensils like environmental friendly charcoal stoves, cooking pots, hoes, bill hooks for which raw materials are scrap metal and tins. In part she deals with battery charging and welding on availability of electricity and gas, in addition to the ordinary blacksmiths duties.



This is one of the blacksmith groups, which although paying revenue to the town council, other departments such as the Ministry of Agriculture know nothing or little of the group activities.

Case record 10:
Place: Uwemba, Njombe District.
Name: Gordon Mwanyika.

Gordon is an ex-Secondary School Teacher of physics and Mathematics who retired from the teaching service and engaged in agriculture and blacksmith skills for which he helps farmers a lot.

In 2000 he first fabricated a welding machine by using used electric wires, empty cement bags as insulators and drums as iron cores. The machine, apart from welding is used for charging batteries. Secondly, in 2003 he fabricated another machine called 'Three in one Machine'. This machine is used for cutting steel bars while cooling its blade with recycling water and it is automated to stop when finishing the cutting. Also used to drill and sharpening. These machines enhance, fasten and make easy some of the blacksmiths works.

Gordon started to be a blacksmith alone, but later on he had apprentices. Now it is a blacksmiths group, which has 7 fundis and 5 apprentices. They have a constitution and have started the process of registering their group as NGO named 'Overcome Poverty Foundation'.

The group efficiently fabricates farm and other tools such as: Knives, hoes, machine spares, bicycle spares. Bill hooks, racks, wood and charcoal stoves, hot water systems, but quite significantly it makes hydraulic ram pumps (also just referred to as *hydram* pumps) copied from an old German mission.

It took him 7 months to design the first hydram pump, but finally he reached to the real fabrication of the good quality pump he wanted. It is now pumping water for his own home, for irrigating his gardens and also supplies water to 22 households in Uwemba Village. He also makes these hydram pumps to order, i.e. designed to the specific location of the customer. Between 2004 and 2008 he made 17 pumps. It is the only group that is organized by a leader who makes use of both formal and informal education. He pays revenue to Rufiji basin water authorities. Yet the government makes negligible efforts to recognize this village enterprise.

The location of the hydram pump system

Case record 11:
Place: Njombe rural district.
Name: Pwagu Black Smith Group.

The founder of the group is John Fute. The group is not registered and it is situated in the outskirts of Njombe Town along the Hagafilo River. In 2002 the group constructed its own hydroelectric power plant using scrap metal. In 2005 one Germany individual, in appreciation of group's efforts, did assist modernizing the hydroelectric power plant that started working early 2008.

The hydroelectric power could run grinding mill, and now work for group activities and domestic needs. The group did also fabricate its own hydram pump, which supplies water to the workshop, fill an experimental fish pond and irrigates the garden

The group has the ability to fabricate, repair, and to innovate farm tools and other equipment such as knives, hoes, including a combined hoe-and-spade in one piece, machinery spares, hydram pumps etc.

The group has enough area for extension of its activities. It looks forward to opening a training centre for innovative people. Although many government leaders and officers keep visiting the group, they do little to enhance their undertakings and to enable it to reach very many farmers and the general community on technical issues.

Case record 12:
Place: SIDO regional compound, Dar es Salaam.
Name: Ngosha Blacksmiths Group.

First visited in 2005, the Group explained that they first had been situated in one of the shanty areas in Dar es Salaam with little opportunity to improve their technological set-up. In particular they had problems to get sufficient charcoal for heating purposes. They were then given the opportunity to move to the SIDO compound, occupying a piece of open empty space. Here they experimented and developed a way to use waste oil from city garages to melt scrap iron into many different household utensils. The group won the 1st winner cup at the 6th Intellectual Property & Technology Day 2005.

In 2008 SIDO's new incubator programme (see more about this Section 10.3) gave the group indoor workshop space even with a small office room.

Here they have continued their innovative performance and made oil fired cooking devices and many other useful tools.

5.5 Summing-up

The hypotheses about the changing conditions of production during the 1994-95 period, which were forwarded in Section 5.2, have by and large been confirmed by our 1998-2003 and 2005-09 surveys.

However, a number of changes in the socio-political settings of the village artisans have occurred during these later periods, e.g. the schooling system have improved. What other changes that have happened and probably are forthcoming are highlighted in Part III and will be analysed in Part IV. But the basic material conditions of production appear presently to be more or less the same as before.

Achievements

Most of the village blacksmiths visited have been stabilized and many have impressively changed their technology systems. They are daily searching, searching and searching for solutions to innovative improvements in response to their ever changing socio-economic conditions of production.

We may say that they are constantly *researching*. However, this term is generally confined to universities and other R&D organizations, and we have been up against hefty discussions of this assertion: Are we not being too nostalgic? No, our data show that we are being realistic, and – as indicated in Chapter 2 – we apply a more holistic technology conception than is normally used by R&D organizations.

Opportunities

The rural diversification processes – described in Figure 3.2 – have increased the demand for all kinds of artisanal tools and household utensils. Moreover, the overhanging food crisis mentioned in the introduction, has brought the national development focus toward agricultural technology improvement.

However, very few – if any – of the initiatives taken so far in this respect have made specific reference to the village blacksmiths as such. Most research and promotion projects that deal with agricultural technology improvement appear not to mention or consider the existing rural technological innovation potential – let alone the up-keep and maintenance capacity. A recent proposal (Diyamett et al. 2005) to link the village artisans with on-going agricultural mechanization ventures has not yet been seriously considered.

Problems

The most overhanging problem facing the village blacksmiths is their needed supply of raw materials, i.e. scrap iron of good quality and charcoal.

The scrap iron supply problem.

The SIDO newsletter Habari (2006: 3) summarizes this problem with the heading “Lack of scrap steel becomes critical” and writes as follows: “Ask any blacksmith in rural areas what is their main constraint for production of tools and machinery and their answer will be inadequate access to appropriate scrap metal. Despite government legislation to prohibit export of scraps, there is now very limited supply in almost every region. And the price of imported steel has rocketed, and therefore put the production of vitally needed tools and agricultural implements in jeopardy”.

They are up against the demand by Tanzanian iron recycling factories, and newspapers have not only stories of scrap metal smuggling, but also of steeling of road culverts and rail iron. This seemingly takes place all over the world, e.g.

Village blacksmith cutting up old road culverts

England has recently initiated a country wide campaign against all kinds of metal thefts (Ritzau/Reuters, 10.07.2008).

The charcoal supply problem.

The village blacksmiths are up against rising problems of getting charcoal for their forging hearths. They are competing with the demand from the majority of households that use charcoal for cooking. A recent research estimates that 600.000 tonnes of charcoal are used annually in Dar es Salaam alone (Daily News, 16.11.2009). They are also competing with legal and a lot of illegal timber lugging activities (The Guardian, 14.10.2008). In other words, the question of forest degradation is becoming a more and more pressing problem. This is also linked to the question of curbing deforestation emission that negatively affects the climate change.

Many charcoal saving arrangements are made in the workshops of the blacksmiths and as told in case record 12 above, innovations are underway using waste oil furnaces to replace the charcoal fired furnaces. Local reforestation initiatives were also observed amongst some of the blacksmith groups visited, e.g. by the Kisangani Smith Group (case record 8 above).

6. Artisanal boat building

Pernille Bertelsen

For centuries, local craftsmen along the shores of Lake Victoria have built different types of boats using locally available timber and tools made by local blacksmiths. Since the colonial era and up to present time, the locally made tools have been supplemented by tools bought in general stores and hardware shops in the towns. As deforestation became a predominant problem, logs for building dugout canoes became difficult to get hold of, and timber merchants have then supplied the wood for boat building.

In this way, the boat builders have first of all supplied local fishermen with a means of production that has enabled them to fish on the Lake to supply the population with protein rich food. Secondly, they have provided traders with means to transport goods from place to place on the Lake. None of the interviewed boat builders used drawings or written documentation for design and construction of the different types of boats.

Findings from our field studies between 1998 and 2003 of the boat builders and their craft reveal a close relationship between the availability of fish species, the fishing methods applied, the design of the boats, the technology used for boat construction, and the market for fish.

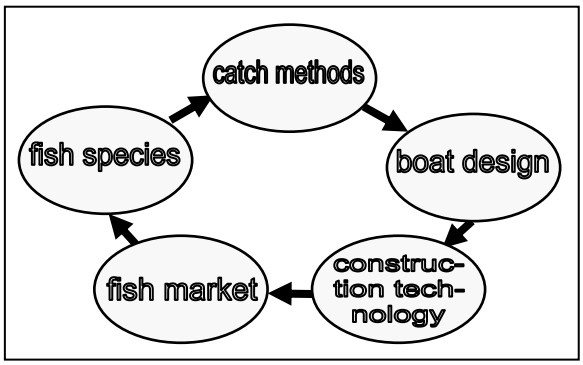


Figure 6.1: Interdependency between fish species, catch methods, boat design, construction technology, and market

The societal conditions for the artisanal boat building technology has undergone a radical change more than once, and thus affected not only the boat building technology, but also the role locally made boats play in society. Most distinct is how the post 1990 growth in fish export industry has affected the demand for boats.

6.1 Historical perspective

During last century (1900-2000) boat builders have innovated and changed their boat designs from predominantly construction of dugout or plank canoes, to 50 feet long container boats with two outboard engines, being the two extremes. Our fieldwork was conducted in the *Majita* area, among the Wajita people, south of Musoma town, at the shore of Lake Victoria. Here lives a population that historically has been engaged in both fishing and agricultural production.

Figure 6.2: Map of the Majita area

The traditional or non-industrial fishermen can be divided into:

a. Fishermen who do not make a cash income from the fishery, since their catch is consumed or distributed to family and friends. They do not have to make a specific income from any particular fishing trip, since the purchases needed to sustain the fishing is very small.
b. Fishermen who need to make cash income from the fishery to sustain the fishing operation, either to pay for fishing gear, labour or to buy fuel for the next trip or kerosene for lamps for night fishing.

The historical records from the National Archives from the early British colonial days document how fishing was very common in the region, and even provided a surplus to constitute a local export industry. From these formal government reports it has also been possible to get historical data on the fishing techniques used, as well as some scarce information about the boats that were used.

Availability and the use of fish

A 1928 report recorded dried fish as:

> "a useful native industry, though the actual exportation are made by Asiatic and the trading class of native numbers of whom come from Uganda and travel back there with their local purchases" (Annual Reports Mwanza District 1924, submitted 1928).

Thus fishing and the local fish processing industry of drying and smoking the fish for export as far as to Uganda, was recorded as a local income activity:

> "The amount of dried fish shown in the schedule of exports is no indication of what is being taken from the Lake. The local consumption is very large and much is also sent to neighbouring Provinces. Little appears to be known about the fish of Lake Victoria" (ibid: 7).

The British colonial government saw little prospect and interest in developing the fishing industry.

Dried and smoked fish ready for marketing, Majita, July 1999

Fishing gear

The old records of fishing gear can be divided into endogenous and exogenous gear. In the report by Michael Graham from his survey 1927-28 on the lake (Graham 1928) it is recorded that Captain B.Whitehouse, who surveyed the lake from 1898-1909, reports that he was the first man to use a net on the lake.

The first major change in the region's fishing technology appeared in the beginning of last century after the Europeans and Indians settled in the Kisumu area of Kenya and started to

introduce seine net fishing[1] in order to export fresh fish by rail to Nairobi. The first few local nets are recorded to have been made by a Norwegian Mr.Aarup and his workers. Shortly thereafter seine nets were imported from Messrs Wm. Barbour sons Ltd, Lisburn, Ireland by the local shops (Graham 1928). Later cotton line was sold for the locals to make their own nets. "In Tanganyika, generally speaking, imported nets are not used, their place having been taken by the fishermen's own make" (ibid: 16).

The reports from the districts in Mwanza and Musoma as well as from Nyanza in Kenya, which were made on request of Mr.Graham prior to his 1927-28 lake survey[2], note that the nets used for commercial fishing was introduce by Mr.Aarup, and he was held responsible for the spread of seine fishing being carried on in 1927. In 1917-18 some 4/500 fish were taken in a night in 5 seines, now (1927) in the same waters only 20-30 fish. A notable decrease was observed, which could refer to over-fishing on those fishing grounds that could be accessed using the traditional boats.

> Aarup was accompanied by a native named Jacobo, who had been taught by him to knot seines and who in his turn taught other local assistants which later, on the departure of Aarup and Jacobo, and the dropping of fishing by Europeans, took up the pursuit on their own account. Until now Seine fishing is carried out by a large number of members of all lake-boarded tribes who sell what fresh fish they can and smoke the balance for carriage into the interior or for export to Bukoba or Buganda.
>
> I have not heard of Indians being engaged here (Tanzania) neither are special boats build for the trade. The industry, such as it is, is entirely in the hands of the local tribesmen, with a sprinkling of waswahili, who fish on their own account from native canoes; the average number of seines down at a time would not exceed 3 per canoe.
>
> The middlemen are waswahili who travelling round the fishing camps buy up small quantities from camp to camp transport them in canoes and then export in bulk to Uganda by steamer or dhow. Dhow loads of 10.000 to 14.000 dried fish are stated to be common.
>
> Seines are now sold in the Indian shops at 20/- per 100 feet.

Box 6.1: Reply to Grahams request for data by Mwanza and Musoma District officers

In Kenya at the shore near Kisumu the situation was different from Tanzania. Here both European and Indians also tried to get involved in commercial fishing – among other things with the prospect of access to Nairobi from the Railway.

In Tanzania, the District Officer in Mwanza wrote, after reading Grahams report in 1928, in a comment to the Provincial Commission about fishing control and hand-made nets: “Large quantities of cheap cotton thread are imported from India solely for the purpose of sale to natives wishing to make their own nets”.

Apart from the fishing nets mentioned above as being introduced to the area in the beginning of the century, Grahams 1927-28 surveys recorded a number of other fishing equipment. The following Table 6.1 is based on the data from his report.

[1] A large net with sinkers on one edge, and floats on the other that hangs vertically in the water and is used to enclose fish when its ends are pulled together or are drawn ashore.

[2] Mr. Graham requested the District people around the lake to collect fishing equipment and report to him on fishing activities in their respective Districts and send the artifacts as well as the reports to Kisumu prior to his arrival. In the National Archives in Dar es Salaam, 1999, we read the records from Mwanza, Musoma and Bukoba.

Years later, probably in the mid 1930' the production of nets in Majita appear to be locally made from sisal leaves – but it is unclear whether it is because import of cotton from India was abandoned or because the number of fish could not pay for the cotton thread.

Baited trap and Barriers setting, Majita, July 1999

Fishing gear	Description
Seine Nets	One end of the net or the end of one warp is stationary and the method of working is to enclose the fish of a body of water and draw them ashore or into a boat. The two instruments used in the manner of a seine are included among the old native methods. One is the curious row of wide-mouthed baskets of the Buddhu cost. The other is the Kavirando 'ngogo' which is made of papyrus stalks. This type is used on sandy coast only.
Lines with baited hooks.	-hand lines require continues attention -long lines which are let out for an interval of time
Unabated weapons	Spear, gaffs and foul-hooking devices
Barriers	Weir across streams or rivers or built out into the lake: -complete barriers as sometimes used at crossed rivers or build into the lake. -Mazeo as sometimes projecting into a river (basket traps may form part of these systems)
Baited traps	On the rat-trap or lobster-pot principal
Hand nets	Nets or baskets, which may be baited or not, but which do not entrap the fish until worked by hand, lifted out of the water or pushed along, or thrown over the shoal of fish (cast nets).
Tangle nets	Nets in which the fish come into net of their own volition or by being driven and are grilled or caught by their spines: -Drift nets - these are not attached to the bottom in any way -Set nets - these are fixed to the bottom or the shore
Trawls	The net moves as a whole and entraps the fish as it traverses the water, usually on or near the bottom.
Baskets in a line	The line of baskets in use on the Buddhu coast and introduced by visiting Wahaya near Mwanza, partakes of the nature or both trawl and seine.

Table 6.1: List of different fishing gear

Our data revealed that people, born in the 1920's and 1930's, did learn how to make nets out of sisal when they were children and young boys. The old Musoma District book from the 1920s supports this with its records of how fishing equipment was locally made: "Fishing equipment: The lake-dwellers, especially in Bukwaya and Majita, make their own nets and they are experts in the manufacture of strings from sisal leafs. The weights and floats etc. they employ are also homemade and their anchors a local product".

Asking an old woman, Mama Heston Nbwire born 1918, about her childhood memory of fishing and boats, she gave the following general picture of the history.

- Her father was a fisherman who was fishing using *pound net* made of grass straw and baskets, i.e. traps looking like lobster baskets. Fish were plenty, and there was not really any need for boats. The people who started using canoes were from Ukerewe island; these were then copied by people at the lake shores. In short, we were told the following details:
- To use nets and traps was the work of men. Both men and women used *hooks on a string*.
- At that time a lot of fish. Why less today? The use of net as well as *dragnet* has reduced the fish. They fish small fish as well. In old days less people - and more fish. Fish was only used for home consumption. Later the cash sale attracted people and increased the catch.
- The business made was to dry fish that was sold up country or to exchange for grain.
- In 1938 business people from Uganda came by boat and bought up fish introducing the cash economy and created rich trade people among the Wajita clan. This trade stopped some years after independence.
- Cotton was farmed when her father was young, but they had to travel far to Bukima to sell it to the Indians. It then had to be transported by car to the Mugango ginnery.
- Bukima was the centre with access road to Musoma - all crops were sold there.
- When the first mitumbwi boats were constructed they drilled holes in the wood and used rope to tie the wood, and then something from the banana plant to seal between the boards. Later they started to use cotton instead of banana.
- The blacksmiths made spears, arrows, knives, small axes to make canoes and bigger ones to cut the trees.

Box 6.2 Personal history of the fishing and boat construction sector at Lake Victoria

Our survey in the Majita area shows that the traditional fishing methods are still being practised by the old men and young boys, that do not go on lengthy fishing trips to the fishing camps, but stays in the village where they provide fresh fish for household consumption. A government band on the use of seine nets from the shore has actually opened up for a comeback of old traditional fishing tools and techniques. Suddenly the canoe again becomes a useful means of transport on the lake.

Fishing boats

The traditional and artisanal fishing boats that can be seen on the Lake are wood made and may be divided into 4 categories:

- Dugout and planked canoes
- Planked paddling and sail boats
- Planked and motorised boats
- Cargo boats

Canoes

Dugout canoes and planked canoes are paddle propelled.

Dugout canoes are becoming rare, as large trees from which they are made are no longer available due to de-forestation. Therefore, it is unlikely that any new dugout canoes will be constructed. The canoes are small in size – up to 7 meters and have a limited carrying capacity. They can fit up to three people in the largest canoes, but are mostly operated by one or two people. They are not suitable for distance offshore fishing, but are used to for operating small fishing gear near the shore.

Planked canoes are also becoming rare. They are made of local wood, however planked. Like dugout canoes, they are used for fishing close to the shore and also suitable for hippo hunting. They are from 4 to 7 meters long.

Planked paddling and sail boats

Fishing boats for paddling and sailboats have construction methods that clearly show Arab influence, in Kiswahili called *Mtumbwi*. The planks are normally about 20 cm wide and for some type only bended in the bow and for others in both ends. Their size varies from accommodating between 3 and 7 people. They used to be constructed in hardwood, but on Ukerewe Island it had become common to construct them in the fast growing soft wood. They are then sold at a cheap price. However, they also only last a few years. Constructed in hardwood their life span is much longer and repair and maintenance pays.

Planked and motorized boats

In the industrial Nile perch fishing business these boats are used to tow smaller boats to fishing grounds and to transport the catch on ice when fishermen have sold it to middle men or factory boats. Most of these boats have inner longitudinal ribs.

Cargo boats – motorised or with sails

The traditional type of these cargo boats – *Dhows* – also show clearly Arab influence on their design. They are operated either by sails or engines and are used to transport food, cargo or passengers. They sail between mainland and islands or along the shore.

Linking the boat types, the fishing techniques and fish marketing

By combining the historical data with our own observations and interviews it is possible to link the type of boats, the fishing techniques, and the fish products to different time periods during the last century. Table 6.2 shows how the change in the types of boats being constructed has been stimulated by either change in the market structure, the catch technology or the fish species available.

Year of domination	Type of boat	Dominant fishing equipment	Fish conservation technology	Dominant fish market
Before 1900	Dugout canoes and planked canoes (1-3 persons)	Baited traps Barriers Hand nets Tangle nets Seine nets Beach seines Harpoons Fishing hook	Fresh fish	Local petty commodity trade
Before 1900	Dhows for cargo	n.a.		
1900-	Freight boat (dhows) two types	Transport of preserved fish and agriculture crops	Dried and smoked	Regional National East Africa
1920-	Planked paddling and sail boats (Mtumbwi) max 7 person	Seine nets Beach seines Fishing hook	Fresh, dried and smoked fish	Local Regional National East Africa
1970-	Dagaar fishing boats	Dagaa nets Kerosene lamp Solar lamps	Dried fish	Regional National East Africa
1980-	Planked and motorised boats e.g. boats with ice containers on board to transport fish or cargo boats	n.a.	Frozen fish, factory fillet	International: EU Japan

Table 6.2: From Canoe to Engine boat.

Without any external technical support, the local boat builders have been able to supply the new industrial sector with enough boats (means of production) to actually run an extremely profitable international export industry. The craftsmen themselves are gaining very little income compared to the profit that the fish industries make. But they gain enough to feel that the industrialization have made their income situation improve, a situation they share with many other rural people along the lake shore near the two big towns Musoma and Mwanza, where more than 10 fish processing factories are located. For many families the income from sales of fish is the only cash income they have.

Regrettably we are not able to quantify the number of the different boats described here, but as said, this is intimately linked to the fish market conditions, and of course to the size of the population along the total lake surroundings.

6.2 Production systems for boat construction

The liberalisation of the economy in Tanzania has from the end of the 1980's changed the local demand for fresh fish for export to EU and Japan. The export market have not only increased the demand for the small fishing boats, but also created a demand for a new type of engine-operated boats, which the local boat builders also have started to construct. The boat builders have responded innovatively to the change in the market situation.

Empirically this can be observed in the organisation of the boat building. The boom in the building of boats has opened up for new ways of organising the boat construction. Whereas the traditional way of organising the construction of boats has existed for centuries, i.e. the master boat builder working in his workshop in the rural area alone or assisted by apprentices, three other types for how to organise the work are now becoming common:

- Boat builders working for a master boat builder in his workshop in the rural area or minor towns when orders are plenty.
- Boat builders working for a timber trader or a fish agent[3] in his workshop in the town together with 8-10 other craftsmen and apprentices.
- Boat builders working on the Indian fish factories to construct engine boats to collect fish on the Lake.

With reference to Section 2.4 we have encountered 2 types of production systems among the boat builders: The artisan system, the putting-out system and the manufacturing system.

Simple artisan system

Relatives train the boat builders who construct one boat at a time and only when they have orders. Preferably they work at their own home or a work site in a nearby place identified by them or the customer. They have agriculture and/or fishing as other income activities, which they and their family maintain at the same time as they from time to time build boats. They may have an assistant and/or apprentices to help with the work when they have orders. They use axes locally made by the blacksmiths and simple carpenter tools either homemade or bought in a shop. They own their tools. The customer will provide the material e.g. wood and metal nails. They work on one boat at a time and only on customer's request. They get new customers on advice from previous customers.

[3] A fish agent buys fish from the small fishermen at the lake and delivers the fish to a fish factory by agreement/contract. A fish agent may have several small fishing boats, which he leases out to fishermen against a share in the catch and an agreement that they only deliver fish to his collection boats.

Case record 1:

- *Place:* Chichale village, Majita ward.
- *Name:* Mafuru Magembe Mjungu.
- *History:* Mjungu is about 60 years old. His father, also a boat builder, tougth him the craft.. He started building his first planked paddling and sail boats (Mtumbwi) in the late 1940s.
- *Technique:* He bought his tools in the shops in Mwanza and in Kenya. His first boat was made out of hard wood (Mninga wood). He still has a planked canoe (kunguro ya Kiboko) made by his father. It is 48 years old and still in use to hunt hippos on the lake. Rope has been used to join the planks and banana plants to seal it to stop water to get in. The base of the boat is made of Samwa wood and the walls of Mkuyo wood. The tools used were made by the blacksmith in Majita and Ukerewe. He has someone to help him when he construct boats, but he does not have enough orders to keep an apprentice all the time.

Hand operated, locally made drilling tool

- *Knowledge:* His father had learned from people outside the family. During that time the boat builder would also select and cut the wood for the canoe. He learned his skills from his father.
- *Product:* His father used to make dugout canoes and planked canoes. He is now making planked paddling and sail boats as there is no wood available for dugout canoes any more.
- *Market:* He makes about 5 planked paddling and sail boats a year. People from many different places press order. They bring the wood themselves and pay him for the labour cost.

Complex artisan system

The next case is as above, but includes also repair and maintenance of boats. Work with assistant and /or apprentices. Construct or repair one boat at a time. Move also away from home if requested to do so. The boat builder can be a traveling journeyman if requested to work on a specific site. He has his own tools.

Case record 2:

- *Place:* A beach south of Bukima village.
- *Name:* Mzee Mugini.
- *History:* Born in 1923. His father bought a dhow (Kalua) in Kisumu (1939) with money he had earned in the European Rice farms. The Dhow was used to transport fish. When he was young his father made him and the other children learn to make big nets and baskets for fishing. When he was 20, the dugout canoes started to disappear. In the old days there was no real demand for other woodwork like beds and tables. His big brother moved to Ukerewe island after having learned to construct boats. He went with him and they continued to construct Mitumbwis. He came back around 1943 and his brother remained there. His wives are cultivating the land. His sons have become boat builders as well.
- *Technique:* Tools: The rander and the axes used to be made by the blacksmiths in the old days. Materials: The wood for the planked canoes are mended with rope and also for the planked paddling and sail boats that used to come from Ukerewe. The wood for dhow are bought in Mwanza.
- *Knowledge:* He learned from his bigger brother who learned from Kenya when he was supervising the construction of his father’s dhow in 1939.

- *Organisation:* He is part of a clan of boat builders at the Majita peninsula who all initially seem to have learned the skill of construction boats from the bigger brother who went to Kisumu in Kenya.
- *Product:* Dhows and planked paddling and sail Mtumbwi boats.
- *Market:* He gets order when people see his boats. The fish availability has gone down. The market is there, but the price is very low.

Putting out system

The boats are built in a workshop where several boat builders work at one or more boats at the same time. Customers either place orders or buy a ready-made boat from the master boat builder who is the owner of the workshop and who employ the assistants. The boats are sold with or without being painted. Customers are local fishermen or fishing agents. The latter are rich enough to buy a number of boats at the same time. The fishing agents are likely to own 50-200 boats and hire them out to fishermen at the remote fish camps. The boat builders purchase the wood themselves and this allows them to have readymade boats for sale.

Case record 3:



- *Place*: Ukerewe Island, Nansio Town Centre.
- *Name:* Elizebiuce Makamlo.
- *History*: Has been working as boat builder for 12 years. After school he went 2 years to Bukongo Vocational Training Centre and received training as a carpenter/wood worker. Later he went to a local boat builder, Bandoma Paulo, for further training. His mentor still works at Ukerewe. He worked as his assistant for some years and when business went up he got his own workshop.
- *Technique*: He has 3 assistants that also have received 2 years training at the Vocational Training Centre. Materials are wood, nails and paint. The wood is soft-wood from Ukerewe Island. Hard-wood is no longer locally available and is too expensive to buy from main land. There is a shortage of hard wood coursed by de-forestation. He buys the planks from the wood-workers who again buy the logs from the forest. He gets his tools from the shops. Some made in Europe, others locally made. The axes are made by local blacksmiths.
- *Knowledge*: In the local Vocational Training Centre they mainly get theoretical training on wood works, but no training in boat building. The boat building craft was learned from his time as assistant for a skilled boat builder. He does not have any boat builders in his family.
- *Organisation*: He works daily in his out door workshop with 3 assistants. He may call upon other boat builders if he has a large order and need assistance. There are approximately 15 boat builders in the Nancio town centre of Ukerewe Island.
- *Products and Market*: Planked paddling and sail boats (Mtumbwi). In his workshop there were 9 boats under construction at the same time. 6 were already ordered, but the rest was

not sold yet. The boats made of soft wood only have a life span of 3 years. The international fish market boom has given him plenty of work to do as he supplies the cheap boats to the fishing agents that hire them to fishermen at the fishing grounds. The cost of his boats is ¼ of the price of a boat constructed in hard wood, because of the cheap and soft wood do not last long.

Manufacturing system

Boat builders are employed as labourers at workshops owned by either timber traders or fish-processing factories. They may or may not own their own tools. The working material is supplied by the workshop. The employed boat builders construct larger engine boats used for the industrial fishing trade. The boats are used to buy fish from the small fishermen and to store fish on ice at the lake far from the factories.

Case record 4:

- *Place:* Mwanza town. Workshop placed in the Nyakato area, close to the bus stand.
- *Name:* Boat builder Robert Mashauli, working for Tumaini Mtesigwa, a private timber trader that has a workshop where he supplies the fish factories and middle men mainly with engine boats.
- *History:* Robert Mashauli has worked as a boat builder since 1979, first as a trainee learning from his older brother, later on his own, and now for a timber trader. Robert came from Majita to assist his older brother in Mwanza. The brother had gone to Mwanza years before to learn from his uncle. All in all they are 7 from his family now living in Mwanza, working with boat building. They have trained each other by taking in a new trainee when they themselves had become skilled. Now his oldest brother is also training his oldest son, and if he fails to get him in secondary school he will also train him to be a boat builder. When he first went to Mwanza, they were constructing mostly dhows and planked paddling and sail mtumbwi boats. A change occurred after the fish factories started operating. That is when they started to construct the engine boats as well.
- *Techniques:* Robert: "When you know how to do your work, you need your own tools. When you get an order, then money is a lot e.g. 200.000 Tsh, and then you buy your tools for maybe 50-60.000, and you will still get some money. That is how I got my tools. When we work together in the workshop we also bring our own tools".
- *Materials:* The only wood that is good for boats is mninga (hard wood). The problem by using other types of wood (soft wood) for boat construction is that if the boat sometimes is taken out of the water, it will be damaged. It can be dangerous on the Lake if the wood is not durable. It will not show the signs of being old; it will just loosen up or break. With mninga they know exactly the signs when the wood is "tired". If planked paddling and sail boats are constructed of mninga, they will be in good working condition for almost 7 years before repairs are needed. The other wood types may stay for max three years, but only if they are painted inside and carefully cleaned all the time. Three years is what the boat builder may tell you in order to sell his product.
- *Knowledge:* In his family they have trained each other by taking in a new trainee when they themselves had become skilled. Now his oldest brother is training his oldest son and if Robert fails to get his oldest son in secondary school he will also train him to become a boat builder. Their boat building skills are different from the skills of someone that has gone to school. Robert: "When I was working at TAFICO, I worked with some people that, when they were working, had their writing pad with them all the time. If you took it from them they would be unable to work. They may have worked for many years, but they were only able to do the work if they had their book with them. The work we are doing is straightforward. We draw directly on the wood, according to the inches that is needed. A boat builder knows straight away the inches of the wood and the possible designs. If you

know the length and the width of the boat that you are constructing, then you know the design as well. When you have first done it – then all these measurements stay in your head".

- *Organisation:* The workshop owner goes to the Indian owned fish processing factories and gets his orders, and then he organises the work. He brings together the qualified boat builders that are willing to work for him. He is like an agent to the Fish factories owned by Indians. The workshop owner used to make a living from buying logs and then process them and sell the planks. Therefore he has a good network and is known to lot of people. When the fish processing industries press orders for millions of shilling they prefer to work with someone they trust to have the capacity to deliver the orders.
- *Product and market:* A number of boats will have the same name painted on. When people make a tender or maybe 15 boats for one agent or one factory, then they will use their trade/business name and colour. Some customers order both engine boats to store fish as well as planked paddling and sail boats to catch the fish. At the moment they no longer use the paddles for the fishing boats. They may tow as many as 20 boats after an engine boat until they reach far out on the Lake, and they leave them one by one to the fishermen because these boats have nets and gear inside for the fishermen to use them. The fishermen drop the anchor and do their fishing, and then wait until morning before the engine boat tow them at shore together with the catch.

Family clans of boat builders are the most common access to a profession as a boat builder. Part of the training of boat builders since liberalisation has moved from the villages to the major towns where the many orders from middlemen and Indian owned fish factories are to be found.

Our fieldwork revealed that the training of boat builders is only being done within the informal training system and not by the formal and public Vocational, Educational and Training Authority (VETA). The VETA technical school in Mwanza town were visited, and they could tell that boat building is not a craft they train, only carpenters and wood workers; apparently because the syllabus they use have to be the same all over the country – despite regional differences in work opportunities.

6.3 Summing up

In 2000, local regional differences were observed in the Southern part of Lake Victoria between the Majita Peninsula, the Ukerewe Island and the Mwanza town. Not only do the boat builders in these places use different type of timber, but the ways they organise their production also differ. In Majita a boat builder only start the construction of a boat after the customer have delivered all timber and nails to the construction site (either the home place of the craftsman or the customer). In Majita no timber is available locally, but has to be bought in either from Musoma or Mwanza. The craftsmen in Majita all prefer to construct boats by the use of hard wood.

There is no doubt that the work of the endogenous boat builders plays a very important role in making it possible to supply the local population with valuable proteins for their diet as well as an income through the sale of fish.

An important finding from our study is the observation of a high degree of diversification of the economic activities among the boat builders in the rural area. The boat builders are also farmers, fishermen, hunters, and carpenters. They practise their boat construction whenever an order is given, and in periods with few orders (as was the case in the period when EU banned the export of frozen fish after incidents of use of poison as fishing method) they have other income activities to rely on. The artisan skills they practice are primarily socially and culturally inherited. However, changes are observed. Young boys from families outside the clans also

get a chance to become apprentices. The boat builders in the regional towns of Mwanza and Musoma are less diversified in their income activities. Their income depends almost entirely on building boats. They have learned their skill from family relatives either in the rural areas or relatives that has already moved to town.

The boat builders are innovative and possess a high degree of change readiness. They have shown an ability to respond to the environmental and economic changes in society by changing their technology and develop new products. They adjust their production capacity to the market demand either when the availability of fish types change or when liberalisation of the economy makes fish export a lucrative income possibility.

Some of their tools are still made by the local blacksmiths but the majority of tools are bought from the hardware stores in the towns. All wood used come from the timber dealers in the major towns and the shortage of hardwood together with a huge demand for boats and fast return of investment has changed the quality of the boats. Add to this that the lack of security when using the boats build in soft wood is not affecting the owners, but the fishermen that spend the night in the boats on the fishing grounds.

7. Rural pottery enterprises

Eginald Mihanjo

This chapter examines why and how Kisi pottery enterprise has survived for centuries, and still continues to survive. It points out that the enterprise continued existence is a result of two main factors. One, its significance to household production and reproduction and survival needs both for food in form of grain supply through barter exchange since the old pre-colonial times up to now, and for money needs through pot selling at weekly and other forms of market. Two, flexibility and dexterity of the producers to cope up with the needs of the time in terms of inventing and making appropriate innovation by designing new types of pots demanded by the consumers. It is therefore concluded that the Kisi potters represent a case of dynamic and entrepreneurial rural producers and enterprises, which if well studied and empowered would demystify the entrenched conception that the African rural population needs an external impulse, a compulsion from the modern world – urge from city – or the thrust of the North to develop and modernize.

7.1 Historical background

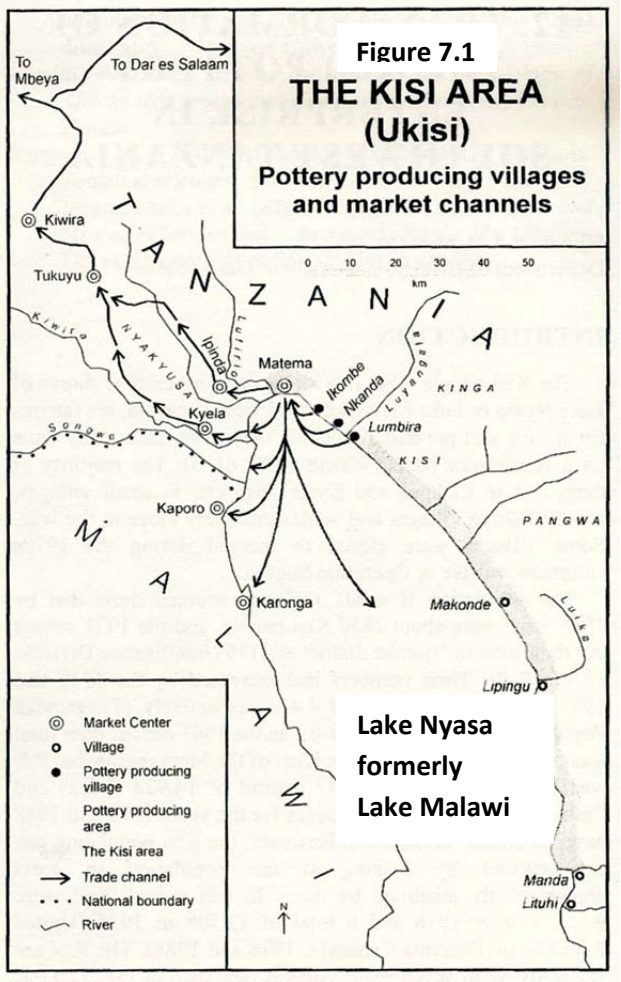
For many years Kisi women have been reckoned as pot makers in Lake Nyasa region. Pot making developed as a domestic activity and played a secondary role in the economy. Pots that were produced were for domestic use and a few of them were exchanged with the Kinga, Nyakyusa and Pangwa neighbours for other commodities. Pots were also bartered across Lake Nyasa (also called Lake Malawi) to Malawi for the same purpose. Girls thus learnt making pottery as part of their traditional role that enabled Kisi women to make pots for their domestic and subsistence needs.

During the 1980’s changes did transform the Kisi's subsistence economy into a commodity based economy, and pottery developed as a commercial activity integrated within the logic of exchange economy. The type of pots that were made became commodities that could be sold and bought. The introduction of a liberal open market economy did stimulate demands for money as well as the opening of Lake Steamer transport along Lake Nyasa, and provided an impetus for commoditization of pottery. Among others, the ability of the Kisi potters to adapt and innovate according to the demand environment, both domestic, local and external, made the pottery enterprise in Ukisi survive.

Inventing for survival

Not much has been studied about the Kisi and their pottery industry in South-West Tanzania. However, in the late nineteenth century Thomson was amazed by the Kisi artistry and indicated that Kisi pottery was a female and highly developed activity (Thomson 1881: 258-263). Thomson wondered about “how quickly and yet with what geometrical exactness” the Kisi formed the pots. He further described that each woman produced two to three pots per day, mostly ‘pombe’ (local drinks) and grain storage pots for domestic use, and a few were bartered for grain supply (Koponen 1988). With colonialism, the German and British colonial states paid less attention about activities that did not produce raw materials, such as pottery activity. The colonial state paid attention on the recruitment of labour and development of agriculture. Lake Nyasa developed as one of the labour reserve areas and supplied migrant labourers to the plantations in Tanganyika and mines in southern Africa (Mihanjo 1989). The Kisi did not stop making pots for their own use. They continued making pots, which they bartered for grain at native markets, one of which was opened at Matema to the extreme North Western tip of Lake Nyasa. The market slowly attracted traders especially from Karonga in Malawi, Ukinga and Unyakyusa.

By the time of independence, the market was a famous one. When Waane visited Ukisi in late 1970s, he found the market called 'liulilo' flourishing at Matema. It operated on a weekly basis between Thursday and Saturday. Pots were made at the time for domestic use and exchanged for cash or bartered for food (Waane 1979). The enterprise was also a feminine and household activity, and the number of pots made in a single day depended on the type of pot and the age of the potter. Girls were by large more productive than the older women (Mihanjo 2001). Pottery production was consequently organised on the basis of domestic needs, rather than on exchange logic, and as a result of this situation, the type of pots that were made were not diversified. They were mostly big types of pots, mainly those used for 'pombe' and cooking.



During the 1980's pot making and pottery enterprise in Ukisi continued to survive, but its logic has changed from production for use in the subsistence economy to production for exchange geared for money. Three reasons were behind this change. First, the introduction of government steamers in the last part of 1970s opened up Ukisi for wider regional market. The three steamers were called MV Mbeya, MV Iringa and MV Songea. By 1980 the steamers became effectively operational. Second, the liberalization of the economy made exchange of goods including pots an important aspect of the economy. It speeded up the commercialisation and imported goods were introduced in the area. Third, all this had impact on the monetization of the fishing economy and other related economic activities in Ukisi.

The Kisi started looking for money so as to buy new goods – sugar, soap, cloth. Out of necessity the demand for money became a historical reality for the Kisi people. This has a dialectical impact; it led into a qualitative and quantitative transformation of the pottery production process in Ukisi. Consequently pottery continued to survive, but in a different way and only those who were able to invent, innovate and adapt in line with the market were able to survive and accrue more money from the market economy. Pottery developed as the easiest way to obtain income. Pots became articles for sale – they were commoditized, and sold for money. And money accrued from selling pots became the basis for the survival of the Kisi households. It was used to buy basic necessities such as cloth, medicine, and food. A few of the Kisi used the money to open small businesses such as shops.

7.2 Dynamism and innovations

Why has the pot making enterprise survived so long? This is an important question and the answer could be found on the art of survival of the Kisi production unit – the household. This is the centre of production and reproduction and the engine of survival of the clan unit. Production of pots has since time immemorial organized the Kisi clan life and their subsistence.

It was an economy that was based on production of pots for export and exchanging them for subsistence, such as in exchange for grain. Pots production has a dual element, domestic needs for household which absorbed very little demand, and an external logic for exchange. The latter was a key for stimulating qualitative and quantitative expansion of the pot making. It is the exchange purpose that re-engineered pottery and potters in Ukisi and made it dynamic and continues to survive. It is this logic that has enabled pots to transform from a useable item to commodity in the post 1990s.

Commoditisation of pots from articles for domestic use to articles for exchange created implications on the pottery enterprise, in particular organization and on innovations. It has effect on the pot making process and the type of pots made.

Pot making process

Pot making is done in three stages: obtaining clay, making of pots and finally burning. Despite the changes in the logic of production the process of obtaining clay has largely remained unchanged and no significant innovations have happened. Clay that is used is of two types: the normal one and the decorative one. Normal clay is dug early in the morning. A large amount is piled up at the family compound. Decorative clay constitute of locally found and a red one called 'lila' bought in cake form from the Kinga.

Pot making is done by women and girls. There is no scheduled time table for the work, though it is widely done in the afternoon. In both cases, pot making is carried at the family compounds. The pot making process involves, first the soaking and softening of the clay. Second, clay is put on a tile called 'lumenyu', from which pots of various types and sizes are made. Third, pots are left to dry and next day pots are smoothed using 'lisengelo' and then decorated by the white or red 'lila' clay as per the market demand. Finally burning is done in an open family compound. Firewood is laid down in an orderly pattern, and then pots are put on top, and then grasses are laid on top of pots. The potter puts on the fire; normally in the afternoon. Well burnt out pots are then selected, or the process is repeated for unburned pots. Potters do it themselves, rarely assisted by males. Breakage is negligible.

Survival of pottery among the Kisi is a function of dynamic dexterity and inventiveness in the pot making process. The potters must produce pots as per market demand. For this reason the types of pots produced have changed over time, and consequently potters must cope with such changing needs. In Ukisi this is one of the conditions which shape the age structure of the Kisi potters. Young girls between age 10 and 29 constitute 62.7% of the potters as shown in Table 7.1 below. This is because young girl’s dexterity is excellent to cope with new type of pots, innovative and well exposed to the wider market.

Age group	Respondents	%
5-9 years	7	2.3
10-14 years	23	7.7
15-19 years	61	20.3
20-29 years	104	34.7
30-39 years	54	18
40-49 years	32	10.6
50-59 years	7	2.3
60 and above	5	1.7
Total	300	100

Table 7.1 Age structure of Kisi Potters

Type of pots

Over time the types of pots have changed and only potters able to make them have survived. New types of pots that have replaced the old grain and water storage pots called ‘ingumbe’ are ‘ndelele’, ‘tukalango’, ‘indeku sya misi’, 'sufuria', 'CCM', 'mkapa', 'birika' and 'vya mapambo'. These pots have also Swahili names instead of the Kisi names. 'CCM' and ‘Mka-pa’ are names with political connotations and they carry names of the ruling party Chama Cha Mapinduzi (CCM) and former President Benjamin Mkapa who came in power October 1995.

Associated with this shift in the type of pots is the fact that the pots are mostly made by girls. They are the ones most knowledgeable on making small types of pots intended to capture wider urban market rather than the local market. These are the type of pots that are mostly demanded at Matema market as shown in Table 7.2. As shown in the pictures below, the pots are tukalango, indeku sya misi, ndelele, sufuria and CCM. Most of these are water and cook-ing pots. Their demands, unlike ‘ingumbe’ and ‘vijoli’, are very high among households in Unyakyusa, Ukinga and among the urban population in neighbouring towns, Kyela, Tukuyu, Mbeya, Dar es Salaam and Karonga.

Type of Pot	Potters who make the mentioned type	Potters selling the mentioned type
Tukalango/makalango	133	119
Indeku sya misi	88	85
Ndelele	62	35
CCM	59	26
Masyala	30	13
Sufuria	28	34
Mafuniko	28	1
Fijoli	3	8
Mkapa	2	3
Fingumbila	1	13
Birika	1	2
Vya Mapambo	1	2
Ingumbe	1	0

Table 7.2: Type of pots made in Ukisi and sold at Matema Market

Types of pots at Matema Weekly Market, December 1996

While young girls make most of the pots, potters above age 60 are the most skilled and the masters of the craft. The old generation of potters made the big traditional pots such as 'ingumbe' which cannot be made by the new generation of potters. However the big pots take time to make and have no potential market at Matema Market.

While the change of pots into commodity for sale has increased the types of pots, the other impact related to this change is the increase in pottery production. It is estimated that between 3000 and 10,000 pots are weekly sold at Matema Market. The concentration is not only on the type and good design of the pots, but also on the quantity or volume. It is the volume which brings a meaningful turnover to the household in terms of income. This factor stimulates the volume of pots produced by the household and sold at the market.

The gender perspective

A number of generalizations could be made pertaining to the impact of the transformation of pottery enterprise into commodity production on household survival, the roles of girls and gender in the Kisi society. Certainly this change has brought pottery to the fore as the main-stay of Kisi household survival. In the post 1980s pottery has replaced the male dominated fishing activity. Among other reasons the decline of incomes from fishing, increase in the price of fishing gear, small and unreliable fish catch has been very fundamental for the shift in economic activity. In addition, the migratory nature of men fishing activity in search of fish and income largely contribute to the declining role of men and fishing activity in the Kisi household survival. Lack of money has made adult males and boys more migratory and they spend more time far away from home in search of money. This puts more pressure on girls. They assume more economic and social responsibilities, and thus the survival of the Kisi depended on the girls.

For this reason, women based activities both pot making and petty businesses are the engine for the Kisi economic survival. However because pot making activity has an age component it has dual consequences on the girls: it empowers them and also it has impact of girls' education performance. Commodity production in Ukisi has a general impact across gender on education. Both girls and boys in pot producing and non-pot producing areas are affected. Engaging in commodity production makes boys and girls engage in income generation activities rather than direct their efforts on education. However, in the case of girls, engaging in pot production had an important impact on their schooling life as it helped most of the Kisi girls' complete primary education. The income obtained from pot making enable them meet school basic needs. It is the boys who dropped out from schools rather than the girls. Nevertheless, engaging in commodity production has impact on girls' school performance due to the fact that girls were overworked. Their chances for selection to secondary education are therefore low. This can however be overcome by modernizing and inventing new pottery production techniques.

7.3 Conclusion

From these observations, the conclusion that rural traditional enterprise survival are dynamic and innovative is more than a valid argument and dismisses the old modernization thinking that such industries would disappear in the wake of industrialization push. They too develop sophisticated systems of tools and organization in line with the new demands of the market local and foreign. For this reason the Kisi pottery enterprise has survived. Its survival can be explained in relation to complex factors, historical and non-historical. Penetration of money and the transformation of pots into commodities is one of the factors. Under the influence of cash economy, pottery enterprise continued to operate as informal domestic industries, but its logic was transformed from production for domestic use to production for exchange. This

change significantly demonstrates the basis for the innovation and transformation of the product, the technique and the organizational aspect of the pot making technology.

The conclusions arising from the Kisi experience are multifaceted. However the most significant conclusion is the fact that pottery enterprise in Ukisi reflects endogenous systems of innovations and that it shows the adaptive ability and capability of local systems. The potters exploited chances provided by the market and used this as an opportunity to their advantage, and in so doing the enterprise continues to survive. In the final analysis it can be concluded that the market economy stimulated entrepreneurial spirit among the Kisi potters and their dynamic invention of new types of pots.

8. Horizontal user-producer relations

Pernille Bertelsen

The different artisans being dealt with in this book are primarily operating in the rural areas. We have offered a vertical analysis of some specific crafts and showed how the social and technical dynamics have influenced their innovation potentials. As already pointed out, the blacksmiths, the boat builders and the potters are not the only artisans operating in the rural areas. In this chapter we wish to give a horizontal snapshot account of the numerous other income generating activities that take place in most rural communities. We will show details and make an analysis of the non-food producing income-generating activities in two selected rural areas.

We start discussing of the Kiswahili terms *fundi*[1] and *ufundi*[2]. With our knowledge of Kiswahili we find it problematic to make a direct translation of the term fundi to the English term craftsman. If the term craftsman were used synonymously, a number of details stemming from how production is organised in rural communities in Tanzania would not be taken into account. Thus, we discuss if there is a significant link to be seen between the much diversified livelihood strategies and the manifold use of the terms fundi and ufundi. This is followed by a discussion of how most of the non-food producing artisan sector in the rural communities historically and at present can be traced back to manufacture of the natural resources.

Then we explain the different field investigation methods used to collect data in Rusoli village at the Majita peninsula in the South-Eastern part of Lake Victoria. First we present the result of a 50 household survey on income generating activities in the village. This is followed by a record of how many people perform the different activities identified from the survey, and how known they are to the villagers. We then discuss where the household utilities of 10 households are produced.

Finally we present the result of a brief survey of the origin of the tools used by a number of village craftsmen in and around Ngindo village at the North-Eastern shore of Lake Malawi.

8.1 Tanzanian rural artisans

Is the Kiswahili word *fundi* the same as the English artisan or craftsman? Or does the fundi concept denote something more?

The interest and need for a discussion of the word fundi came to our mind during our field-work in Rusoli. While investigating the different crafts (ufundi) that could be found in that particular village, we became aware of how the term artisan (fundi) is used in this particular context; not only to people that had been trained by a mentor/master, but to all people having a non-food producing skill that made them able to manufacture things, which is not possible for everyone to produce in the same quality – an expert.

The term fundi seem to be a broad term used regardless of the length of the training, the type of skills etc. However, since we were researching on endogenous technologies and the systems of innovation as well as the interaction with other crafts in the rural areas, there might be an academic point in differentiating and elaborating on the types of crafts and ways of being an artisan.

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[1] The word fundi has according to the Swahili dictionary several meanings: Fundi *noun:* Craftsperson (usually male), expert, instructor, mechanic, skill full, technician, craftsmen, master (of something), and skilled worker. http://research.yale.edu/swahili/kamusi/browse/s/F/b2.htm

[2] Ufundi being defined as: ability (technical), craft, craftsmanship, skill, dexterity, master (position of) proficiency, qualification, and technology.

The broad definition

In this context an artisan is a person that produces material goods that are indirectly related to the provision of food through agriculture, fishing or hunting; someone who in one way or another manufacture the means of production needed for the villagers to be able to supply themselves and maybe also others with food. This is a very broad definition, which may be narrowed by an additional, but reverse definition, stating that an artisan *is not* a person directly involved in rehabilitation of the human body (i.e. medical service). We have to do with people primarily involved with production of the means of production.

Production of exchangeable goods

The goods made by the artisan need to be exchangeable or marketable in one or another way or add value to a product, and thus need to be something that can be sold or exchanged if not used by the customer. It can be a knife, a rope, a clay pot or the repair of a radio or a bicycle. Service providers who perform activities like hairdressing, cooking or secretarial service do not in general express their profession by the use of the term fundi, most likely because the service cannot be directly exchanged when first delivered. Someone is seldom called a fundi without a specification of the craft in which he or she is being an artisan.

Training or quality of work

The designation fundi is not linked to the length of training the person has spent to acquire the craft practised. Some artisan train for 3-4 years with a mentor (a master fundi) before they can call themselves a fundi and before the members of community refer to them as fundis. Others are learning on their own for maybe 2 month, copying what they see other artisans are doing, but are still referred to as a fundi.

Some category of artisans perform skills that, because of the particular local environment, are skills which most people in the local community know how to perform with the limited training that comes from growing up in the environment. These are for example skills on how to make ropes, cutting wood, making fishing gear, and make straw mats or baskets. However, those people carrying the title fundi in relation to those skills are able to produce these products of a quality better than most other people in a village. They are the experts that others prefer to learn from if given a choice. Other artisans are practicing skills that it takes years to learn (i.e. blacksmithing, boat building, masonry, and carpentering). The years of training follow the difficulty in acquiring the skills, however the quality and variety of the products may also influence the time spend for training.

Some people claim to be fundi in a number of different crafts. Having acquired a skill may not be the same as having a solid knowledge of how to use the skill to produce a variety of products. But, being able to perform a skill also depends on ones knowledge of the basic cultural norms and values in society as well as the local time and place knowledge – ones context sensitivity. The easier the skills can be acquired the more commonly known the skills are, and therefore its practice may be a result of a horizontal division of labour in a community and not a specialization. Thus, the number of years it takes to learn a skill, mixed with the demand for the products, will influence how many people in the community are able to perform the task and potentially being able to call themselves fundi in the particular area.

The less specialized the craft is in the community the more is it performed to supplement other economic activities like agriculture, livestock and fishing; or, the more specialized the more of the artisans time is spend on practising only his or her skill. The skills that many people in a community are able to perform is likely to be particular for that area and more related to special conditions (natural resources) in the area than the specialized craft, inter alia, to

make straw mats out of the grass growing along the lakeshore, or to make and repair fishnets, compared to the blacksmiths or the boat builders.

Summarizing, three issues can be said to characterize a rural artisan:
1. Kind of goods produced (market exchange value and support to food production);
2. Length and type of training (self-learned, short training, long training);
3. Demand in community/specialisation (to meet a local or a national demand).

User, producer and natural resources

In rural Tanzania there has been, and still is, a close relation between the user, the producer and the availability of natural resources. Those products that are locally made by artisans in the villages are to a large extent manufactured by use of the same 4 fundamental types of natural resources, namely: Wood – Clay – Straw – Metal.

Over time, there has been a change in the local availability of in particular metal and wood. Where iron in the beginning of the 20-century was procured by melting, scrap metals are used nowadays (cf. Chapter 5). The availability of big wood trunks, big enough in size for construction of canoes and boats, or hard wood in amounts big enough to make charcoal for iron melting are no longer to be found everywhere. Population increase, deforestation, regional specialization and change in forms of accumulation have changed the local availability of these 4 resources. However, this does not change the fact that the locally produced goods still are made from the 4 materials.

Let us try to give an example of the change in the cooking pot material and how that has affected the availability of local crafts. Nowadays we find metal cooking pots in the rural areas produced in Kenya or Dar es Salaam together with the traditional clay pots produced by local potters. This has given rise to a new metal craft, different from the blacksmith - the tinsmiths - whose work is to mend metal pots, buckets and basins when they get a leak. In addition, after the introduction and importation of plastic buckets, basins and other containers to supplement the clay and metal containers, the tinsmith has expanded his skills to mending plastic containers as well. The tinsmith also uses recycled cans to manufacture small kerosene lamps, funnels etc.

8.2 Survey of village craftsmanship

Our intension with this section is to provide an understanding of:
- The income generating activities to be found in one village.
- How known the craftsmen are to the villagers as well as how many there are of each type.
- Household utilities that was found in a remote village with 7 km to the nearest bus stop.
- Where these household utilities are produced.
- The relation between the types of crafts offered in the village, the type of household utilities as well as means of production.
- How the different crafts has emerged and innovated as a response to the different changes in society.

Survey methodology

Our investigation of non-agricultural production in Rusoli village was based on 4 different data collection methods applied in time, one following the other.

Our choice of research methods had a considerable impact on the type of information that we were able to retrieve. We therefore start by giving details on how we collected the data. See Figure 8.1.

First we designed a quantitative questionnaire survey to investigate the possible income generating activities in 50 households. The design was inspired by a questionnaire developed by Seppälä (1998) for a survey in the South East of Tanzania. It has been slightly modified to appropriate the economic activities in Rusoli village (primarily fishing activities). After we had analysed the results, some 18 crafts and traders/service activities was identified. These did not cover all the crafts to be found in the village, but gave a fair picture of the diversity in income opportunities for the villagers.

Figure 8.1 Data collection procedure

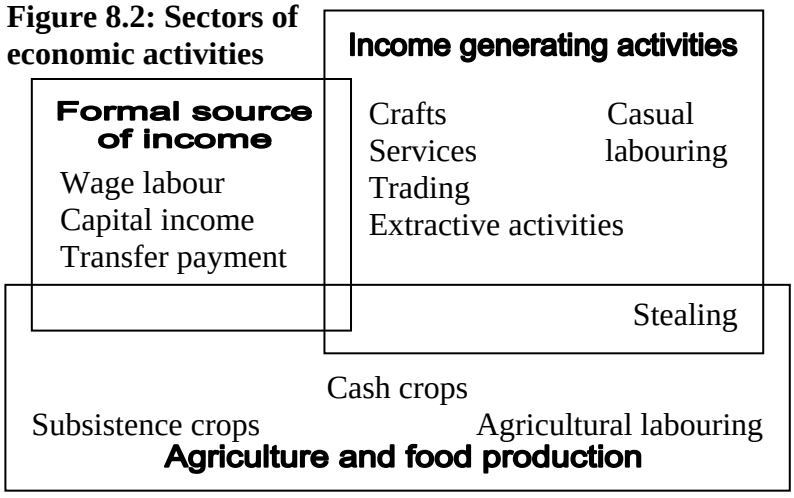
The activities were listed, and by applying a mixture of the snowball method and socio-metric method (used to make a survey to record the 'indigenous specialists', in this case the craftsmen) a new survey was undertaken in the village (Mundy 1996). Crafts and services was defined as all the productive activities taking place with exchange or sale of a product or a service that do not have to do with food products or with the human body. We made a list of the activities and asked 7 informants to name three persons in each category of crafts on the list. After analysing the result (for each of the 18 distinct crafts), the most often mentioned person was selected for an interview. The objective was to throw light on these peoples background, how they had acquired their skill, as well as how it is practised in the village today.

As a final investigation we made a survey of the household utilities to be found inside a house and were particularly interested in where these items were produced. We distinguished between locally, regionally, other regions in the country, Africa, Europe and the rest of the world as production sites. The enumeration was done in 10 households. The head of household was interviewed in his or her home and the items were observed and recorded.

Income generating activities in the village

Compared to the survey done by Seppälä in Kilemahe-wa village (Seppälä 1998: 60-96) our survey were modified to include the different fishing activities taking place in Rusoli village at the shore of Lake Victoria. The survey was designed to cover the three major income categories: Agriculture and food production, formal source of income and income generating activities as shown in Figure 8.2.

Figure 8.2: Sectors of economic activities



The findings from the survey show that all 50 households are involved in mixed food cultivation, cassava, millet, sorghum, maize and cotton being the main crops. In addition a whole range of other income generating activities take place. The activities are grouped in the following categories; extractive activities, crafts, training/services, agriculture/livestock/ fishing, wage labour and others. The survey findings are presented in Table 8.1 with the number of different income activities indicated. Some crafts e.g. pottery, are due to the randomly selec-

tion of informants not present in the survey though they are practiced in the village. The number of heads of household informants: 47 men and 3 women

Income generating activity: (only monetised or partly monetised)				**Agriculture and food production**		**Other incomes**	
Extractive activity		***Trading/services***		***Agriculture***		***Wage labour***	
Hunting	1	Local beer club	2	Mixed food cultivation	50	Casual labour	8
Grass for thatching	4	Local root snacks	2	Rice cultivation	31	Carrier	1
		Selling cooked food	1	Vegetable gardening	3		
Crafts		Selling local tobacco	2	Fruit trees	13	***Capital income***	
Making ropes	1	Selling local fruits	2	Spice and drug gardens	3	House rental	1
Carpentry	2	Selling kerosene	2	Tree seedlings	11	Selling/renting land	1
Masonry	2	Tea room	1			Renting out boats	2
Building houses	2	Kiosk	1	***Livestock***			
Making mats	1	Hoarding food crops	3	Keeping goat & sheep	5	***Others***	
Tinsmith	1	Trading dried fish	1	Keeping cows	14	Making baskets	10
				Keeping local chickens	27	Making fish traps	6
Services						Cutting wood for tools	1
Tailoring	1			***Fishing***		Making mats for beds	7
Cutting hair	1			Fishing	26		
Repairing bicycles	1			Selling fresh fish	26		
Traditional doctor	4			Selling smoked fish	1		
Community adm.	2			Selling dried fish	3		
Religious teacher/	4			Drying fish	2		
				Mending fishnets	9		

Table 8.1. Survey of income generating activities in Rusoli village (year 2000)

The span of activities employed by the individual household to generate an income for the household was extensive. The table below shows those activities that got the highest score in the survey.

The number one income activity for the villagers is crop cultivation followed by livestock production and fishing.

The average number of people actively contributing to the income in the household was 3.8, with 1 and 8 people respectively as the largest variation. All households showed diversity in their income strategy. In average, a household was involved in 5 different income-generating activities with 2 and 11 activities respectively as the largest variation (in addition to mixed agriculture). If we look isolated at the non-food producing income-generating activities we were able to identify 18 different activities in the sample.

Income activity	**No**
Mixed agriculture	50
Rice	31
Local chicken	27
Fishing & sale of fresh fish	26
Cattle	14
Brewing local beer	11
Make and repair fish nets	9
Casual labour	8

Table 8.2: Score of the activities performed among the sample of 50 households

We found many households with a number of crafts and services in practise and later, during our interviews, we disclosed that diversification in income strategy seem to be a chosen strategy for survival, more than a direct focus on professionalism and specialisation. Harsh environmental condition for agriculture and livestock production together with an unstable fish market seems to keep up a diversification in the income strategy.

The different types of non-agricultural craft and service activities in Rusoli village (August 2000) were the following:

• Making fishing net	• Making straw mats
• Making fish traps and baskets	• Making baskets for food preparation
• Cutting sticks for hand tools	• Tailoring
• Making mats for beds out of lake grass	• Making ropes
• Carpentry work	• Making paddles for sailing boats
• Mason work	• Making small kerosene lamps
• Cutting grass for roofing	• Mending pots, buckets, stoves
• Repair of bicycles	• Traditional doctor
• Hairdressing	• Community administrator

Identifying the crafts specialists

In the study referred to below we have excluded some of the crafts from the list of income activities identified through the 50 questionnaires, and through discussion with a group of villagers, extended the list to include some of the other crafts practised in the village. This made it possible to come up with the following list of 14 crafts practised in the village:

Mason	Wood cutter	Making fishnets
Tailor	Mender of plastic and metal	Potter
Fish trap maker	Bicycle mechanic	Making of rope
Carpenter	Making grass roof on houses	Radio and watch mechanics
Putting up iron roofs	Making straw mats	

Having made this list we then used a method where we asked informants to name 3 people they knew were doing each category of crafts. Names that appeared many times in the study are known for either the quality of their work, the amount of work they are did or the many years they have been practising their skills in the village.

We identified a number of informants and approached them one by one, to ask them each to name three people practising each of the 14 selected crafts. After having interviewed 7 people we had a clear picture of one person from each craft category that was more known than the rest. In table 8.3 the crafts investigated are divided into 3 categories according to the number of craftsmen identified in each craft category by the 7 informants. For some crafts (4-6) there seems to be a higher specialization, which could either indicate that there is not a high demand for the skills they offer, or that it is a craft that demand some degree of professionalism to be able to practise. In the other end we find a number of crafts where a high number of people are able to master the skill (11-14). Here we find indication that this counts for the very local developed and specialized skills depending on the local natural resources as their inputs.

The information in Table 8.3 may indicate how widespread the craft are in the village or how sought after the skills are.

Between 4- 6	Between 7 – 8	Between 11-14
Shoe maker	Making pins for tools	The making of rough mats to use e.g. sleep on the floor
Potter	Making of straw mats	Making of straw bawls and trays
Mender of plastic and metal	Bicycle mechanic	The making of rope
Wood cutter	Tailors	Making of fishnets
Making Iron roofs on houses	Carpenter	Making grass roofs on houses
		Fish-traps making craftsmen
		Masons
5 crafts	**5 crafts**	**7 crafts**

Table 8.3 Number of names given for craftsmen for each skill mentioned.

Survey of household utilities – where they are produced.

The local availability of crafts was investigated by a study of the household utilities present in the households and in particular where they were produced. The objective was not to look into the means of production as such but to supplement our knowledge with a record of the items that people kept in their houses. In retrospective a survey of what was kept inside as well as outside would have been more appropriate.

Thus, our aim was to investigate whether the availability of many different crafts in the village also was reflected in the local accessibility of household utilities.

What we found was a high number of 'containers' in different size and materials (bucket, bowls, basins and cooking pots) externally produced (other regions in Tanzania, Africa or China) but locally repaired and maintained whenever they break. We also found radios and watches produced in other part of the world but locally repaired by the local tinsmith.

The total list of items is a list of observed items. There was a variety of number of items between households, indicating those with many items as being better off than those with few. The list has been divided into 6 different categories where

1. The **local** covers items produced at the village or ward level.
2. The **regional** covers Musoma Region.
3. The **national** is all of Tanzania
4. **Africa** is the rest of Africa but in practise used to refer to Kenya
5. **Europe** is western Europe and USA/Australia/Canada and New Zealand
6. The **world** covers the rest but turn out to be China.

The local products count for almost half of the items registered in the households. Similar results were recorded from Kagera Region by Smith (2001).

Table 8.4 below gives the details of the survey, and Table 8.5 summarises how the crafts with the local materials used.

1. Locally made in Bukima ward	2. Musoma region	3. From Tanzania	4. Africa (Kenya)	5. Europe	6. World
Bed Madras Table Small Kerosene lamp Chairs Tooth brush Water pot in clay Clay cooking pot Spear Knives Grass mat Straw plate used to clean rise Cooking spoon in wood Rope to hang clay pots in Hand axe Floor sweeper Wood bucket to grain flower in Grinding stock	Metal bucket Water jack Metal basin	Bed Sheet Bag Hoe Metal cooking pot Bowl Cups Past jack Sewing nail Radio Bed Madress Table Hoe Mirror Cooking pots Sack Books Cupboard Fishing hooks Line for making fishing nets Bucket Mosquito net Watch Fishing nets Big water container glass	Plats bucket Cops Basin Iron roofing Bed Cooking pot Wheel barrow Bag Plates Water jack Bawl Plastic gallon	Suitcase Mirror bucket Hammer Saw for wood Cloth Fishing hooks	Hoe Mirror Spoons Tea spoons Radio Bicycle Padlock Toothbrush Bowl Big axe Watch Bush knives Cups Plates Slash knives Axe hoe Kerosene lamp Saw for metal Torch Blankets Suitcase Umbrella
46,8 %	2,9 %	25,7 %	11,6 %	2,1 %	10,7 %

Table 8.4: Total list of items recorded from 10 households

Craft	Metal
Blacksmith	Spear, knife, hand axe
Tin-smith Pot menders	Kerosene lamp

Craft	Straw
Basket maker	Straw plate used for cleaning grains
Mat maker/weaver	Mats, madras
Rope maker	Rope to hang clay pots

Craft	Wood
Carpenter	Bed, table, chairs
Hand tool stick cutter Paddle maker	Grinding trunk Grinding stock Hand axe handle Cooking spoon

Craft	Clay
Potter	Cooking pot
	Water pot

Table 8.5. Locally made household items matched with the crafts and materials used

8.3 Local tool making

A somehow similar survey was made of the origin of the tools and implements used by the village artisans in Lipingo Ward, Mbinga District in the Southern part of Tanzania. The Ward area, situated close to Lake Malawi has about seven villages. 13 artisanal activities were identified a number of which were visited and interviewed in order to get an impression of the products produced, the use of these products, and in particular to find out what tools were used, and finally to determine the origin of these tools. Table 8.6 gives a summary of the survey.

Activity	Product	Use of products	Tool used	Source of tools	Origin of tools
Agriculture	Cassava, maize, rice, sorghum, tomatoes, vegetables	Food, making of liquor, animal feeds, sale for cash	Hoes, 'nyengo', axes, 'panga', knives, rack	Bought	Shops and blacksmiths
Fishing	Fish	Sale for cash, food	Nets, nylon strings. Dugout canoe, paddles	Bought	Shops, canoe makers, blacksmiths
Blacksmiths	'Nyengo', hoes, knives, spears, 'teso'	Farm implements, repair for sale	Hammer, iron bars, springs, charcoal, stones, bellows	Bought, self-made	Self-made, shops
Canoe Making	Paddles, canoes	Sale for cash, for fishing	Sharpened hoes, knives, specialised knives, 'teso'	Bought, self-made	Shops, blacksmiths
Pastoralist	Eggs, milk, meat	Food, sale for cash	'Nyengo', spear	Bought.	Blacksmiths
Bicycle repair	Repairs puncher, rings etc.	Social service to get cash	Spanner, hammer, needle	Bought	Shops, blacksmiths
Wooden grinder	Household wooden items	Flour making for sale	Axes, 'teso', 'panga', knives	Bought	Blacksmiths
Timber felling	Timber products	For sale, making furniture	Seesaw, ropes, nails, axes, 'panga'	Bought	Shops, blacksmiths
Mason	Building and construction activities	Building and construction	Ruler, tape measure, nails, 'mwiko'	Bought	Shops, blacksmiths
Mama Ntilie	Sells food	For sale, food supply, service	Spoons, cups, 'sufuria' pots	Bought	Shops, blacksmiths
Carpenter	Household wooden items, construction activities	Making of furniture for sale	'Teso', 'panga, randa' chisel, patasi	Bought	Shops, blacksmiths
Tailor	Making and repairing clothes	Social service to get cash	Needle, sewing machine, 'string'	Bought	Shops, blacksmiths
Fishnet repairer	Repair or making new fishing nets.	For fishing, service	Needle, nylon string	Bought, self-made	Shops, blacksmiths

Table 8.6: Summary of the Lipingo ward activities

As can be seen, all 13 economic activities and artisan industries are dependent and linked with the blacksmith in various ways, all using tools and implements made by the local blacksmiths.

There are five blacksmiths' family workshops in the ward with a total of 13 blacksmith masters. The number of apprentices has not been ascertained because they are in most cases not very permanent except for the members of the blacksmith family.

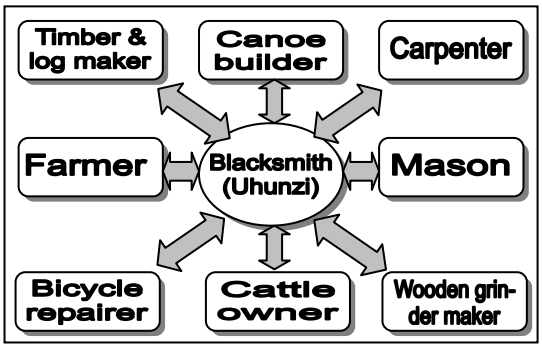


Figure 8.3: Blacksmith's interaction with other craftsmen

Figure 8.3 shows the 'customers' of one of the Lipingo ward blacksmith groups. In one case, we came across a person that did not only master and practised the blacksmiths' craft, but also did canoe construction, carpentry works and

fishing, apart from agriculture and being the local dancing team leader; making all the tools he is using himself.

8.4 Summing up

The diversified livelihood strategy needed for survival in rural Tanzania do not request a specialisation in all crafts associated with the non-food production activities. Therefore, behind the use of the local Kiswahili term ‘fundi’ we find a great variation in the length and debts of the qualification and capacity needed to be called or name yourself a rural artisan.

There is a great variation of crafts found in the village and we were able to identify those that most informants mentioned. The products made by the local artisans and the items found in the home of the villagers are closely linked to the local availability of raw materials – being iron, clay, wood and straw. The combination of different methods of investigation has provided data that allow us to get a comprehensive understanding of the link between income potentials, income activities and the availability of resources. The rural artisan skills and products indicate the existence of a local technological capacity that match the prevailing conditions for production, and that even - due to the diversified livelihood strategy – point to a potential excess capacity that, given the right incentives, can be mobilised.

9. Individual inventors

Bitrina Diyamett

Although technological invention and innovation processes have been accepted as a key aspect in socio-economic development and thus poverty reduction, countries in the South have largely been left out of such processes. Despite this fact there are individuals, especially in the informal sector, who are coming up with the inventions, which have been declared new to the world. But these are largely constrained in the innovation diffusion aspect by socio-political factors that includes: (i) the level and nature of the science education and research systems that create and reinforce the dichotomy between these systems and the societal needs; (ii) recognition and hence reward by the government; (iii) tax incentives; (iv) venture capital and (v) the Intellectual Property Rights (IPR) system.

One of the reasons for this has been the belief that the best technological road to a better life for poor developing countries was technology transfer from the North. There was no need to reinvent the wheel, and any wheel invented somewhere else could easily be adapted to local conditions. While this is true, a certain level of endogenous technological capability, especially absorptive capacity is a prerequisite. The problem has been that those responsible for such transfers often do not take this fact into account, and as a result, technologies were transferred wholesale with little or no attempt to build local technological capability.

As Fransman (1986) succinctly stated in regard to the Third World:

> "Previously attention was focused largely on the question of choice of technique and cost of transferring foreign technology".

However, this chapter reports of a recent investigation into individual inventors and innovators in Tanzania by Diyamett & Mabala (2007).

9.1 Research outline

Despite the lack of attention on the endogenous inventors/innovators, such people do exist. In the course of a previous research on diffusion of technological innovations to rural women (Ditamett et al. 1998), in a mere 16 villages in 4 districts of Tanzania, we stumbled upon several potential and actual technological inventors and innovators at all levels of society right down to the community level. In most cases they had invented new technology (even though not in the area of so-called high technology) or made radical adaptations to existing ones. What is interesting is that most of them were not employees of R&D institutions or similar organizations, and therefore had none of the institutional advantages of other researchers. In addition they had gained little significant profit from their innovations as a result of unfavourable system factors such as venture capital to turn inventions into innovations, economic hardship and a general lack of recognition and support for their activities from both state and private enterprise. Yet, they still continue to experiment and innovate.

In one sense, a preliminary step has been made. The Tanzania Commission for Science and Technology (COSTECH) tries, with very limited resources, to identify and even award a few technological inventors/innovators through Tanzania Awards for Scientific and Technological Achievement (TASTA). However, such an initiative is inevitably limited.

Firstly, as observed by Wangwe (1996):

> "The recognition through TASTA seems to be a symbol of recognition once the results of an invention is out, but support before and after the invention is not ordinarily provided for".

Secondly, there has been no systematic effort to make a comprehensive inventory of such people, and more importantly for any sustainable technological development, there has been no in depth study of these important individuals and their environment. They tend to be treated like a black box out of which inventions and innovations naturally come out.

The primary objective of what follows is therefore to open the black box and examine its contents. The intention is to present a number of cases that identify what specific characteristics of inventors and environments emerge. The purpose is to propose concrete policy directives that would enable inventors to turn into successful innovators.

Specifically, the research questions addressed in the study were:
1. What made them inventors/innovators? From where did the original impetus come? What encouragement did they receive from family, community or educational environments?
2. For those who have turned their inventions into innovation, what facilitated the process?
3. What motivates them to continue inventing and/or innovating, both from within themselves and from the environment in which they live? What support have they received from institutions and individuals?
4. What constraints have they faced/do they face in their work? What do they feel they need in order to be more successful and effective?

On the basis of the answers to the above questions, an attempt is made to come up with indications of the necessary educational background and environment that can enable inventors and innovators to emerge and succeed.

Two groups of people have been dealt with:
1. The inventor who, as a result of either personal or environmental factors has failed to turn his/her invention into an innovation.
2. The inventor who succeeds in transforming her/his invention into an innovation.

The specific objectives were to find out from the inventors and innovators and document:
1. The influence of family and society, including significant role models;
2. Educational background (subjects preferred, academic progress, level of education);
3. Previous work experience and factors which have facilitated or constrained their innovative activities;
4. The institutional and general environmental support they require in order to be successful innovators.

Sampling procedure

Sample Size: In order to reach valid conclusions and outline an acceptable model for the development of technological innovations, we found it necessary to identify and talk to at least 30 technological inventors and innovators in the capital goods' sector. However because of difficulty in following up the inventors and innovators[1] we stopped after identifying about 23 individuals.

Sampling procedure: The research used purposive sampling since the primary aim was to identify a fairly rare category of people. A two-pronged method was used:
- Use of existing records in COSTECH and the Ministry of Trade and Industry as well as previous winners of the TASTA awards.

[1] There was an instant where we had to follow up one entrepreneur for about 10 days, covering a distance close to 600 miles. He was moving from one village to the other. For those who were located at industrial firms, we found that they had already been retrenched as a result of privatization of parastatal organizations. We therefore had to ask for their where abouts and follow them. Most of them had moved miles away from their work places.

- In each of the regions identified, a search was carried out through interviewing district government officials, religious and non-governmental organizations, local private sector businesspersons and entrepreneurs, donor organizations and market and hardware sellers.

Background to TASTA Awards: TASTA is an ongoing award, instituted by the government in 1981 in order to promote and encourage the development of science and technology in the country with the following aims and objectives:

- To develop technological capability in the country;
- To encourage creativity;
- To foster the utilization of such creativity in accelerating socioeconomic development.

The following are the conditions governing the ward:

- Originality of the claim;
- The potential impact of the claim on socioeconomic development, especially in relation to the national development goals;
- The potential of the claim to increase productivity and efficiency.

Any individual or group of individuals is eligible to apply for the award. The award is processed through a committee of experts appointed by the minister responsible for science and technology.

Although our major thrust was to identify those inventors and innovators who have produced something appreciably new (rather than minor adaptations to existing machines), we did not restrict our search to the TASTA awardees, but also to those who were not aware of the award or who may not qualify for the award any way. This was because our major interest here was not the newness of the idea per se, but the spirit of the innovator and supportive environment.

The following regions were chosen:

- *Iringa*: One of the regions of our previous research, where several technological innovators have already been identified in the fields of agriculture and construction. In addition, Iringa has several large private workshops in the regional headquarters.
- *Arusha:* Also one of the regions of our previous research and several innovators have already been identified in the field of agriculture. At the same time, Arusha has an extensive small-scale industrial estate (consisting mainly of private sector manufacturers) and several of the largest R&D institutions in the country, as well as being one of the most dynamic and developing towns in Tanzania.
- *Dar es Salaam:* By far the largest city in Tanzania with a long history of small-scale production and entrepreneurship. It was thus considered to be the best place to identify urban-based innovators working for an urban market with possible greater potential for market expansion.

In addition to the regions chosen, TASTA award winners from other regions were followed up and interviewed.

9.2 Findings and analysis

Table 9.1: List of Interviewees (Both TASTA and non TASTA reworded entrepreneurs)

No	Invention/ Innovation	TASTA or Non	Status	Inventor/ Innovator	Educational background
1	Net winding and net machine	TASTA 1995	Not in use	Mr. Omary	Secondary technical education
2	Locally made bicycle	Non	Still in business	Mr. Shilla	Primary, Trade Tests

no	**Invention/ Innovation**	**TASTA or Non**	**Status**	**Inventor/ Innovator**	**Educational background**
3	Locally made duplicating machine	TASTA 1988	Never diffused. He is using it himself, however	Mr. Nyirenda	Secondary education, Teachers College
4	Mini Hydro Electric Plant	Non	Serving two families in the village	Mr. John Fute	Std VII
5	Use of waste oil as source of energy in heating	TASTA 1982	Improved by the use of waste oil and compressed air instead of water. Currently not in use	Mr. Sherif Dewji	Engineer
6	Punch press machine. Tobbacofine treatment line	TASTA 1986 and 2001	Currently not in use	Mr. Vedustus Byoma	Diploma (technical college)
7	A simple machine for small scale sugar production	TASTA 1991	Still in use though trade liberalization has reduced its profitability	A group of five engineers from IPI	Degree in engineering.
8	Amalgam retort for mercury recovery	TASTA 1995	Highly diffused	A group of Engineers from IPI	Degree in Engineering
9	Water powered solar scanner	TASTA 1991	Not fully developed	Dr. Mbogoma	Masters in Engineering
10	Tractor driven oil press	Non	Still in use, upgraded to motor powered	Mr. Mbise	Form II, Trade Tests
11	Planter	TASTA 1983	Never been developed	Mr. Msigwa	Never been to school
12	Mechanical saw	Non	In use	Mr. Mbuya	Never been to school
13	Welding machine	Non	In use	Andrew Kilibika	Std VII
14	Brick making machine	Non	In use	Romanus Mlowe	Std VII
15	Tile making machine	Non	In use	Emanuel Lubuka	Std VII
16	Sewing machine	non	In use	Mr. Luwala	Std VII
17	Bamboo pipes	TASTA	Not in use	Mr. Lipangile	Diploma (technical college)
18	Teaching aid: 4 stroke petrol engine operation unit	TASTA 1989	In use (in one school only)	Mr. Mazzuki	Form IV
19	Shuttle manufacturing machine	TASTA 1986	Not in use	Mr. Mlaki	Degree in Engineering
20	Hand operated pneumatic drive	TASTA 1982	Not in use	Mr. Charle	Std VII and Trade tests certificate
21	Automatic blastering unit	TASTA 2001	In use	Douglass Akwilapo	Diploma (Technical College)
22	Flat-ceramic biogas iron	TASTA 1995	Using it himself, could not market	Jaustine Mungure	Std VII and trade test certificate
23	Plough	Non	Not fully developed	Romanus Mlowe	Std VII

Level of education and family background

There is no any clear pattern of the educational level of the above inventors/innovators. They range from those who did not go to school at all to those with PhD's in Engineering. Surprisingly, the invention, which was found patentable and original to the world, belongs to the inventor who never went to formal education (Mr. Msigwa – sample no.11). It is also important to note that a large number of inventors and innovators are those who did not go beyond primary or at least ordinary level of secondary education. This is interesting because one would expect more TASTA awards to go to R&D institutions, which have individuals with higher level of education and favourable environment.

However, what is common for all the inventors/innovators is that in one way or another they have worked as engineers or technicians or at least helpers in garages. Most also had role models in their field of their interests. For instance Mr. Byoma (no.6) had a grandfather as a foundry maker and father as a carpenter. Mr. Mbise (no.10) was closely working with an expatriate who invented the firsts oil press (the Bielenberg press).

The above points to the importance of the technical education for the innovativeness of a certain nation. There is also the issue of support and role modelling from the society surrounding the innovators. This is possible only when the society at large is scientifically and technologically literate. One aspect of this importance is the support that the scientifically literate society gives to young scientists.

Original forces behind the studied inventive/innovative activities

Many of the innovators were employees who were inspired or rather forced to innovate because of bottlenecks caused by the breakdowns and unavailability of spare parts in their work environment caused by the economic hardship of the late 70's and 80's and macroeconomic policies on import restrictions. Thus to a large extent, innovations were demand driven (though it was a temporary demand or rather as it is put in the old saying: "necessity is mother of invention"). This applies to the shuttle making machines, punch press machine, the fishnet machines, the hand operated pneumatic drive, small-scale sugar-processing machine as well as the bamboo pipes. There was also a determination to save scarce foreign exchange as well as to overcome the obstacles related to import restrictions. This, in our view, was the major contributing factor towards the government policy on TASTA awards. It also suggests that some degree of import restriction is important, even under the current free market environment to spur innovative activities in the private sector.

The rest of the technologies evolved as the result of the felt needs of the community in which the innovators live. For instance, Mr. Mbise invented the tractor driven oil press because of the complaints about the hard work required by his manually operated Bielenberg press. Mr Msigwa developed his planter because of his awareness of the tedious and unremitting work faced by the farmer, while Mr. Nyirenda's (no.3) seminal work on the duplicating machine was the result of his experience as a teacher in rural schools, which did not have access to any kind of technology for photocopying.

Two other innovators also stated that they developed the technology as labour saving devices for themselves, such as the mechanical saw and welding machine.

Several also saw the technology as a means of personal income generation, although only one stated specifically that he was looking for a gap in society so that he could make money by filling it. When Mr. Shilla (no.2) saw that imported bicycles were too expensive for most people, he developed his own bicycle, which is much cheaper, and he has already sold several of them. All the innovators hoped that the machines they developed would be more widely diffused.

On the part of the government, the major impetus for the TASTA awards was the shortages of the 1980's.

The enabling/disabling systems elements

Education System: Even though, in the original development of an idea, the level of education does not seem to matter (especially with those with innate special qualities), surely the level of education do matter when it comes to successfully turning an idea in to a viable prototype. This is because this stage requires complicated technical drawings, which can only be done with high-level knowledge of engineering. Some of the first class inventions like Mr. Msigwa's Planter got lost because of the problem told in Box 9.1.

Mr. Msigwa (no.11) spent 7 years developing a planter which was able to measure, dig, plant and deposit fertiliser. When he completed it, it was examined by international experts (from America, India and Sweden) who pronounced it to be original and he was given a medal and a prize by the President (the late President Julius Nyerere) in 1983 (together with Mr Lipangile – no.17). Since he was not able to mass produce the planter himself, he was asked to take the machine to the University of Dar es Salaam who would dismantle and draw the machine so that the production process could start. He was also advised that it was important to take out a patent and that the people in Dar es Salaam would do this for him. He believed them and returned to Njombe.

There was no communication at all for about 6 years, after which they came and asked him for another planter. After much probing they admitted that the machine had been 'lost' and that they suspected that some English lecturer had taken it to Kenya. Mr Msigwa refused to give them another until they showed him where the previous one had gone or paid him for the original one, neither of which has been done until today.

Box 9.1: A case of systems frustrations

The planter would probably have been developed into useful innovation, if he himself was able to make technical drawings of the planter and had venture capital to turn his invention into innovation, and perhaps might have sought for the patent himself. It is also important to note, in this connection, that the technologies which find their way to the market place are those, which are relatively simple and therefore do not require any complicated technical drawings and large investments.

Another related issue with the education is the existing dichotomy between science curricular and the real needs of the society. As argued by Vitta (1992) and Adeboye (1999) and many others, in most of the Sub Saharan African countries science has largely been divorced from the mainstream of economic and social activities, and it is either sought for its own sake or for copying what is happening in the developed world. Most of the science curricular and related textbooks emphasize theoretical learning and reproduction of memorized facts that are unrelated to and out of context with simple and real life experience of the communities. As a result most of the inventors who are responding to real problems of the community are those with minimum level of education, i.e. those who did not have a chance to be brain washed by the current curricular.

In addition, there is also a tendency, on the part of those responsible in spearheading science education, to at best neglect (as it happened with Mr. Msigwa's planter) and at worst despise those technologies originating from the real life experience of communities. To drive this point home we quote part of a presentation made at a University of Dar es Salaam convocation symposium in 2000:

> …..”Not long ago the Tanzanian national science awards were being given in appreciation of the “discoveries” of antiquities! How can scientific advances be taken seriously by school children this way? While others in science conscious societies are engaged in ad-

vances and inventions of the state of art technologies like satellites, we in Tanzania orchestrate the use of bamboo for water distribution or fabrication of wooden duplicating machines. Indeed these are examples of the dubious concept of appropriate technology, which has been used by some external funding agencies to substantiate motive towards scientific underdevelopment of developing countries. It tends to marginalize the conceptual thinking of policy makers and some scientists who may be victims of this concept. Hence **relevant science** (our emphasis) suffers through government and policy makers getting indulged supporting mediocre research that perpetuate what may be termed as traditional ways of doing things that goes down to antiquity. This effectively thwarts prospects for developing science and technology in developing countries" (UDSM 2000: 129).

Such attitudes has been translated into mistreatment of the inventors (see example Box 9.2)

Mr. Nyirenda (no.3) is a teacher. In 1972, he developed a duplicating machine using local materials (wood, sponge and cloth) which could be used in rural schools which would never have the money to buy an imported machine. It was shown at trade fairs in 1977 and 1982. When he entered for the TASTA awards in 1982, his forms were lost. He did not lose heart, but continued to correspond with COSTECH until 1988 when, with some improvements suggested by the University of Dar es Salaam workshop, he won the award (16 years after the original invention!).

He then asked for some money to carry out field-testing. This money was sent instead to the university who made 10 machines, which did not work and took them to be tested in urban secondary schools, instead of rural primary schools from where the idea for the innovation came and to which it was directed. The report came back that the machines could not cope with the volume of work and could not compete with the imported machines to which the urban schools had access. As a result, Mr Nyirenda still has his own duplicating machine, but the idea has never been disseminated and primary schools still have no access to duplicating machines.

Box 9.2: A case of mistreatment of inventor

The most sustainable path, according to most scholars of technical change, is that which take into account the social economic environment of the community and evolve with the knowledge of the endogenous people. The Nyirenda duplicator might seem an antiquity' now, but has a potential to grow into something better than anything ever existed, only if it will get necessary support. This is an example of a 'road not taken' as explained in Section 2.6.

In this connection COSTECH has the tradition of linking the TASTA awardees to the University of Dar es Salaam for cross fertilization of ideas, especially since most of the awardees are limited in educational level to provide technical drawings for their initial ideas. But they are very useful in the sense that, as against the higher learning institutions such as the universities, the individual inventors are the ones in touch with, and therefore responding to the real needs of the society.

However, because of the attitudes of most of our scientists, such interactive learning is being hampered as demonstrated in the box above, and we think to a large extent that this has largely contributed to the current problem facing TASTA awards, and the whole issue of the dichotomy between endogenous knowledge and modern knowledge. Here we refer to the dichotomy between the formal education with foreign textbooks with foreign illustrations, foreign aspirations etc. as against individual inventors/innovators who acquire knowledge through informal means such as apprenticeship.

Two issues are obvious from the above case. First it was wrong to try to develop the prototype in the absence of the individual with the original idea. He also was denied the chance to upgrade his knowledge through the interactive learning with the university people. Similarly the university people would have a lot to learn from Mr. Nyirenda. Second, the machine was test-

ed in an environment different from that where the original idea was conceived. It is true that the machine would not have worked in large cities such as Dar es Salaam where teachers have access to computers and photocopying machines. But in the rural areas where there is not even electricity, Mr. Nyirenda's idea is indeed a brilliant idea. However, to the contrary, the machine was dumped as a useless antiquity.

This is the result of the current convergence between science and technology, especially in the areas of biotechnology, nanotechnology and information technology. For developed countries, with advances in technology, there is little problem in the usual coupling between science and technology; and there is therefore appreciable degree of complementarities between university science and technology in the productive sector. For poor developing countries however, there is a big dichotomy between the science pursued at the universities and the endogenous technology; while science and scientific community is one and global, and therefore scientists in poor countries have to be at par with their colleagues world-wide, technology is local, and at another level compared to contemporary science.

Of course, even for the developed countries, high level of technology does not necessarily ensure automatic relevance of science to socio-economic development. There has to be deliberate policy effort to make science relevant. For instance, currently there are worldwide movements in an effort to make science responsive to the needs of society. Example of such movements is the new science education programs emerging in different parts of the world. To mention but a few, these are: ASEP (Australia), CORST (Canada), SATIS and Salters science (UK) and ChemCom (USA) (Solomon & Aikenhead 1994; Eijkelholf 2001)

What the above programs advocates in general is to make science more responsive to the needs of the society. According to Eijkelhoff (2001) this can be done by including societal issues in school sciences courses. If this is done, the following is most likely to be achieved:

- Justify information included in science courses;
- Allows students to find sciences relevant to their daily lives;
- Enables the teachers to evaluate students success at application and synthesis of ideas;
- Redefines the teachers role to the "facilitator" and relegates the text books status to information sources;
- It may allow for increased scientific understanding of concepts, based on cognitive theories of learning;
- Provides a vehicle for tying the whole school program together.

Lack of appreciation and support of inventors by the Government

Most of the inventors/innovators, especially those who made their inventions as part of the production lines of large-scale industries, by then belonging to the government, have now been laid off as a result of the privatization exercise. Some of them like Mr. Mlaki (no.19) and Mr. Byoma (no.6) were able to set up their own offices, and with the minimum capital they can afford, are struggling to produce few gadgets. However inventors like Mr. Charle (no.20) of the formally Ubungo Farm Implement factory and Mr. Omary (no. 1) of Tanzania Fishnet are in a very desperate situation. We had an opportunity to visit them at their homes. Mr. Charle especially looks to be in a very bad economic hardship. We reminded him of those good old days in 1982 where he had frequently appeared on the front pages of newspapers as a famous inventor. When we inquired as to why he did not attempt to set up a business using his experience, his replies were: "no space, no funds etc.". He also bitterly complained of the low level of remuneration he was given when he was retrenched. Mr. Omary and Mr. Lipangile also had their own story to tell (see Box 9.3).

Mr. Omary (no.1) was working for Tanzania Fishnets, which was a government parastatal. There were insufficient machines and the workers were subjected to very hard labour so he decided to develop machines for netwinding which produced more with less labour and which are continuing to work until today. He succeeded and was given some money by the management after two years. However, he feels that the money was in no way commensurate with the contribution made by the machine to production in the factory. His supervisor was actively opposed to him and deprived him of loans and his fellow workers were also jealous of him. Before he retired he was working on a new machine. He offered to continue developing it but no body listened; and he retired with no continued connections with the company management.

Mr. Lipangile (no.17) was regional water engineer in Mwanza. There was a severe water shortage in one area and no hope of getting water pipes. He therefore developed bamboo water pipes which are five times cheaper than plastic and fifteen times cheaper than metal. His idea was enthusiastically received and he won a national award, and the issue was forwarded to the ministry responsible for water for further action; but when the economic situation improved and the more expensive imported pipes were available, he and his technology were forgotten.

Mr Lipangile also initiated the Tanzania Association of Inventors (TAI) and was able to obtain TAI's membership in the International Federation of Inventors' Associations (IFIA). According to Mr Lipangile, he only has contact with the 10 leaders. He has lost contact with the other innovators. They once asked for funds from the Ministry of Technology and Higher Education so that they could identify more inventors and their inventions, but their request was turned down.

Box 9.3: Cases of disappointed inventors

Despite the above, the government still offers TASTA awards, but more because of a tradition than necessity as during its inception in the early 1980s.

Inefficient patent law

Patenting is still a very cumbersome process in Tanzania, and most of the potential inventors are not aware or conscious of the IPR.

Inefficiency of the patent law, especially in the protection of the endogenous technology, is revealed by the loss of Mr. Msigwa's novel invention.

To some extent it is also contributing to the lack of innovativeness. Mr. Mbise, who originally made the first version of the tractor driven oil press, and later on improved it to be a motor oil press, had to stop producing the machine. He moved to a very distant village which was recently electrified, to set up a business of producing sunflower oil, with his machine instead of producing machines. According to him he had to move and stop producing machines, because of the declining profit he was getting from machine production, because other people had freely entered his line of business. If Mr. Mbise's prototypes were protected in some way, and earned enough capital from his designs, he would have been motivated to do something more advanced, expecting more protection and more profit.

The same thing also happened to Mr. Shilla who was producing his version of locally made bicycle, based in Singida. He had to move to Haydom (recently electrified village) to continue earning profit from his work. Some people in Singida had already started copying his designs. Although this in a way has facilitated diffusion of this innovation, but it will most likely kill the creativity.

Tax disincentives

This problem was mentioned by most of the innovators who at least tried to set up a business. Mr. Mbuya (no.12) who developed a mechanical saw and currently using it for his own business, expressed this problem in a very interesting way. When asked whether he had ever tried

to commercialize his invention, he replied as follows: “we tried, but stopped because when you try to advertise anything, the first person to visit you is not a customer, but people from the Revenue Authority and your advertisement effort will produce more tax demands than customers”.

Lack of venture capital

Innovating is a risky business even for a well-established company, let alone an individual. Most of the inventors have no starting capital and have not been supported in any way. Working premises and facilities were not available either. As a result, relatively successful inventors were those who invented within their production line with support from the company where they were working. One innovator (Mr. Mbise) had to work for a garage in order to have access to the machinery and space he required. Additionally, innovations, even those market driven, require vigorous advertisement to achieve wider diffusion and this requires money.

The effect of availability of space and venture capital is also demonstrated by success of the two innovations made with the formal R&D Structures (Sugar processing machine and Mercury recovery amalgam retort). These two inventions (no.7 and 8), had access to donor money through their institutions, good working environment, and all the necessary support system. In fact they had all the above-mentioned in adequacies of the individual innovators. According to inventors from Institute of Policy Innovation (IPI) the two innovations are doing well, especially the amalgam retort. The sugar-processing machine is facing very stringent competition from the imported sugar, and it’s profitably and hence diffusion has radically been reduced

Globalization and privatization

This study has shown that most of the innovations that were made as part of the production lines in the industrial firms, which were by then owned by the government, have been abandoned after the privatization exercise. Worse still, not only were the innovations abandoned but also the respective inventors. Important innovations such as the sugar-processing machine are facing serious competition from the cheap imported sugar, and according to the researchers from the IPI its profitability has radically been reduced. In fact its existence and further development is in serious threat.

Much as privatization and globalization are good for efficiency and innovativeness, in case of a poor country such as Tanzania these provide a serious challenge and have to be embraced with caution. At the very least, some form of protectionism approaches are important, especially for some few selected areas and/or sectors.

9.3 Conclusions and recommendations

This study has demonstrated that both the technology push and demand pull are fundamental forces at work in the beginning of the innovation process. However for successful and wider diffusion, many of the other interactive forces which are unique for every one nation come into play. For the Tanzanian environment and for this study in particular, the following factors or forces were found important: Science education, both level and nature; recognition of the inventors, especially by the government machinery; tax incentives; globalization and privatization; venture capital, and the IPR system.

The findings also indicate that very few of the identified innovations are currently being utilized or have achieved wide spread diffusion, largely because of the blockage caused by the above environmental factors. We therefore preliminarily recommend the following, divided into long-term and short-term measures:

Long term measures

- Popularize science and its role to the society to the wider society.
- Work towards reducing the dichotomy that exists between science and social and economic needs by radically overhauling the current higher education and research systems. By proposing so, however, we do not suggest that university science should come down to the kind of low science input technologies we have identified, but rather, even the high level science should be made relevant to social and economic needs of the country through contribution of knowledge to intermediary institutions that conduct more applied research commensurate with the demands of low tech. private investments.
- Increase opportunities for high quality and high level technical education.

Short term measures

- Continue with TASTA awards, but at the same time provide venture capital in terms of marching grant for those inventors who can move their inventions to the market place themselves or who can identify an entrepreneur interested in investing in the invention.
- Support forum where innovators can air their views and exchange ideas on issues of their interest and providing forum to market their products. Recognizing and supporting the initiatives started by Mr. Lipangile could be a starting point.
- Popularize the IPR system to the wider society and reduce the bureaucracy in patenting.
- The whole issue of Free Trade and Privatization has to be rethought to protect and develop endogenous knowledge.
- Tax incentives such as tax holidays should be given to emerging technological entrepreneurs.

Part III. Social conditions of production

Here we now supplement the case studies in Part II with an account of some of the most relevant social conditions of production observed in Tanzania, primarily in regard of the village artisans during the period of the main research project since 1998.

We first provide a brief overview of the socio-political and institutional settings, including a brief of some of the overall policy change attempts that were made by the Government of Tanzania. To what extent are the informal sector operators being recognized?

Infrastructure was defined in Section 3.5, arguing that in order to understand what changes may happen in the structure of production we need to understand what changes do happen in the infrastructural setting. We therefore review the social and economic infrastructure sector segments that are immediately relevant for the rural artisans. This includes the educational and in particular the vocational training sectors, the road and transport sectors, the power and water supply sectors, and finally the communication sector. To what extent and how have recent changes within these sectors in Tanzania possibly been affecting the technological transformation in the informal setting of the village artisans?

10. Socio-political settings

Jens Müller

As indicated in the brief historical overview of Tanzania in Chapter 4, the country has undergone drastic structural adjustments of its macro-economic setting, including a kind of multi-party democratisation process. From 1995 and onwards a number of broad policy declarations and strategy pronouncements have been published.

10.1 Recent policy conversion

Here we give a brief overview of policy announcements that seem to be most relevant for our study of the informal artisan sector.

Tanzania Development Vision 2025 (1999):
It is projected that Tanzanian will have graduated from a least developed to a middle-income country by the year 2025 with a high level of human development. The economy will be transformed from a low productivity agricultural economy to a semi-industrialized one, led by modernized and highly productive agricultural activities, which are effectively integrated and buttressed by supportive industrial and service activities in the rural and urban areas. Inter alia, micro-finance service institutions are recognized as the driving force behind the achievement of the Vision. Banks, Savings and Credit Cooperative Societies (SACCOs) and NGOs are free to develop micro-finance services.

SME Development Policy (2003):
In recognition of its growth potential the Government will be supporting the development of the SME sector. The policy is aimed at increasing the contribution of SMEs to the Gross National Product and export earnings.

- The *vision* of the SME Development Policy is to have a vibrant and dynamic SME sector that ensures effective utilisation of available resources to attain accelerated and sustainable growth.
- The *mission* of this Policy is to stimulate development and growth of SME activities through improved infrastructure, enhanced service provision and creation of a conducive, legal and institutional framework so as to achieve competitiveness.

- The *overall objective* of this Policy is to foster job creation and income generation through promoting the creation of new SMEs and improving the performance and competitiveness of the existing ones to increase their participation and contribution to the Tanzanian economy.

National Strategy for Growth and Reduction of Poverty - MKUKUTA (2005):
This is a second national organizing framework for putting focus on poverty reduction high on the country's development agenda. It is inter alia emphasised that

- weak agro-industries and poor *linkages* within the marketing, processing and production chains affect the performance of agriculture, as do poor market-orientation and inadequate processing of commodities, coupled with high levels of waste;
- poor state or lack of rural infrastructure is causing high transport costs for distribution and marketing of inputs and produce, leading to lower farm gate prices to the producer. Incomplete liberalization and poor regulation of food markets critically constrains agricultural development. All these lead to low profitability for the sector.

Property and Business Formalisation Programme - MKURABITA (2006):
This programme was initiated as a vehicle for implementing the suggestions of the Peruvian economist Hernando de Soto[1] in Tanzania (Mkurabita 2007). The underlying argument and solution are: People remain poor mainly because their assets (capital) in the form of land, housing or small business activities remain informal and marginalised from the benefits of the formal modern economy.

- *The strategy* is to set up a unified national system of property rights and businesses. This system will be built from a harmonious marriage of standardised and modernized customary practices from the bottom-up and relevant modified laws from the top-down;
- *The goal* is to empower groups and individuals, especially in the informal sector, so that they can participate effectively in the modern, formal, market economy;
- *The objective* is to empower the marginalised majority in the informal sector so that they can make better use of their property and business assets and take advantage of other opportunities in the modern market economy.
- *The expected results* are reduced individual household poverty, improved living standards of the target group and an expanded national economy that is governed by the rule of law.

Copied from the front page of Mkurabita (2007)

Agriculture First - KILIMO KWANZA (2009):

The Tanzania National Business Council recently declared policies and strategies for the transformation of Tanzania's agriculture under the theme KILIMO KWANZA, which resolves to:

[1] The programme is very much identical with the analysis and recommendation of what de Soto proposes in his book The Mystery of Capital (2000).

- Embark on KILIMO KWANZA as Tanzania's Green Revolution to transform its agriculture into a modern and commercial sector;
- Integrate KILIMO KWANZA into the Government machinery to ensure its successful implementation;
- Mobilize increased quantum of resources towards the realization of KILIMO KWANZA;
- Mobilize the private sector to substantially increase its investment and shoulder its rightful role in the implementation of KILIMO KWANZA (www.actanzania.org).

Policy Implementation

Our research project did not go into details of the above well-argued policies. However, it was our impression from discussions with the selected informal sector agents and from own observations that only little effects of these policy declarations are felt and can be seen in the field.

Nevertheless, our impressions and intuition give reason to agree with Hyden & Mmuya (2008) where they on the front page of their book "Power and Policy Slippage in Tanzania – Discussing National Ownership of Development" write:

> "This study of mainland Tanzania shows that power is centralized and significantly influenced by development partners. Power is also dispersed among patronage-oriented individuals who fail to coordinate or act in a strategic manner in order to realise the common objectives stated in strategic development documents and declarations".

The authors (ibd:12) further tell that "the fundamental question that has driven the study has been why there is such large gap between policy and practice". They do not accept the superficial explanation as being 'lack of political will', but venture into an in depth power analysis. Among other things, they give a record of the relations between formal-informal institutions with the purpose of assessing how policy implementation may be improved.

In other words, Tanzania, like many other countries in the South and North, can be characterized as 'fragile' defined as having "institutional instability undermining the predictability and accountability of public decision-making processes" (Engberg-Pedersen et al. 2008:6).

10.2 Registration conditions

Informal ventures are officially defined by not being 'registered'. As appears from our case studies in Part II, only one of the case enterprises was registered; and when we asked others if they intended to register, very few really understood the question. However, some of the enterprises in district towns told us that they were 'licensed' since they were situated on municipal council premises, and were requested by the Tanzania Revenue Authority to pay some licence fee.

We therefore have to refer to other studies of the requirements to become registered and thus enter the formal sector confines. The findings of a study of the informal sector in Mainland Tanzania by ILO-UNIDO-UNDP (2002:2-3) conclude:

> "The truth and findings of other surveys and reports confirm that the regulatory and policy environment is a definite handicap to the upgrading and growth of MSEs, who thus tend to remain informal. Insurmountable regulatory hurdles turn attempts to operate formally into an obstacle that only the most determined, and better off MSEs attempt to finish" … "The reality of substantial, important and valuable economic activity taking place in small firms has not yet been reflected in the legal, regulatory and policy framework to any great extent".

The study provides a number of very illustrative cases, one of which is fully quoted in Box 10.1 in regard of a carpentry entrepreneur in Arusha town.

Venue: Tanzania Revenue Authority (TRA), Income Tax Department, Arusha

1st visit: The entrepreneur arrives around 9.00 a.m. and asks for an application form. An official asks him: "What kind of business do you want to licence?" He answers: "Carpentry". The official: "You will pay Tshs 200,000. Go to the office next door". He goes to the office, is given a form and told to make a photocopy and return the original. He pays Tshs 100 for the photocopy, and is told to fill the form very carefully and to return it the following day.

2nd visit: Same office, two women are chatting. He wants to return the form and is directed to another office. Here they take his form, and he is told to pay Tshs 50,000. He goes home to get the money.

3rd visit: He returns with the money and he is told that his tax number is missing because he was supposed to pay the money the same day, and that it will take a day to find his tax number. He decides to wait on the spot. After a while he is given his tax number, but told that the signatory is not around. He says that he will wait for him. After another bout of waiting, the very same officials finalize the process, and tell him to go to the Municipal Council Office.

Venue: Municipal Council Office, Arusha

1st visit: The entrepreneur is asked for the form he had filled in at TRA. He replies that it remained with TRA and is told that he vas supposed to bring it with him. He is given a form and told to fill it and come back the next day.

2nd visit: He returns to the Municipal Council Office: The officer responsible is not around.

3rd visit: He returns to the municipal office, gives in his form, and is directed to the health office. The official: "You are required to pay Tshs 30,000, but I am being nice to you, pay only Tshs 4,000. Beware of the trade officers; they might want to charge you a lot of money". He pays the Tshs 4,000 and returns to the municipal office. The official: "The officer responsible is not around and we cannot see your form, so please fill in another and come back tomorrow". He takes the form for the second time and goes home to fill it.

4th visit: He returns to the municipal office. The responsible officer is not around.

5th visit: He returns to the municipal office: His form is still being processed.

6th visit: He returns to the municipal office and gives in his form and told to pay Tshs 61,500. A trade officer tells him that he is only supposed to pay Tshs 41,000 and that he should come back with the amount he was told and she will help him.

7th visit: He returns to the municipal office. The official: "You are now supposed to pay Tshs 55,000, but I will help you so that they will lower the amount". He gives the official Tshs 55,000; she takes it to another office and comes back with his license stamped for a payment of Tshs 48,000, but without any change.

Venue: Business Registration and Licensing Agency /BRELA), Dar es Salaam

1st visit: The entrepreneur goes again to the municipal office and asks about registration procedures. The secretary tells him the registration is done in Dar es Salaam, but directs him to see her boss. The boss tells him to collect the forms from the secretary. He collects the forms and will fill it in and return it the next day.

2nd visit: He returns to the municipal office. The responsible officer checks and stamps the form, and tells him to take it to BRELA.

3rd visit: He has travelled to Dar es Salaam and booked into a hotel. At the BRELA office he is told the cost is Tshs 6,000. He pays and asks if the process can be finished early so he can go back to Arusha and avoid paying further hotel expenses. The official: "If you want things to go faster, you will have to pay Tshs 15,000. The money will be given to those who are facilitating the process. If they do not speed it up, I will give your money back". He pays.

4th visit: He returns to BRELA. The official: "Your name was similar to someone else's, but we helped you to cross that obstacle. Come back in the afternoon, the responsible officer has gone to a meeting". He returns in the afternoon. The official: "Are your business premises in the measured area? They need to know the plot number". He tells that they are not. After a while the lady gives him the form, telling him that the business registration process is complete.

Box 10.1: Typical experience of would-be entrepreneur (ILO-UNIDO-UNDP 2002: 22)

As for the motivation to be registered the following quote from a study in Dar es Salaam (Mnenwa & Maliti 2008:xi) reports that:

> "overall the study shows that the potential to generate higher profit lies mostly with formal firms compared to informal enterprises. However, further findings indicated that although formality might have an influence of profit generation and employment growth, it was not capable by itself to enable small businesses to increase their performance".

The authors did a follow-up study reporting that it is known that most of the constraints facing the MSEs could be eased through effective institutional frameworks, and that:

> "despite the existence of many MSE institutions, the plight of MSEs in the country continues to worsen raising questions as to whether the institutions have adequate capacity to support the MSEs"…"A cultural revolution is needed and MSE support institutions could be encouraged to support social entrepreneurship development" (Mnenwa & Maliti 2009:ix and 26).

The question is to what extent the above mentioned MUKABITA strategy eventually will be instrumental for such a cultural revolution.

10.3 Public Private Partnership (PPP)

In this section we give a description of selected Public Private Partnership (PPP) arrangements that have been actively engaged with providing services aimed at informal, primarily rural, artisan enterprises in Tanzania.

But first we give a general definition and overview of how PPPs come about and are defined; illustrated in Figure 10.1.

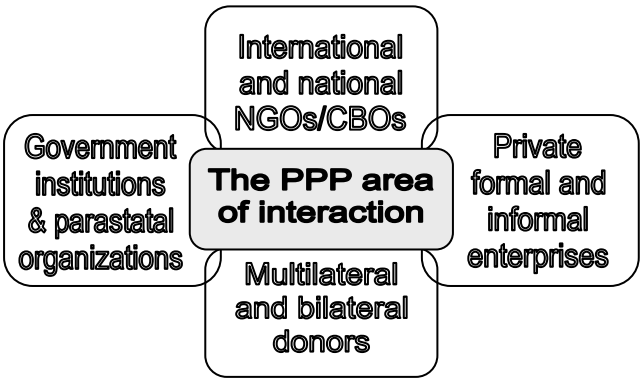


Figure 10.1: The PPP agencies in general

A PPP is commonly defined as a *contractually established entity that joins forces with, and which benefits from, the respective strengths of the public and private partners to provide a public good and/or service.*

These arrangements have been established since the state was forced to reduce its services after the introduction of the structural adjustment policies in the mid 1980'ies. As a result, the role for civil society in development and service delivery expanded, and the number of NGOs and Community-Based Organizations (CBOs) increased dramatically (REPOA 2007).

The REPOA (2007:23) survey also notes that:

> "poor, rural and isolated communities are often cut off from collaborative efforts and forced to act alone, whereas a handful of strong 'elite' professionalized groups get notice. Indeed, findings show that the regional distribution of Tanzanian NGOs is highly skewed with the majority of organizations in and around Dar es Salaam and other major urban hubs".

As far as the donor segment goes, we are told that NGOs in general view donors as more powerful than the Government, and that the Government often sees civil society as a competitor for resources. Here we just indicate the current debate of so-called aid-dependency (Moyo 2009) that makes the PPP issue difficult to tackle. A recent study by Whitfield (2009:5) offers what salient questions are at stake:

"The big question is how to change the status quo: change how aid is given, change how aid agencies work, change the international aid structures and processes, and change the (ever growing) aid industry".

Anyway, in the following we report of a number of seemingly useful cases of PPP undertakings that we have come across during our surveys.

Small Industries Development Organisation (SIDO)

SIDO is the most relevant parastatal organization to mention. Established in 1973 with the mission to create, sustain, promote and develop the indigenous entrepreneurial base in small-scale business sectors through equal opportunity initiatives. The objective is to promote and support the indigenous micro and small enterprise sector in Tanzania by providing it with demand-based services. We already in the Introduction did mention SIDO and the positive change in its outlook in regard of the informal artisans that has taken place, and a number of noticeable SIDO engagements have been referred to in Chapter 5.

Snapshot from SIDOs regional compound in Dar es Salaam

SIDO has also currently been under reorganisation in the light of the public sector restructuring and the concomitant difficulties to earn adequate returns and revenues from the services supplied to cover the costs of service delivery. Three line activities are undertaken: (i) credit; (ii) business development services; and (iii) leasing of enterprise facilities. According to its web-side www.sido.go.tz SIDO is

- actively promoting linkages between the corporate sector and SMEs and encouraging commercial sponsorship for marketing events.
- networking with other NGOs and umbrella organizations working with SMEs to broaden the support base and enhance lobbying activities.
- playing a big role in promoting public private partnership by building a strong private sector, mainly through capacity building of associations in the SME sector.

SIDO also runs an Artisan Support Programme (ASP); however the outreach to the informal MSEs in the vast remote rural areas of the country is still to be established.

Impressive PPP arrangement

The ASP is actively involved in one of most impressive PPP arrangement we have met. It deals with formal but primarily with informal enterprises and is situated in the Northern regions of Tanzania and named Lake Zone Artisans Association (LAZOA). It has members from 4 regions and includes a wide range of artisan groups, i.e. blacksmiths, carpenters, tailors, tinsmiths and metal fabricators. It offers their members skills exchange, help with marketing, subsidised tools and equipment, business skills training, and raw materials acquisition.

An international NGO called Tools for Self Reliance (TFSR) has been one of the most active supporters of LAZOA. A national NGO called Sengerema Informal Sector Centre is a centre for its location.

LAZOA is also linked to the Support to Local Economy in Mwanza (SLEM) programme based at the Regional Commissioner Block and assisted by a number of multilateral donors, i.e. United Nations Development Programme and United Nations Capital Development Fund. Likewise, various bilateral donors have over the years been involved with similar projects. A particular activity under SLEM is to help CBOs to be recognized. This should be seen as one of the first attempts to formalize informal sector artisan enterprises.

Another illustration of initiatives to promote informal enterprises is the small sticker printed by TFSL some years ago and given to some of the village black-smiths in the area.

All this said about the PPP arrangements we need to repeat that the cases given here are exceptions. And it also needs to be said, that most of the artisans visited during our research are operating entirely on their own. A case in point is quoted in Box 10.2.

At a revisit to one of the village blacksmith we were really surprised to see how the workshop building, the tools and products had been progressively developed. So we wanted to praise him by saying "this is a fantastic development of your place". This we said in Kiswahili using the word we knew for 'development' being 'maendeleo'. Immediately he did reply:***" This is not maendeleo – we did it ourselves!"***

Box 10.2: 'Development' is what?

11. Infrastructural conditions

Jens Müller

This chapter gives an overview of resent changes in the formal and informal infrastructures that are most directly affecting the village artisans' condition of production.

In regard of the social infrastructure we only consider the education system or the so-called knowledge infrastructure here, although the health care system and other social services are important. We start out by giving a brief overview of the formal education system including its relevant vocational training arrangements. We then zoom in on the informal vocational training issue trying to illustrate and understand how this is manifested concerning the village artisans.

In respect of the economic infrastructure we converge on the roads and transport sector, however we also provide a brief overview of the power and water supply sectors. Again, the focus will be on the informal sector. The important communication sector, which can be viewed both as social and economic infrastructure, is dealt with in Chapter 12.

11.1 Formal education and vocational training

Throughout the 1980s and 1990s school enrolment declined due to introduction of school fees, declining quality of schooling and, possibly, declining returns to education (Terme 2002). However, primary school fees were dropped in 2005 and the number of pupils who have enrolled since has doubled. But with 70 pupils to a class and parents still to pay for school uniforms and other costs there is still improvements to be wanted (Shepherd 2009). As far as we understand, the public secondary and tertiary schooling system also leaves much to be improved, but here private schools including universities are up-coming.

A particular issue relevant for our study is the extent to which relevant so-called entrepreneurship is being nurtured. Discussions in the late 1990s with the then Faculty of Engineering, University of Dar es Salaam (UDSM), indicated a need to enhance the socio-economic relevance of the curricula of the engineering education (Dahms et al. 1998). Since then a number of restructurings and new venture within UDSM have taken place. Lately, other universities are venturing into engineering curricula developments, e.g. at St. Augustine University of Tanzania, however it appears that the traditional engineering training culture is still alive, namely with focus on technological solutions without in-depth understanding of the social problems needed to be addressed, in particular in the informal sector.

A case of particular interest for our study is the National Business/Technology Incubator Programme (NBTIP) under the College of Engineering and Technology of UDSM. The objective of the project is to pilot replicable case studies of demand-driven business/technology incubators that are sustainable, demonstrably technical feasible, economically viable, and relevant to national policy objectives. One of the NBTIP projects is placed in the regional town of Morogoro (CoET 2006). But it is still to be seen to what extent these and other projects get a country wide outreach, in particular to the informal rural artisans.

Vocational Training

The most important formal vocational training agency is the Vocational Education and Training Authority (VETA). It dates from 1974, but has recently been reformed. In 1994 it was established as an autonomous authority with the mission "to ensure provision of quality and appropriate vocational skills to meet labour market needs of both the formal and the informal sector of the economy in co-operation with other social

partners" (VETA 1999). VETA is active in most of the regions and provide various trade test certificates.

In particular, the reform focuses on attempted demand-driven outreach to informal sector operators. And donors have for many years been involved in vocational training; apart from improving the training facilities directly under VETA, co-operation is also initiated with so-called private VET providers like mission schools. However, during our surveys of the village artisans we did not meet any, neither blacksmiths nor boat builders, who had had any contact to VETA.

Another relevant formal vocational training institution is the Folk Development Colleges (FDC) under the Ministry of Community Development, Gender and Children. Established in 1975 its mission is to meet the needs and challenges of post-literacy continuing education, by providing residential education opportunities, both general and vocational, for rural development. The colleges provide short and long courses to answer the real and practical needs at village level. These needs are determined in co-operation of the villagers themselves, and they usually choose the participants (Kassam 2008).

The FDCs were heavily affected by withdrawals of state and other funding sources during the 1980s and 1990s making it compulsory for the students to pay most of the costs of their training courses; e.g. this made many previous instructors to resign and did reduce the idea of providing relevant demand-driven training at the colleges.

During our field survey in 2000 we visited the FDC College in Mbinga District Town (Ruvuma Region). It did look a bit run down, and the headmaster complained of reduced trainee intake and of resigning instructors.

Next morning we visited a blacksmith group a bit outside Mbinga town. The master blacksmith gave us an impressive demonstration of his workshop and of various innovations, e.g. a windmill for water pumping. He also told us that he could use and train more apprentices, but that he had difficulties to get them.

We then got back to the FDC College the same afternoon and invited the headmaster to come with us to visit the blacksmith group, which he did not know about. After 10 minutes discussions at the workshop, the headmaster invited the blacksmith to come to his FDC as part time instructor, and they arranged that some of the FDC students would come to the blacksmith's workshop for some period of apprentice training.

Box 11.1: A case of interaction between a FDC College and a village blacksmith

Since 2005 many of the FDCs have recovered and are active again supported by a number of donors. Yet as quoted from The Guardian (14.nov.2009):

> "Vocational training centres will produce skilled people if the government and other stakeholders give them facilities for students to put into practice theories they learn and make products that meet customers' needs … Lack of facilities have forced the Michocheni Vocational Training Centre (supported by Finland) to teach more theory than practice"

A case of donor supported vocational training

The Rural Integrated Project Support (RIPS) funded by the Finnish International Development Agency (FINNIDA) was initiated in 1989 in Lindi and Mtwara Regions. Among many activities a Village Artisan Service programme was started in cooperation with SIDO. A particular focus of this programme was on a Blacksmith Training Project (BTP) that was linked to the FDC in Chilala close to Lindi Regional Town (RIPS 1998).

We already did refer to RIPS with Table 5.1 and Figure 5.2 showing the location and number of active blacksmiths recorded in 1991 to be 690 in 140 groups (RIPS 1998). Objectives of the BTP were (Poston 1996):

- Long-term: to improve the access of artisanal farmers and crafts-people to tools of higher quality;
- Medium-term: to increase the quantity and quality of production, and the incomes, of existing blacksmiths;
- Short-term: to work with the rural blacksmiths to develop a sustainable system of supply of raw material, and to assist them to improve the quality of their products.

Briefly speaking, the BTP did arrange extra training of 4 very experienced village blacksmiths in the making of high quality blacksmiths tools, in particular hammers. They were then appointed as instructors, given 2 motorbikes, 2 bicycles and 4 trailers with which they did travel around the regions to selected village groups giving 5 weeks intensive courses.

The groups were gathered by up to 10 blacksmiths trainees from nearby village groups. They were advised to construct a new raised forge so the work would be performed standing. They were primarily told how to make improved working tools for their own operations, e.g. hardened steel hammers. Bringing neighbouring blacksmiths together this way did reinvigorate the profession, and it did break up the traditional superstition and suspicion of witchcraft that had kept the profession confined within the old clan system (Mkwawa & Müller 1998).

> Sitting with one of the old blacksmiths in his low hanging work-shed next to one of the new raised workshops, he told us that he had been scared of letting young apprentices making their own hammers. According to what he had been told by his father, a youngster would lose his arm if he made his own hammer before the master smith, the *fundi*, handed over the workshop to him.
>
> In order to avoid this, he had taken the young trainees into the forest and given them some *dawa* (medicine). He refused to tell us what kind of *dawa*, but he was satisfied: the youngsters had not lost their arms.

Box 11.2: Overcoming superstitious 'rules of the game' (Mkwawa & Müller 1998)

One of the most difficult problems of the programme was to provide the scrap steel for the tool making. Initially RIPS financed the collection of steel from old sisal farms and government workshops, but then the nusu-nusu (half-half) system (also mentioned in Section 5.3) was introduced. This builds on the traditional barter arrangement whereby a customer bring double the amount of raw materials to the artisan as is required for the order. In this case, half of the tools and implements made by the trainees were given to the project management who made a wholesale arrangement, whereby part of the trainee costs could be covered. The idea was that the training programme eventually could be self-financing when FINNIDA withdrew its RIPS support, but this turned out not to be feasible (Mkwawa & Müller 1998).

A noteworthy outcome of RIPSs BTP was the formation of a blacksmiths association named CHAWAHUMA. It consists of 6 practising groups of forgers, sheet metal workers, casters and welders located in Mtwara Region. It works with VETA to introduce technical courses and certificates. It also works as a broker business encouraging traders to place orders, and it

is sourcing raw materials (Kileo 2002). In other words this is another case of a PPP arrangement.

11.2 Informal vocational training

As already indicated, most of the village artisans of our surveys did acquire their skills through various apprentice arrangements. Relatively few craftsmen had more than a few years of formal primary education or contact to the formal vocational training system. But almost all had been apprentices with elder relatives or neighbours. In a sense the apprentice system therefore constitutes the predominant part of the informal social infrastructure.

The knowledge acquired by craftsmen in the informal sector is based on autodidactic experiential and implicit learning with a high degree of tacit knowledge. In the informal apprentice system for skill transfer the apprentices learn, not only how to produce a range of specialised products, but also how to co-operate with other craftsmen, customers and to navigate in the community and society as such (Coy 1989). In other words as shown in Figure 11.1, the *local time and place knowledge* is of crucial importance for the artisanal performance. This adds to the more general definition of endogenous knowledge presented in Figure 3.1.

Figure 11.1: Structure of capabilities for effective business operation

This definition is in line with Bangasser (1996: 2) who refers us to the Aristotle distinction between "science and scientific knowledge" (epistme), "practical art or technical skill" (techne) and "prudence or practical wisdom" (phronesis).

The acquisition and transmission of the artisanal skills, knowledge and capabilities thus primarily must come from within the local communities. The apprenticeship institution is defined by Coy (1989: ii) as "the means of imparting specialized knowledge to a new generation of practitioners. It is the rite of passage that transforms novices into experts. It is a means of learning things that cannot be easily communicated by conventional means".

And we agree with Poston (1994: 102) that:

> "unlike centralized formal training, contextual training allows for the continuing development of skills by both direct transfer and empirical development, and facilitates the acquisition of vocational skills by illustrating continually the relevance of the content, and encouraging trainees to judge the validity of what is being transferred".

The apprenticeship agreements between the mentor and the apprentice in the informal sector vary from locality to locality. Nsana (2001: 131) reports from a survey in regional towns and rural villages that the cases of apprentices paying for their training were very rare, and that the 'free labour for free education' principle works very commonly. Often the mentors were paying some token to the apprentice to meet some minor personal requirements like washing soap. Shelter and food were the main form of payment that the apprentices received, but payment in cash did also take place.

11.3 Classified roads and transport

The relative reduction of the large and small- and medium scale enterprises coupled with an increase in the informal micro- and small scale enterprises noted in the introduction have changed the significance of the roads and transport settings.

The previous relatively vertical structure of production or social division of labour has to some extent been replaced by a more horizontal division of labour. E.g. previously UFI bought steel from abroad, turned it into hoes, which were 'vertically' distributed to the para-statal shops in regional and district towns for the use by the peasants on their farms. Today this distribution system has changed. It is now possible to buy imported Chinese hoes in most district towns. But these hoes are neither better nor cheaper than before; so, many peasants still prefer to buy the locally made hoe, if and when the 'horizontal' distribution is available; and as indicated in Part II, an increasing number of farm implements are being maintained, repaired and even reinforced and reshaped in the small blacksmith workshops scattered all over the territory.

According to the Ministry of Infrastructure Development records, Tanzania has about 85.000 km of classified roads[1] of which about 1/3 are so-called trunk roads. The principal highways are confined to the north-eastern, central-eastern and the south-eastern regions of the country. About 10% of the trunk roads are paved, and there are no paved links from the capital to the south-eastern, western, central and northern regions. Most of the roads between these areas are dirt tracks, with a few improved gravel sections (www.infrastructure.go.tz).

2/3 of the classified roads consist of so-called district roads (about 30.000 km), feeder roads (about 20.000 km) and urban roads (about 6.000 km). These are under the Local Government Authority and a programme has been made to promote the capacity to improve these roads through a recently launched Local Government Transport Programme (LGTP).

The core problem that will be addressed by the programme is the isolation or lack of access to economic opportunities and social services of the poor. The immediate objective is "Accessibility in urban and rural areas significantly improved on a sustainable basis" (LGTP 2006).

11.4 The non-classified road network

Above we primarily did refer to what we can call formal infrastructure. However, a massive volume of infrastructural facilities are established and maintained under a vast variation of informal institutional settings. Among such informal infrastructure we find transport facilities that can be seen in the high quality maps in the scale 1:50.000 that cover the whole country (Survey and Mapping Division, of Ministry of Lands, Housing and Urban Development). These maps are based on aerial photos during the 1970'ies and show, inter alia, an incredible number of paths across the landscapes.

During our interviews with the blacksmiths and other village people this network of paths was time and again referred to as the most important facility that connects the communities as regards market access, raw materials supply, information exchange and many other interactive activities. Various recent improvements by the communities of this network were reported, e.g. in the form of new footpath bridges.

> At one of these meetings we asked why the village had not made an effort to do some simple repair to a nearby culvert on the public district road that obviously had been spoiled for a long period (we had problems passing it ourselves). The immediate answer was this was supposed to be done by the district engineer's office, and that the district roads people would not like others to do their job. A little later we learned that using the particular district road implied a considerable detour for most of the errands of the village, and that people therefore did prefer to use the path network in any case. Only the transport of scrap metal was mentioned as a real problem.

Box 11.3: Interviewing members of Ngindo Village, Mbinga District (Nsana et al. 2002)

[1] Classified roads are those being included in the public works setting.

Similar observations are made more generally by UNECA (1997) and Barwell (2001). Here strong arguments are put forward for assistance to improvements of such path networks and provision of intermediate means of transportation; e.g. bicycle or motorbike trailers.

Apart from the informal transportation and communication networks we must mention the presence of a wide range of different assembly places that ensures the connection or tying together of the territorially dispersed individuals, households and enterprises of all kinds (De Soto 1989). Here we can mention commonly accepted spaces for feasts and dances, churches and mosques or other facilities for cultic exercises, buildings and areas for village or clan councils, and for that matter, graveyards. All these utilities are managed according to locally formalised basic institutions that vary from place to place, but escape public regulation (Wilson 2004).

It should be emphasised that it is essential for an analysis of the territorial structure to get an in depth conception of what *nearness* or *proximity* and what *access* or *isolation* include and imply. Physical distance is only one aspect of these issues. Social access and not least trust, sometime usefully expressed by the concept of social capital, are definitely equally crucial factors (Lema et al. 2006).

The Makete approach

The importance of *access,* rather than just dealing with road connections, has been promoted to include the whole issue of transportation by the International Forum for Rural Transport and Development (IFRTD). This forum was conceived in the early 90s as a global framework to advance new knowledge on rural transport and to help promote policy advocacy. Here we quote extracts from one of its newsletters (IFRTD 2007):

The emergence of rural transport as a transport sub-sector with its own particular set of issues that require specific policies, institutions and planning tools has only occurred in the last fifteen to twenty years. Its evolution can be traced to a small pilot project in South East Tanzania known as the Makete Integrated Rural Transport Project (MIRTP).

MIRTP was implemented in from 1985 to 1996 in Makete District. The project applied an innovative action-research approach that eventually led to a unified framework for understanding the various constraints to access and mobility in rural areas, and their links to poverty. It came into being on the following premises:

- *The household as a basis for understanding rural transport needs*: The use of the household as an important unit of analysis was a key innovation.
- *Recognition of village level transport infrastructure:* Lower-level transport infrastructure, i.e. tracks and paths, were identified as an important part of the transport network.

The following concepts and programmes were developed as a result of MIRTP:

- *Integrated Rural Transport Planning* conceiving transport as an integrated system consisting of vehicles and infrastructure. Recognition was given to low-cost means of transport, or intermediate means of transport.
- *Integrated Rural Access Planning* as a response to the need for a simple tool for planning interventions for improving access to services and facilities in rural areas.
- *Village Travel and Transport Programme in Tanzania (VTTP)* that was designed as a seven district pilot programme in 1994. Currently, VTTP is being rolled out as a national programme in Tanzania.

A few problems are highlighted in the IFRTD (2007) newsletter as follows:

- *Mismatch between analysis of rural transport problems and implementation of solutions:* While the general principles of holistic approaches to rural transport are well argued in re-

search papers and policy statements, their translation into programmes and projects remains problematic.

- *Lack of comprehensive knowledge on the state of rural transport:* Though many countries in Africa and other developing countries have adopted rural transport as an important transport policy concern, implementation strategies are hampered by the lack of detailed understanding of rural travel and transport problems.
- *Access infrastructure vis a vis transport means and services:* Emphasis on the improvement of access infrastructure is not usually matched by the development of appropriate rural transport services in order to improve mobility and optimise the benefits of investments.

Labour-based road construction

Both the above mentioned LGTP and VTTP initiatives are promoting labour-based construction methods. The LGTP envisages that through extensive use for construction and maintenance, approximately 250.000 person-years of employment can be created over five years.

The introduction of the labour-based methods is of particular interest for our study of the village blacksmith. We already in Box 2.1 did mention a case of a major labour-based road construction project. Thousands of hand-tools were required and needed repair and maintenance as reported in Box 11.4.

> The 3.800 so-called unskilled workers employed on the 480 km gravel road mentioned in Chapter 2 Box 2.1 were equipped with about 3.000 shovels and a similar number of pickaxes and other hand tools including wheel barrows. Many of these tools quite often got bend and broken, and in the beginning new ones were ordered from distant towns, costing a lot and were often delayed.
>
> Instead 4 local village blacksmiths were employed and moved into the roads camps with their tools. They did most of the repair jobs and were also producing special axes and hammers, as well as iron nails for the wooden bridges that had to be constructed instead of the concrete bridges, for which too little materials were forthcoming.
>
> In other words, these blacksmiths were doing highly skilled and cost saving jobs – but had to be paid unskilled labour salary only. The project was a public works venture and the blacksmiths had no formal trade test certificates.

Box 11.4: Local tool repair back-up by village blacksmiths (Müller 1973)

The same observation has been made in numerous other labour-based road construction projects, e.g. in Tanzania, Kenya, Ghana, Zimbabwe and Laos, and lately in Benin from where the picture here was taken. Not only did the project employ the local people for construction and afterwards maintenance of rural roads, but the local blacksmiths were heavily involved in making, maintaining and repairing the shovels and pickaxes of the workers (Danida 2008).

11.5 Power and water supply

The electricity sub sector contributes about 0.6 per cent of total energy consumption. Two thirds of Tanzania's installed capacity is hydro powered. Blackouts and power rationing as a result of low water levels in the hydro dams have forced Tanesco to rely on gas-powered generators and to look increasingly at thermal projects for future capacity increases. Only three quarters of the country (mainly urban areas) is connected to the national grid

(www.areed.org/country/tanzania/energy). It is intended that the rest of the country, including an estimated 8,200 villages should be supplied with electricity to curb deforestation.

The biomass energy resource, which comprises fuel-wood and charcoal from both natural forest and plantations, accounts for 93 per cent of total energy consumption. The electricity consumption is growing at the rate of 11-13 per cent. Therefore the Government is encouraging investments to expand generating capacity and the distribution systems as well as developing indigenous sources of energy.

According to Mwakapugi et al. (2010: 57):

> "With the potential for more than one million direct and indirect job opportunities from electrification the next five years, the energy sector and accompanying skills training deserve priority attention".

Alternative sources of energy include coal. Tanzania has 1,200 million metric tons, which could provide energy for paper mills, cement factories, agriculture and household consumption, and generation of power. Wind and solar energy and biogas are other sources of energy. Very little attempt has been made to utilize this source of energy which could be a viable alternative source to reduce use of wood and oil for heating purposes.

Projects to address the problems of electrification in remote areas are being promoted. Tanzania is in the process of implementing a National Solar Programme under the World Solar Programme. These are also village level solar electrification and small islands solar electrification. Efforts have been made to seek donor support.

As reported from some of the blacksmith case studies in Chapter 5, some efforts are made in the informal artisan sector to promote alternative electricity provision as well as other means of power supply. However, nowhere did we find references to this.

Water supply

The water supply and sanitation in Tanzania is characterised by decreasing access to improved water sources and sanitation, and generally low quality of service (Ministry of Water and Sanitation 2009). An ambitious strategy that promotes integrated water resources management and the development of urban and rural water supply was adopted in 2006. Responsibility for water and sanitation services has shifted to local government authorities, and the water sector was included among the priority sectors in the MKUKUTA strategy referred to in Section 10.1.

Braathen (2004) reports that 13% of local communities were involved in a Water Management Committee. However, local governments did spend less than 2% of its funds on water. The report calls for greater local autonomy, closer national scrutiny and earmarked funds. Councils need 'profound changes' to improve their capacity to respond to local community priorities.

The sector has a big range of fields for investing into, i.e. from direct delivery of water to construction of infrastructures, manufacturing and supply of machinery, equipment, and training of professionals. Yet, only very few of the village artisans interviewed by us did mention being engaged in such work for local authorities. Not having formal trade test certificates, they rarely get orders from the authorities.

On the other hand, many did mention being engaged in various self-help water delivery and maintenance activities in their home areas. As already mentioned in case record 10 in Section 5.4, the village blacksmith there do manufacture hydraulic ram pumps for water supply for his own and for neighbouring villages.

12. Communication sector

Mona Dahms

The endogenous technological innovative potential among peasants and artisans in the South can be greatly enhanced through communication, to an extent where it could be argued that innovation is proportional to the possibility for members from the local community to communicate among themselves and with outsiders. Communication as a human endeavour can take place as face-to-face communication and as communication at a distance using different technological means of communication, so-called telecommunication. In this chapter the focus will be on telecommunication.

Obviously, the ability and possibility to communicate will depend upon the historical and cultural context. In pre-colonial Africa the means of telecommunication were mainly either human messengers or sound signals, e.g. drums. When electrified telecommunication was introduced in the North, Africa missed out. For many years the means of telecommunication, especially in rural areas of Africa, have been appalling, leading to global concerns within the UN system. In 1984 International Telecommunication Union produced the report "The Missing Link" on the role of telecommunication for development and the importance of strengthening means of telecommunication in underprivileged areas of poor nations (ITU 1984).

This global debate and concern has gained renewed strength with the discussions on the role of Information and Communication Technologies (ICT) for Development, the 'Global Information Society', the 'digital divide', etc. Often this discussion has been based on an implicit assumption that ICT is equivalent to computers linked up to the Internet. Many ICT projects have been initiated over the last two decades, partly or wholly funded by donor organisations, whether bilateral, multilateral or NGOs. Parallel to this ICT development, mobile telephony as a private commercial business has spread throughout the African continent and in a number of African countries there are now more mobile than fixed telephone subscribers.

In the small district capital Sengerema in the North Western part of Tanzania a so called Multi-purpose Community Telecentre (MCT) with computers and Internet access was established in December 2000, and within the next three years three mobile telephone operators started business in the town and the district. Thus, the ICT deployment in Sengerema town has been extraordinarily high over the last 10 years. The question is to which extent this has led to related development, i.e. improvement in living standards as seen from the perspective of local community members.

A longitudinal research project on the impact of the Sengerema MCT has been on-going since 1999 and in connection with this project several surveys have been carried out. This chapter is based on the research findings from a base line study on indigenous information and communication systems carried out in February 2001 and a study on access to, usage of and impact of ICT carried out in 2008, respectively. The two studies did not have identical aims, thus people interviewed and interview guides were not the same. However, it is assumed that results from the two studies can be compared in so far as the information and communication systems are concerned.

We first describe the case study of Sengerema town and district, including the telecommunication situation before the telecentre was established, and after 7 years of operation. In the second section the results from the base line study, February 2001, are presented, while in the third section the results from the impact study, May 2008, are presented. In the final section, the results from the two studies are compared and discussed from a theoretical as well as from an empirical perspective.

12.1 The case study: Sengerema

As mentioned above the telecommunications deployment in Sengerema has been extraordinarily high over the last decade, thus the town and district poses a good case for empirical studies on the impact of telecommunications infrastructure. In this section we first give the basic facts about the district, then the telecentre is presented shortly and finally the overall telecommunication situation before and after the telecentre establishment is described.

Basic facts

Sengerema town is the semi-rural/urban capital town of Sengerema District, Mwanza Region, Tanzania. The district covers 8.817 km2 of which 3.335 km2 are dry land and 5.482 km2 are covered with water, i.e. Lake Nyanza (formerly Lake Victoria). It has a total population of approximately 375.000 people, with 45.000 living in Sengerema town and the rest living in 125 registered villages (Tanzania 1999). Main sources of income in the district are agriculture, livestock herding, fishing, softwood and hardwood timber production, mining and to a lesser extent industry and trade.

The telecentre

Centrally located within Sengerema town is the above mentioned Multipurpose Community Telecentre (MCT) with computers and Internet access. The centre was established as a pilot project in December 2000, funded partly by three international donors, partly by national organisations and by local contributions. One of the objectives of the MCT project was:

> *"To demonstrate the impact and usefulness of the accelerated introduction of information and communications enabled services and programmes into rural community life in Tanzania with special emphasis upon the rural development, small business, education, health and government service sectors"* (Tanzania 1999).

Services offered at the MCT are, among others: Computer training; Internet access with e-mail and Web-surfing; secretarial services, including typing, photocopying and binding; computer consultancy; telephony and telefax. Furthermore, thanks to dynamic and innovative local actors, a local radio station, Radio Sengerema FM, has been added to the list of services provided by the telecentre, as has Internet Service Provision to institutions in the community, including the District Headquarters. These two services were not part of the original project plan but have been added as a result of study visits to other telecentres by some of the local actors. The author has since 1999 carried out research on the impact of the Sengerema MCT and has visited Sengerema more than 10 times over the last 10 years. For a more detailed description of the Sengerema MCT see Dahms (2004).

A somewhat unusual means of telecommunication was introduced to the author in January 2006 when interviewing Mzee in Mayuya village, Tabaruka Ward. I had heard talk about a communication drum which was still in use and had come to learn about this special drum, the *Katumba drum.* At the time of the interview the drum was being used approximately twice a month to call people from the village for a meeting, a celebration or other special purpose. According to Mzee the use of the Katumba is similar both in purpose and in frequency to the use in the older days and is not restricted to any special group of people - everybody who has a message to convey can use it. Even if Mzee is not around it can be used, as long as the user has learned the special beat, which is taught to children, boys as well as girls, from the age of 10 years in the local village school where Mzee is the teacher. The teaching takes place for about an hour every evening and during the weekends for somewhat longer time and it will take a child approximately 2 weeks to learn the special beat of the Katumba if they practice daily.

Box 12.1: Report of a traditional telecommunication technology (Dahms 2004)

Telecommunications in Sengerema

In February 2001 the telecommunication infrastructure consisted of a manually operated switchboard and an analogue external telephone plant which delivered local communication services of poor quality to approximately 60 fixed line subscribers while long distance services were of acceptable quality. A telephone call to Dar es Salaam from the Tanzania Telecommunication Company Limited (TTCL) office in the building where the switchboard was located went through clearly, while a telephone call from one of the telephone booths outside the same office to the nearby Nyampulukano Secondary School (app. 2 ½ km away) was almost unintelligible. Ultimo 2002 TTCL completely upgraded the network by providing a digitalised trunk- and access network as a national contribution to the MCT project.

Following the introduction of the MCT, mobile telephone operators started coming into the town and the district. The first mobile telephone operator, Vodacom, introduced services in August 2001. The second mobile operator, Celtel, started services mid-2002 and a third mobile operator, Mobitel, started operations in November 2003. Today there is fierce competition between the three operators and the mobile networks have been expanded from covering only the town and the main road through the district to covering nearly all of the land in the district.

Thus, it can indeed be said that there has been an '*accelerated introduction of information and communications enabling services and programmes into rural community life'* and the question begging an answer is: Has it led to the expected 'impact and usefulness'? This question will be discussed in the final section – but first we shall have a look at the information and communication systems and the access to, usage of and impact of these systems at two different points in time, in February 2001 and again in May 2008.

12.2 The 'pre-telecentre' situation

In preparation for the longitudinal research on the impact of the Sengerema telecentre a base line study was carried out in February 2001 at a time when the telecentre had hardly started operating and no mobile telephone operators were present. The purpose of the study was to reveal the situation concerning sources of information and means of communication used by local peasants and artisans in Sengerema. In this section the base line study is described.

Data collection

For the base line study a total of 11 informal sector groups, undertaking productive activities within a range of different areas, from agriculture over handicraft to blacksmithing and house construction, were interviewed using a semi-structured interview guide focussing upon productive activities and indigenous information and communication systems related to these activities.

The groups interviewed embraced a total of 187 members, of whom 107 were women and 80 were men. Three groups were women's groups, four were men's groups, and four groups were mixed. Members were aged between 14 and 61 years. Eight of the groups were located in or very close to Sengerema town while three groups were located in villages at a distance ranging from 6 to 35 km from Sengerema town.

Findings

The base line study took the point of departure in the following research hypothesis concerning indigenous systems of information and communication: *The indigenous systems of information and communication are based upon 'organic' technology, i.e. they rely on human beings as the main media for producing, storing, processing and transmitting information between members of the community and between the community and the outside world.*

All of the groups interviewed stated that their main source of information were other people, whether suppliers, customers or ‘informers’, i.e. people sympathetic to the group and its activities. All groups regularly sent ‘messengers’, i.e. group members, relatives or friends travelling to bigger towns such as Mwanza or Dar es Salaam, to obtain information about materials and tools and to buy if and when prices were right. Only one group mentioned radio and newspapers as a source of information. This is hardly surprising since at the time of the interview there was no local radio broadcasting, and newspapers sold in the market were at least one day old and mainly contained news from the bigger cities.

In terms of presenting information on their products one group made handmade posters, which were put up at the roadside, while another group displayed their products at the roadside. Yet another group had produced a leaflet and also mentioned the use of newsletters and newspapers for advertising their products. Two of the groups had participated in national trade exhibitions in Dar es Salaam and Arusha.

Concerning communication, the main means of communication was face-to-face communication with suppliers, with customers and with other producers. Four of the groups mentioned letter writing, four mentioned telephones (although at the time of study the services were of very low quality) and one group used e-mail which was available from the Small Industrial Development Organisation office in Mwanza.

Discussion of findings

Based on the above findings it can be argued that the hypothesis about ‘organic’ technology as the basis of indigenous information and communication systems seems to have been rather well supported at the time of the base line study. It should be noted that none of the groups were satisfied with the sources of information and means of communication available for supporting their productive activities. Specific complaints were related to information not being received or received too late to act upon, as well as to the lack of accessible, reliable and affordable telephone services and the lack of transport facilities.

One of the groups interviewed expressed certain scepticism towards the use of telephones, saying that ‘sometimes you do not get the right information via the telephone’. Thus, an interesting question is to what extent the use of ‘organic’ information and communication technology is being replaced by the digitalised information and communication technologies made available by the telecentre and the mobile networks. This question will be in focus in the next section.

12.3 The ‘post-telecentre’ situation

The impact study on access to, usage of and impact of information and communication technologies in Sengerema was carried out in May 2008. The purpose of this study was to contribute to an assessment of the impact of the Multipurpose Community Telecentre in Sengerema town and District. This section describes the data collection and the findings of the study.

Data collection

The study included 14 women's groups, carrying out some form of joint production, such as weaving, pottery, tailoring, gardening, agricultural activities, fishing and processing of fish, etc. Each of the groups were 'talked through' a questionnaire, including closed quantitative questions on access and usage as well as open qualitative questions on impact. The 'talk through' was done with the assistance of a research assistant capable of speaking the local language, Kiswahili, and also capable of reading and writing English. Answers to the questions were noted in the questionnaire in English by the research assistant.

The questionnaire was administered to 14 women's groups, evenly distributed throughout the district and representing a total of 349 women, 1/3 of whom had tertiary, secondary or vocational education, while 2/3 had primary or informal education. The questions were categorised into questions on 'sources of information' and 'means of communication'.

Findings

Results concerning access to and usage of sources of information were as follows: All 14 groups had a radio and all listened to Radio Sengerema FM on a daily basis. Other radio channels were listened to, but not by all groups. All groups stated that the most important information on the radio was 'development programs', especially business and agriculture. Concerning TV, only one group had an own TV but 10 groups used TV regularly for information, again with 'development programs' as the most important type of information. Three groups, all located within less than 10 km from Sengerema town and the MCT, stated that they used the Internet for searching for information about prices and markets.

Results concerning access to and usage of means of communication were as follows: No groups had a fixed line telephone but all 14 groups had mobile phones and in some groups several of the members had mobiles. All members had access to a mobile through each other. The most frequent uses of the mobile were for social networking and for business, 9 of the 14 groups stating social networking as the most important use and five groups stating business as the most important use. Only one group located in Sengerema town had an e-mail for communication and this group stated that they used the e-mail for business and for social networking, with business being the most important use.

Results concerning the impact of sources of information are given below in the form of some characteristic quotes from the questionnaires, structured according to the source of information.

On radio impact:
- We learn about the modern method of fishing through the radio and we learn the types of fish and at what time a certain fish should be fished. We also know the prices of goods at a certain time.
- Through the radio we manage to know what to produce, when to produce and for whom. Our group deals with garden. We manage to get the proper seeds and insecticides.
- According to the price fluctuation we control the price of our goods throughout the year. We advertise our work monthly through Radio Sengerema FM; this enables us to get more customers.

On TV impact:
- Through TV we manage to discover different designs or fashions, we design and make them. This helps us to get more customers for the case of tailoring.
- Through watching TV group members are able to appropriate technology like irrigation, post-harvest programs etc.

On Internet impact:
- We have now customers from our district, where they send fishes (fried ones) to other places outside our country.
- We managed to get customers from Kenya and Uganda for some rice. Most of them come direct to our group during harvest time.

Results concerning the impact of means of communication are given in the form of some characteristic quotes from the questionnaires, structured according to the means of communication.

On mobile impact:

- We manage to meet our goals through simple communication. It saves us time and costs.
- Meeting together, business information exchange, reminding ourselves on the responsibilities we have, knowing one another's condition.
- The mobile telephones help us be aware of bad news, particularly thieves. We manage to work as a team through this simple means of communication. We also get more customers through it.
- We manage to communicate simply. We also save time for other activities instead of walking far distance to send a message. We get customers through our mobile telephone.
- Some of our customers have our mobile telephone numbers. We communicate with them regularly on the production because of the quantity demanded.

Impact of the e-mail:

- By sending e-mail the group has got a grant of US$ 6000 from the Self-help Fund, USA Embassy, Dar es Salaam.

Discussion of findings

The above results on access to and usage of ICT among women in rural Tanzania confirm overall tendencies from general studies on access and usage in poor countries (Gillwald 2005; Mahmood 2005: 204-220; Mercer 2005: 243-264; Etta & Parvyn-Wamahiu 2003) in a number of ways. The widespread diffusion of radio is confirmed, as is the widespread use of mobile phones. It might be somewhat unusual that so many women, and many of them rural women, own (or have access to) mobile telephones, but this may be explained by the tough competition between the three operators in Sengerema District. Also the usage of TV is rather high, with 10 groups out of 14 using it regularly for information. As mentioned above, the three groups using the Internet in the telecentre are all located within less than 10 km from the centre. The study did not go to the individual level and therefore the question of who is actually capable of using the Internet cannot be answered.

A finding which is not in accordance with the more general usage studies reported, is the fact that all groups specify that they consider 'development programs' the most important programs both on radio and on TV. Also, 'business information' features relatively high on the list of uses of the mobile telephone. There may be two possible explanations for this discrepancy: One is that women in general are (considered to be) more serious in their consumption of information, maybe because they do not have so much time to sit and listen to the radio or watch the TV, and therefore want to gain something useful from this type of activity. Another explanation may be that the research assistants carrying out the study were assistants of the local 'Business Development Coordinator' for a well-known United Nations Capital Development Fund project in the district, and this may have biased the answers towards more focus on business.

In terms of ICT impact on group activities the findings are as follows: The radio is mainly used for innovative purposes, getting information about new ways of doing things, including knowledge about new raw materials and new methods of production. Also, it gives information about prices, both prices of raw materials but also prices of produced goods, allowing the women to achieve higher gains when trading. Some groups use the local radio for advertising their produce and thus attract more customers. The TV is mainly used for getting new ideas, i.e. for innovation, while the use of the Internet seems to be closely connected with identifying and developing markets abroad, in this case in Kenya and Uganda.

The use of the mobile telephone has benefits in terms of saving of time and money as compared to having to use another form of communication, for example, traveling by bus. It also

has benefits in terms of easy communication, both with customers and among the group members themselves. One of the remarks worth noting is the repeated use of the word 'simple' - these rural women with little or no formal education find the mobile technology simple to use.

Although the impact study was a small pilot study with no quantitative indicators of impact collected, it seems validated that there has been a positive impact from the usage of the local radio station and from the widespread use of mobile telephones. The impact seems to be mainly in terms of innovation and better information about prices and markets, but also the social networking is an important impact.

12.4 Comparing and concluding

In Sengerema in 2001, more than 150 years after the invention of electrical telecommunication (in the form of the electrical telegraph invented 1840) the Katumba communication drum was still in use and the main source of information and means of communication was 'organic' technology, i.e. human messengers. Seven years later, in 2008, there was universal mobile network access, Internet access via the telecentre and local radio broadcast – the question is whether this accelerated introduction of ICT has led to an improvement of standards of living in Sengerema town and district.

In this section the findings from the base line study in 2001 and the findings from the impact study in 2008 are compared and discussed. Furthermore, the results from the impact study are analysed using the diffusion of innovation model. Lastly, a conclusion concerning the positive impact of ICT in Sengerema will be proposed.

From drums to mobile phones

Leaving the Katumba drum aside as a curiosum it could be argued that the use of human messengers as sources of information and communication has the advantage of the personal encounter, a fact which was highlighted in a study that examined the impact of infrastructural constraints on entrepreneurship in Northwest Tanzania. The study found that *"reliable telecommunications remain of rather minor importance to entrepreneurs"* (Trulsson 1997: 133). The explanation offered by Trulsson for this apparent lack of concern with telecommunication infrastructure was that due to cultural reasons the personal encounter is what matters in business relationships.

The base line study described above seems, however, to counteract this explanation. People interviewed in 2001 were clearly dissatisfied with the means of communication available and were pointing to the disadvantages of the 'organic' technology and the personal encounter, namely the lack of updated, timely and relevant information. Other disadvantages which became clear from the impact study in 2008 were costs in terms of money for transport and time spent on travelling. Similarly, the impact study clearly demonstrated that the peasants and artisans have had no problem taking up the use of digitalised telecommunication technology in the form of mobile telephones once this technology became available to them.

As mentioned before the ICT deployment in Sengerema has been extraordinarily high over the last years and it is worth studying which types of telecommunication technologies have been appropriated and diffused into the local community. The impact study clearly demonstrated that the radio and the mobile telephone are the two types of technology which have gained the most widespread use as compared to TV, the Internet and the e-mail. In order to understand this situation, the model for diffusion of innovation described by Rogers (2003) is useful.

Diffusion of innovation

In the diffusion of innovation model by Rogers (2003) the following five attributes of innovations are singled out as important for the rate of adoption:

- *relative advantage*, i.e. whether the innovation is better than what it replaces;
- *compatibility*, i.e. consistent with existing values, beliefs and needs;
- *complexity*, i.e. the ease with which the innovation can be used by all;
- *trialability*, i.e. possibilities for trying out the innovation on a limited basis;
- *observability*, i.e. the visibility of being a user of the innovation.

Using these attributes some possible explanations may be given to the above findings.

Radio is a well-known innovation which became widespread in Tanzania in the first decade of independence when adult literacy programmes were broadcast throughout the country by the national radio, as were speeches by the charismatic first Tanzanian President Nyerere. Thus, it is consistent with existing values. The relative advantage of the local radio as compared to the national radio is the fact that local news of importance to the local community is broadcast on the local radio but not on the national radio. The radio is easy to use (complexity) and sufficiently widespread that everybody has a chance to try out using it before eventually deciding to invest in an own radio (trialability). Because the radio has been around for a long time and is widespread in the community the observability does not seem to play an important role for the women's groups.

In the case of mobile telephones, Rogers states that they "have an almost ideal set of perceived attributes, which is one reason for this innovation's very rapid rate of adoption" (Rogers 2003: 261). This is confirmed in the impact study, where relative advantage (saving of time and money), complexity (simple to use) and trialability (borrow from another group member) are obvious from the women's statements. Concerning compatibility and observability the study does not give any information on these two attributes.

Looking at the attributes of the computers and the Internet in the Telecentre, the main barrier to the use of this innovation may be the complexity, as mentioned before. The relative advantage is not (yet) clear to most people in the community since the majority does not have family or friends with an e-mail, nor do they know what information may be found in the Internet. Compatibility with existing values is an important issue, especially in connection with the amount of pornographic sites found on the web and accessed by users of the telecentre in spite of notices around the centre stating that such use of the Internet is not allowed (Mercer 2005: 243-264). Another barrier is the trialability which the Telecentre has tried to overcome by having free introductory computer sessions every month. Finally, the observability is one positive attribute of the Telecentre - it is perceived as a sign of modernity to be seen using the Telecentre services (ibid.).

Conclusion

In conclusion it is fair to say that the local radio station and the mobile telephones have led to development, i.e. improved conditions for productive activities among local artisans and peasants in Sengerema town and District. This improvement is mainly in the form of updated and relevant information about prices and markets, saving of time and money for transport of messengers and knowledge, inspiration and new ideas for innovation of the production. The computers and the Internet have contributed to development - but only for a minority located close to the telecentre - by enabling the establishment of international contacts, whether funders or markets.

When comparing with the original MCT project plan it becomes clear that the two services most useful to the local community, the local radio and the mobile network, were not part of the original project plan. Based on this observation is may be concluded that ICT projects in general should be more aware of the concept of 'technological blending', i.e. a combination of traditional and newer forms of ICT, as argued by James (2005: 285-296). This is emphasised by the fact that the results found in the impact study, i.e. the widespread use of mobile telephones and local radio, are confirmed by general studies on ICT usage, as well as by the Rogers model of diffusion of innovation.

Although Sengerema may not be typical for semi-rural/urban areas of Tanzania because of the location of the Sengerema MCT, which is by far the biggest and the most expensive telecentre in the country, the above conclusion might be useful in planning new ICT for development initiatives in Tanzania, as well as in other poor countries in Africa and elsewhere.

Part IV: Analytical outline

With reference to the previous theoretical and empirical parts of this book we now venture to provide a generalization of our Tanzanian case studies, claiming that our findings apply to many technological transformation sites in the South, certainly in most African and many Latin American countries. It needs of course to be said that the many details of the "case of Tanzania" only will be applicable to other Southern countries in very general terms.

Yet we claim that the following analytical outline can lead the way towards a greater in depth understanding of what particular technological transformations that appear to take place in the South, how these can be understood, and finally – with reference to Chapter 1 – why these seem to be overlooked and neglected.

13. Socio-technological background

Jens Müller

For analytical purposes, the national systems of production in the South should not only be divided into formal and informal segments. They can also be split up between endogenous and exogenous segments with reference to the qualitatively different systems of technologies that characterise them. Both sets of segments have been subject to a number of studies, but they have rarely satisfactory been *integrated*. What is most important to note from our empirical studies is that we find numerous informal social carriers of technology embedded in all kinds of informal systems of innovation.

13.1 The double set of segments

As indicated in Section 3.2, the distinction formal-informal sector is relatively well described, although certainly not always emphasizing the same features. Our contention is that the distinction primarily must be in regard of *institutional* disparities. At the extreme ends we find very different rules of the game as defined by the predominant, but co-existing modes of production (Jansen 2000: 195).

The informal rules of the game differ from those of the formal sector, and also vary from region to region within the same country. See e.g. Raikes (2000: 65) explaining that it is a fatal mistake to think of one and only one market setting at work: Several markets are instituted with very different 'rules of the game'.

Formal sector	Informal sector
Primarily euro-centric norms and value systems. State and/or capitalist market liberal regulations with strong international relations.	Post-traditional norms and value systems. Civil society dominance, mainly performing under petty commodity market relations.

Figure 13.1: Dichotomy of Southern institutional settings

Exogenous technology	Endogenous technology
Imported capital goods and inputs, mainly depending on foreign management systems. Science based knowledge and learning systems.	Capital goods and inputs of domestic origin, managed and maintained by locals. Skills based knowledge and learning systems.

Figure 13.2: Dichotomy of Southern technology systems

As shown in Figure 13.1, in the formal sector we find so-called modern norms and value systems, and state and/or capitalist market liberal regulations, frequently with strong international relations. On the other hand, in the informal sector we find post-traditional norms and value systems, civil society dominance and mainly petty commodity market relations. De Soto (1989: 13) refers to these as "extra-legal norms".

It is important though to note that there exist considerable areas of interaction between the two sectors, depending of course on what features one looks at[1]. In particular in regard to the legality of activities, Tokman (1992: 6) observes that an *intermediate* status is common. He cites cases where the production process of some products is illegal, but the marketing system is legal.

And as previously indicated and shown in Figure 13.2, we also distinguish between two technology systems, the exogenous and the endogenous.

Exogenous technology is largely of foreign origin. It depends on imported inputs in terms of technique and knowledge, and its organisation is thereby to a large extent technically determined and influenced by foreign management structures. And perhaps most importantly, the products are not locally embedded as explained in Section 2.1.

Endogenous technology is largely of local origin. Traditional artisan operations belong to it, but it also includes all kinds of technologies that originally came from abroad. The distinction is whether or not this technology has been innovatively assimilated (Müller 2003: 78). The operators of endogenous technology are capable not only of handling all aspects of the technique and knowledge component but more importantly, of the organization component; they are also able to adapt it to changing circumstances. Again, the area of interaction between the two technology systems is of noteworthy dimensions.

Putting the two sets together, as we do in Figure 13.3, we begin to be able to go into some details of the dynamics, both of what we call the institutional segments and the technology segments of the national systems of production.

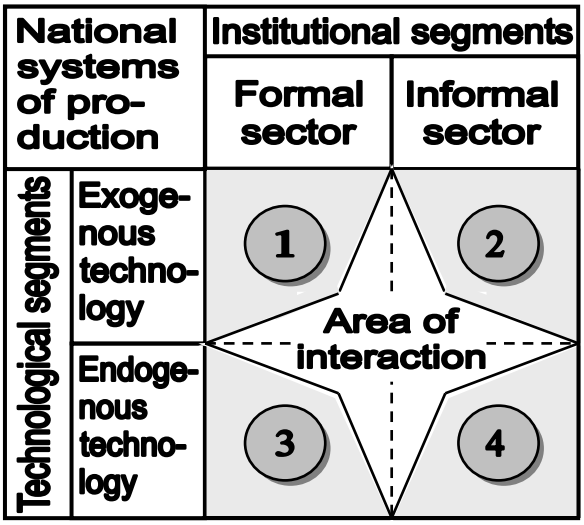


Figure 13.3: Matrix of the 4 segments of the national systems of production

There has been a tendency to conceive the structure of production in the South as being situated either within segment [1] or [3] as an indication of the so-called technological divide. In the formal (modern) sector we saw either large-scale industries - often parastatals - in segment [1] or small and medium scale enterprises (SMEs) in segment [3]. In the informal sector we saw micro and small-scale enterprises (MSEs) in segment [4]. What is happening in segment [2] was blurred, and in any case the area was looked upon, if noticed at all, as a rack bag of all kinds of activities.

However, it is the *area of interaction* that is the most interesting to penetrate empirically when the focus is on innovation. What kind of interactive learning, user-producer communication and other exchange processes take place between the four segments?

[1] We are not proposing to use the conventional dual economy theoretical outlook. We address the national economies as a whole, and apply the notion of segmentation for analytical purposes only.

13.2 The intriguing 'by-pass'

The conventional idea that exogenous technology inputs in the formal sector would be assimilated and eventually become part of the endogenous technology system, i.e. be directly transferred from segment [1] to segment [3] has largely been frustrated as indicated in Section 2.3. All kinds of so-called modern factories that were transferred from the North to the South in the 1970s did not fit into the local contextual conditions; if working at all, they hardly ever did operate at the capacity they were designed for. In fact, it was this failure that was one of the reasons for the dept. crisis experienced since the 1980s**.** And as said before, the number of small and medium scale enterprises that were established under previous import-substitution regimes is declining.

On the other hand it must be mentioned that an increasing volume of South-South technology transfers are recently becoming more common. E.g. Diyamett et al. (2005: 22) reports of a relatively successful transfer and local adaption from Brazil to Tanzania of conservation agriculture implements.

However, as illustrated in Figure 13.4, a noteworthy and increasing amount of exogenous hard-ware (technique), but also soft-ware (knowledge) is transferred from segment [1] and *adapted* to the organizational settings in segment [2]. E.g. some of the retrenched or dismissed workers from the formal sector get employed or establish themselves in the informal sector with similar activities, applying their accumulated knowledge base, and even sometimes bringing all kinds of exogenous hard-ware components.

Also, knowledge and bits and pieces from segment [2] are eventually *assimilated* in the endogenous technology systems in segment [4] and become inputs to the innovation efforts that constantly take place here.

Finally, some technologies in part or whole may gradually be *domesticated* and embraced by the formal institutional setting in segment [3].

The movements from segment [1] via [2] to [4] and then to [3] we see as a 'by-pass' to the conventionally projected path from [1] to [3].

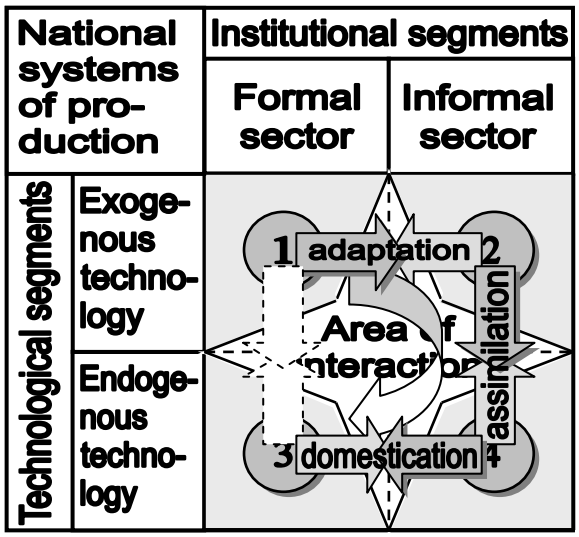


Figure 13.4: The technological assimilation 'by-pass'

Direct adaption and assimilation from segment [1] to [4] are of course also happening. Just one such case is shown in Box 13.1.

In the first half of the1970's a team of Danish architects and engineers working on a DANIDA financed low-cost housing scheme in Central Kenya did invent a special low cost roofing product using chicken mesh, jute cloth and a particular blend of concrete. A number of houses were built with these roofs. The project was discontinued because the houses – intended for poorer strata of workers – ended up being leased to middle class people at a high rent that was pocketed by corrupt city councillors. And the project was announced in the Danish press as (yet) another failure of development assistance. However, a few years later, in Western Kenya, the local house builders from the project did travel around in small teams erecting houses for ordinary people *and they were using precisely the new roofing materials.* The new technique, knowledge and product was thus transferred from the formal sector and assimilated in the informal sector.

Box 13.1: Case of direct assimilation of exogenous technology (interview 1978)

Some empirical recordings have been devoted to segment [2] where we e.g. find various repair workshops (King 1996). Transistor radios, video cameras, computers etc. are being repaired in numerous urban and rural workshops. Repairs that are rejected in European shops (why don't you buy a new one?) are now effectively and very cheaply done in such workshops.

Informal radio and TV repairers, one from rural Tanzania, one from rural Nicaragua

King (1996: 102) also provides very detailed records of numerous instances of what he terms 'second stage' import substitution that takes place in the informal sector via the 'by-pass' described above. In other words, although the former state directed and subsidised import substitution efforts are diminishing, it increasingly takes place in the private, however, informal sector. One reason for this is a combination of decreasing incomes for the majority of populations and devaluations that are not compensated by falling prices of imported goods (Qualmann 2002: 172).

To give another example: To day you can buy about 18 different types of imported hair shampoo in super markets in the major towns in Tanzania. However, only a minority of people can afford buying these, and this has given rise to local hair shampoo manufacturing, which inter alia serves the many hairdressing shops that recently have popped up all over the country.

Shampoo manufacturing and hairdressing shop; Mbinga District town, Ruvuma Region

In sum, while most politicians and academicians are mainly trying to find ways to improve formal sector national production systems with the aim to maintain or achieve *international* competiveness, informal sector operators are daily striving to maintain and achieve *national* or local competitiveness, making use of informal sector systems of innovation. They are daily searching and searching – constantly re-searching – for technological solutions to their business problems.

13.3 Informal carriers of technology

With reference to Section 2.7 we are now able to induce that the informal village artisans certainly can be conceived as important social carriers of technology. They are constantly chang-

ing their endogenous technology systems, and at the same time adapting and assimilating all kinds of exogenous technologies.

And with reference to Section 2.6, they are adapting these technologies to their needs along 'roads not taken', i.e. selecting other formation, application and consumption means than applied in the formal sector using highly iterative processes of innovation.

This is not to say that they are not in need of improved conditions of production as outlined in Table 13.1.

The conditions	Status of the village artisans
1. Interest	They are highly motivated to apply improved techniques and to diversify their products to meet the ever increasing local demands
2. Power	They are locally empowered, but need to be institutionally recognized and to have access to improved economic means
3. Organisation	They are internally well organised with some external task networks, which could be improved by formation of more associational settings
4. Information	They are aware of improved technical options, but in need to be more informed about possible alternatives
5. Access	They are getting hold of basic inputs, but lack in particular improved access to tools and raw materials
6. Knowledge	They possess most of the knowledge required to adapt improved technologies, but improved and relevant vocational training is needed

Table 13.1: The village artisans as social carriers of technological innovation

The artisans constantly strive to improve their conditions through what can be seen as *flexible specialization* settings. Originally this concept was introduced to show how the economies in the North have experienced a relative decline of fordist mass production and a corresponding expansion of flexible modes of industrial organization. However, having studied SME developments in Kenya and Bangladesh, Billetoft (1996: 169) concludes that the concept is equally valid for the study of petty producers in the South:

> "The flexible specialization concept is useful in at least three respects. First, it deals not only with constraints on the demand side, but also with fluctuations on the supply side … Secondly, it draws attention to the social and institutional aspects in understanding the environment within which micro-entrepreneurs operate … Thridly, the paradigm breaks with the notion that dynamism necessarily connotes steadily larger production units".

However, Sverrisson (1994: 53) concludes from a study of SME carpentry networks in Kenya and Zimbabwe that it is difficult to apply the flexible specialization thesis directly to Africa. But modified, and linked to the perspective of the 'new' comparative political economy of development, it can be shown that there is not one general path of development, but *multiple paths*.

13.4 Informal systems of innovation

As argued in the previous sections, all kinds of technical, organisational and product innovations take place in the informal sector. What can be inferred is that since the informal sector apparently is expanding and co-evolving with the changing socio-economic and institutional settings in the South, this is empirical manifestation of innovative capability of informal sec-

tor craftsmanship. Thus, since this is the case it must be possible to identify some of the related informal systems of innovation.

In other words, it appears that the Systems of Innovation approach introduced in Section 2.8 can be usefully applied to the study of informal sector technological transformations. Doing so may facilitate a more expedient technological transformation process nationwide than is presently at work, i.e. a process that eventually could ensure synergetic interactions between the formal and the informal systems of innovation.

In sum, we hold that the national systems of innovation in the South are made up of two distinct and *different* sets of systems. One set of systems of innovation in the formal sector, another set in the informal sector.

The informal setting

We must imagine that there, so to speak, 'behind' the formal innovation systems are numerous informal systems at work. In fact, most of this chapter has been devoted to highlight exactly some of the contents of these hitherto hidden systems.

Figure 13.5 shows a model slightly adapted from Figure 2.8 to the situation of the informal craftsmen who are the social carriers of the technological innovations described.

The groups of external network actors are identified as follows:

1. *Suppliers and related enterprises:* Providers of raw materials, sometimes recycled items of scrap from formal sector industries; dealers in tools and equipment, often obtained from neighbouring artisan workshops.
2. *Customers and middlemen:* Local consumers; other craftsmen and competitors; farmers and local food processing units; travelling traders.
3. *Civil society organisations:* PPPs; CBOs; local associations; religious groupings; extended family units.
4. *Local regulatory authorities:* Local municipal or district government offices, primarily interfering in the market sphere only. All kinds of other locally embedded institutional settings.
5. *Informal learning systems:* Apprenticeship arrangements of all kinds; NGO facilitated training arrangements.

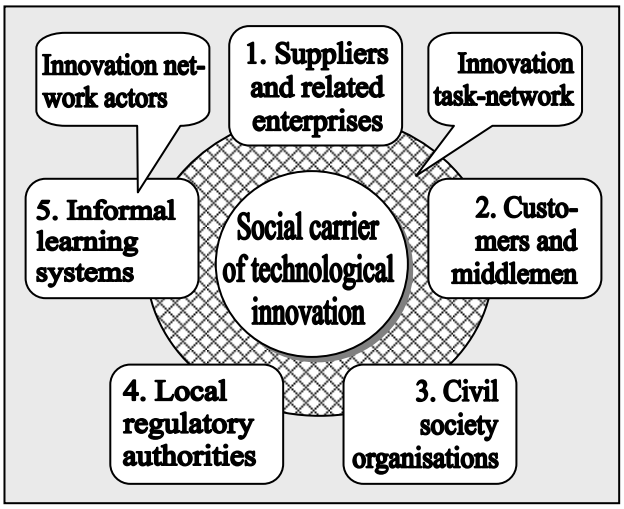


Figure 13.5: Informal innovation system

Meagher (2009: 7) comments on the issue by saying:

> "Amid the destabilizing forces of economic restructuring, the regulatory authority of the state is being eroded from below by a proliferation of informal economic networks and civil associations, and overwhelmed from above by transnational business, social issue and even criminal networks".

All the network actors are connected through innovation task-networks or various types of cluster arrangements (Parrilli 2001), where informal infrastructures and not least social capital are of utmost significance (Sverrison 2002). Of course the formal infrastructure does play a role, but as demonstrated, not to the extent conventionally believed. The informal craftsmen have managed to maintain and even expand their operations in the face of its deterioration in many areas.

New organized expressions among 'silent' and 'invisible' sectors of the population are emerging (Pearce 1998). Here PPPs and CBOs have become major new organisational actors. These may be helpful in e.g. the formation of local producer's associations.

Cross (1994: 6) notes:

> "Informal entrepreneurs must be constantly organized and politicised since their activity is subject to the constant re-sanctioning of their activities by the state, and is very often objected to by large companies who cannot be informal. The effect is that informal entrepreneurs are usually highly organized and constantly prepared to pressure state official on their behalf".

Innovation actor outline

In Figure 13.6 we show a more specific local system of innovation with indication of the most important user-producer links including an explication of the most important task-network actors (Diyamett et.al. 2005: 27).

Central user-producer actors:

1. *Farmer household units:* Single family units and farmers associations.
2. *Agricultural technology manufacturers:* Local artisan units making farm tools and processing implements.
3. *Post-harvest processing enterprises:* On farm processing for own consumption and local market.

Less central, however essential systems actors:

4. *Public/Private Partnerships:* Local networks of inventive farmers and artisans.
5. *Crop husbandry suppliers:* Local seeds and sidling distributing entities.
6. *Extension & training actors:* District extension service providers.
7. *Vocational training providers:* Local artisan apprenticeship actors.

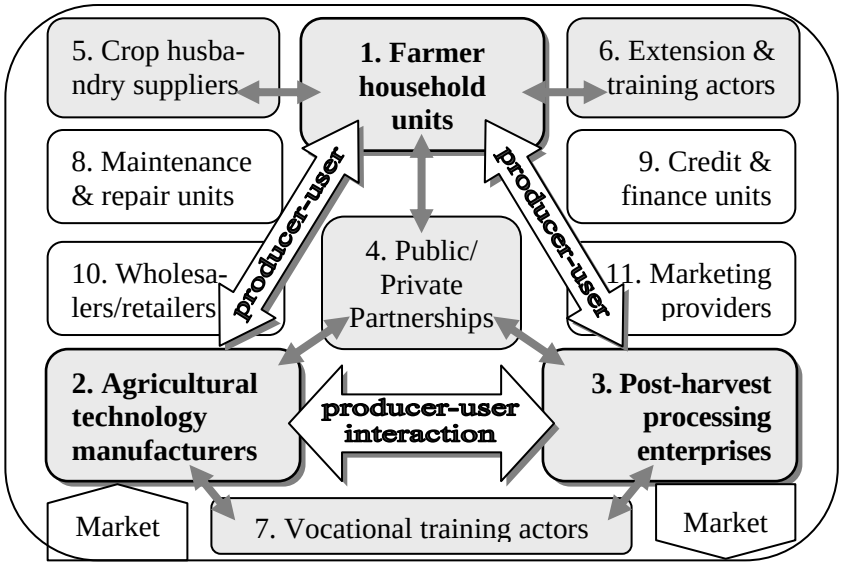


Figure 13.6: Overview of innovation task-network of agricultural producer-user systems

Secondary systems actors:

8. *Maintenance/repair units:* Local artisan units serving the upkeep of farm tools and processing of implements.
9. *Credit & finance units:* Local barter arrangements and family/friends informal loan arrangements.
10. *Wholesalers & retailers:* District markets for locally produced implements and spare parts.
11. *Marketing providers:* Local/district distributors of processed farm products.

Figure 13.7 gives a picture of the overall problems facing the agricultural sector, in particular of the causes and effects of the weak user-producer interaction that needs to be strengthened to ensure food security and related predicaments (Diyamett et al. 2005: 7).

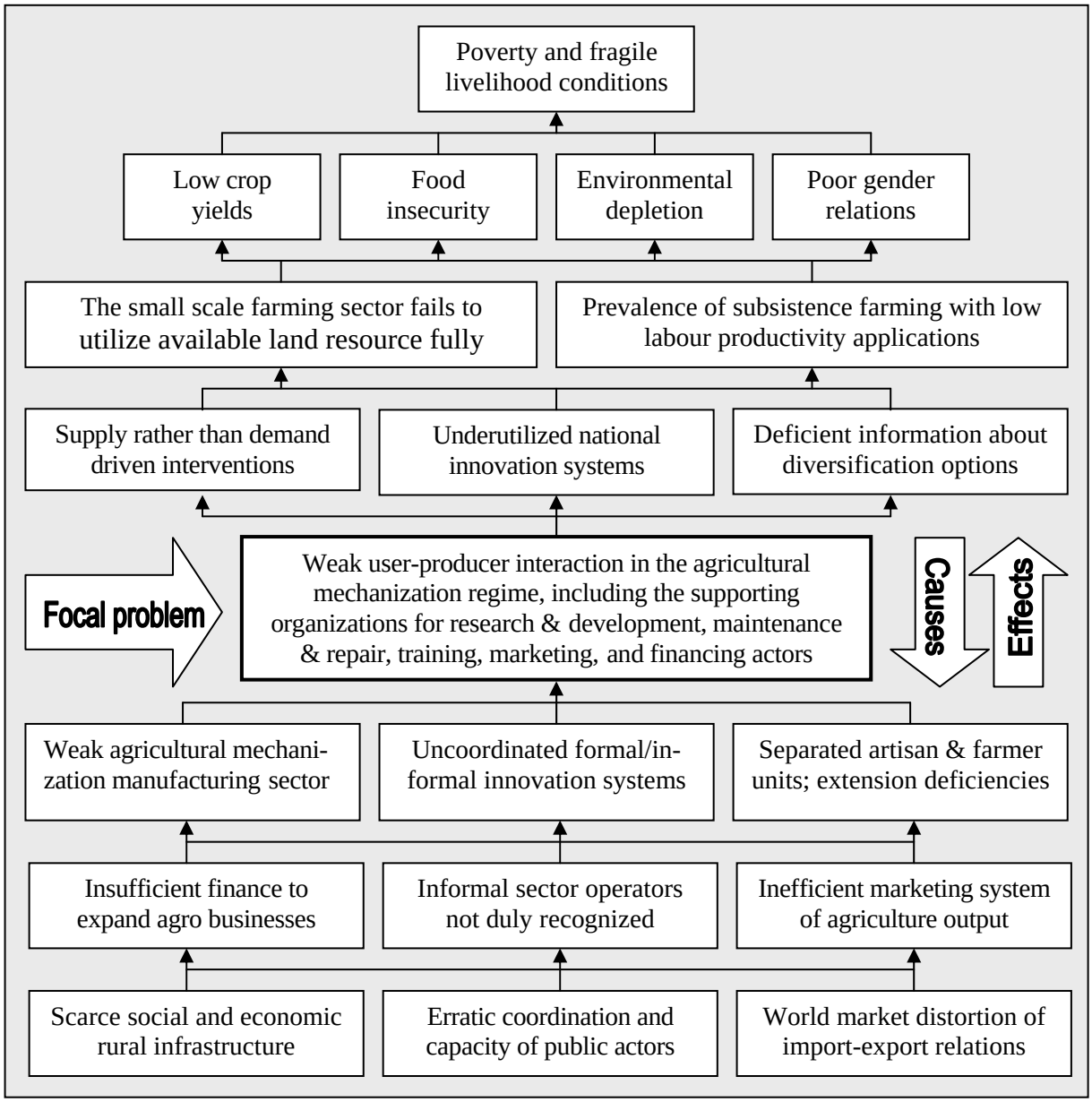


Figure 13.7: Overall problem tree for improved agricultural technology strategy

14. Diverging Paths

Jens Müller

In this chapter we attempt to generalise our empirical and methodological findings and to offer a framework for understanding some of the important features of what technological transformations presently are happening in the South.

14.1 Technological transformations in the South

When it comes to describe the technological transformation witnessed in the South we are, as indicated, hard up against the prevailing modernisation discourse. E.g. we often talk about the *less* developed countries. This is an expression of fruitless and derogative euro-centric comparative perspective that leads us nowhere if we really want to understand what happens in these social formations.

As already indicated, studies of the change process that took place in many Southern countries in the 1980'ies and 90'ies have labelled this as a *de*-industrialization process (Nyong'o & Coughlin 1991). This has been, as said, a convenient catchword where former state subsidised enterprises and SMEs have more or less collapsed under the structural adjustment policies.

However, these analyses in the South are - as in the North (Rowthorn & Ramaswamy 1997) - concentrating on the diminishing fordist factory systems. What they miss out is the dynamic diversification processes – explained in the previous chapters – that primarily are found in the informal sector. It should be said, that our study did concentrate on the rural informal sector; but with reference to studies of the urban informal sector, e.g. King (1996) and de Soto (1989), we claim that similar technological transformations take place in the urban as in the rural settings.

The technological transformation taking place in the informal sector we, for argument sake and for lack – for the time being – of a better expression, propose to term *convolution*[1], the meaning of which according to Collins Thesaurus dictionary (1995) connotes "coil, coiling, complexity, contortion, and intricacy". We may also use the concept of *co-evolution* already introduced in Section 2.2 and elaborated by Norgaard (1994), but here primarily referring to the mutual merging of co-existing production systems.

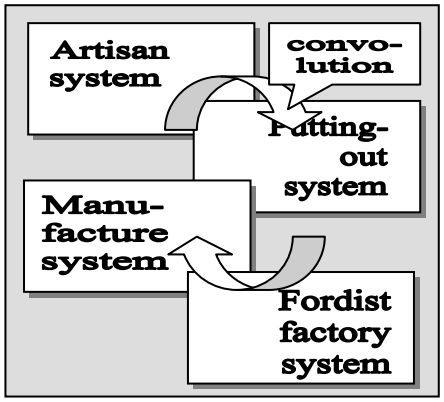


Figure 14.1: The process of technological convolution in the South

Referring to the production systems explained in Section 2.4, we see what emerges to be a picture of integration of the artisan system, the putting-out system, the manufacturing system *and* the fordist factory system as depicted in Figure 14.1. The local techniques, knowledge systems and organizational forms make up unique production systems that provide locally embedded products.

Further research is of course needed, and most importantly, new non euro-centric conceptualization of these production systems must be formatted, in order to come to grips with a proper characterisation.

[1] We were initially inclined to use the term 'involution' in line with Geertz (1963). However, this concept is denoting a situation of stagnation and degeneration.

The convolution process at work we define as: *Flexible integration of innovative and novel, increasingly sophisticated, co-existing systems of production.*

14.2 Diverging social constructions of technology

In other words the national systems of innovation (referred to in Section 2.8) in the South must be seen in two highly separated and diverging systems, (1) the formal system attempted pursued by the present dominant socio-political setting and (2) the informal system as indicated in Figure 13.5.

Another way to explain the same is to use the model presented in Figure 2.2. We must realize that the formal social or contextual conditions of technology are qualitative different and moving in *opposing* directions compared to the informal conditions, thus shaping *qualitatively different technological transformations*.

Contextual conditions	Formal settings	Informal settings
State regulations	Uniform and centralized institutional regulations	Diversified, weak and decentralized institutional regulations
Market conditions	Relatively high national and international market outreach	Limited and primarily local market outreach
Social division of labour	Primarily vertical structure of production	Mainly horizontal structure of production
Labour relations	Formal labour market institutional environment	Highly differentiated labour market conditions
Organizational culture	Mixed nationally and internationally influenced norms	Somehow differentiated and influenced by local norms
Social capital	Relatively low trust between different groups of population	Somewhat trustful interaction between local groups
Social infrastructure	Officially managed health and education systems	Locally managed health and education systems
Human resources	Highly differentiated human capabilities	Somehow homogeneous, but slightly recognized capabilities
Economic infrastructure	Primarily aimed at the formalized system of production	Scantily established and maintained
International relations	Highly influenced by the ever globalising setting	Relatively little direct influence from international settings
Ecological conditions	Poorly acknowledged and only scanty precautions taken	Locally recognized and some attempted precautions taken
Living conditions	Relatively differentiated in terms of sustainability	Relatively differentiated in terms of sustainability

Table 14.1: The diverging formal and informal contextual conditions of technology

Table 14.1 lists and briefly describes – one by one – the contents of the contextual jigsaw pieces given in Figure 2.2, and outlines the difference between the formal and the informal pieces as indicated throughout the empirical Parts III and IV.

Moreover we claim to have seen and experienced diverging movements of these conditions, i.e. the formal conditions becoming more and more distanced from the informal conditions. In other words, the situation as we see it is one of the formal contextual setting *and* its corresponding technology systems being positioned up front and, so to speak positioned *behind* this, we find the informal setting *and* its corresponding technology systems.

And as primitively as it may look like, we then in Figure 14.2 illustrate the ever moving and *diverging* parts of both sets of the entire jigsaw puzzle: (1) being the formal contextual setting and technology systems moving in one direction, and (2) the informal contextual setting and technology systems moving in *an other* direction.

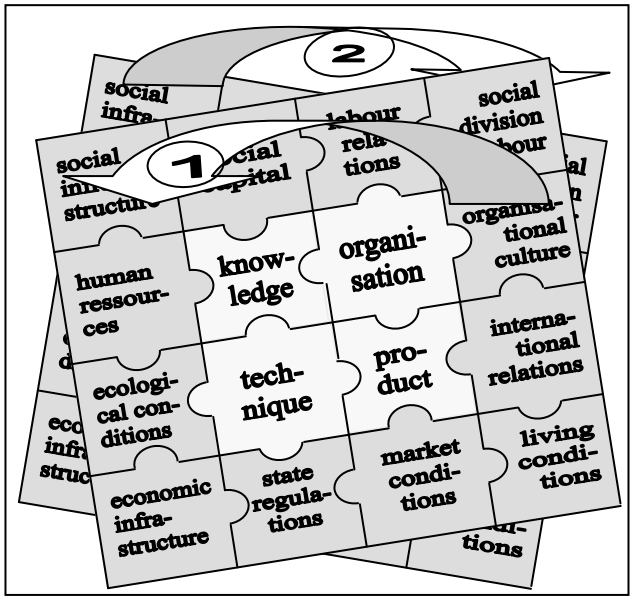


Figure 14.2: Formal sector (1) and informal sector (2) diverging movements

It needs to be said though, with reference to Figure 3.4, that both sets are moving within the same overall societal contextual conditions. Figure 14.2 is also to illuminate how to conceive the *internal* national technological divide experienced in many countries in the South. To some extent this divide picture may resemble the schematic *international* divide conception presented in Table 1.1. However, as said, this divide primarily follows the uni-liniar or one-path conception of technological transformation, whereas Figure 14.2 provides a multi-path conception.

14.3 Free trade and export zones

Counter to this technology divide thesis we must be aware that numerous fordist factory systems are being so-called 'out-sourced' from the North and established in the South. This mainly happens through foreign direct investments (FDI), most often in the so-called free trade zones (FTZ) or export processing zones (EPZ), where 'unskilled' labour can be exploited and with hardly any tax or other benefits to the host country. These were originally found in the so-called newly industrialised countries, NICs (AMRC 1998).

February 2003 in the provincial town Granada in Nicaragua we asked for a photocopy of a pamphlet about the Granada Free Trade Zone exhibited on the door of a tourist bureau. The lady in the bureau asked us "are you really interested?" and "yes", we got it, reading the following:

"All utilities are privately held and for the exclusive use of the Granada Free Trade Zone. Other incentives are as follows: 100% income tax exemption; no capital gain taxes; no duties on raw materials; no duties on building supplies; 100% foreign ownership permitted; no sales, excise or consumption taxes; no export taxes; no foreign exchange regulations; free capital repatriation".

And before we left we were wholeheartedly greeted by the local director of the zone, and told that questions of pollution, waste management etc. - like in Scandinavia - would be of no concern for the authorities: "So why don't you move your factory to our place?". We later tried by email to have this lack of pollution restrictions confirmed, but with no reply.

Box 14.1: Incentives for investment in Free Trade Zone in Nicaragua, 2003

A large number of countries in the South are presently competing to attract FDIs through incentive schemes that introduce an institutional set-up that differs significantly from that of

ordinary formal sector 'rules of the game'. The Box 14.1 and 14.2 provide case recordings of what rules are introduced.

In Tanzania 4 EPZs, three in Dar es Salaam and one in Arusha, have been established where both local and international investors are welcomed.

Objectives of establishing EPZs:
- To attract and promote investment for export-led industrialization
- To increase foreign exchange earnings
- To create and increase employment opportunities
- To attract and encourage transfer of new technology
- To promote processing of local raw materials for export (value addition)

Fiscal incentives:
- Exemption from corporate tax for 10 years
- Exemption from withholding tax on rent, dividends and interests for 10 years
- Remission of custom duty, VAT and other taxes on raw materials and goods of capital nature related to production in EPZs
- Exemption from taxes and levies imposed by Local Government Authorities on products produced in EPZs
- Exemption from VAT on utility and wharfage charges

Non-fiscal incentives:
- Exemption from pre-shipment or destination inspection requirements
- Unconditional transferability of profits, dividends, loyalties, etc.
- Lower port charges compared to other cargo box rate (transit cargo)
- Accessing the export credit guarantee scheme
- Allowance to sell 20% of goods to the domestic market

Procedural incentives:
- One-Stop-Service Centre by EPZ Authority for setting up, facilitation and aftercare service
- Operation is under one license issued by the EPZ Authority
- Rapid project approval
- One site customs inspection the EPZs
- Heavily composed EPZ Council to avoid bureaucracy in decision making

(http://invest-in.tanzania.ru/export.htm)

Box 14.2: Purpose and incentives for Export Processing Zones in Tanzania, 2009

Also, international labour standards are often abused in many countries in the South, including in the FTZs and EPZs (ILO 1996). In the case of Tanzania, the International Confederation of Free Trade Unions (ICFTU 206) has reported that:

> "trade union rights are extremely hard to exercise in practice due to antiunion discrimination in the private sector and serious restrictions on the right to strike, which workers in some occupations are prevented from exercising entirely".

In other words, the free trade and export zone enterprises are operating under institutional settings that to some extent are *similar* to those in the informal sector. We chose to call this setting for the *regionalized, fordist free-zone system.*

14.4 Overall global technology co-evolution

Summing up, we have now described three technological systems. In Figure 2.4 and 2.5 we presented the two phases of the technological evolution in the North. The second phase being the one where the fordist factory system merged into the science based factory system and further into what we call the *globalised science based production system.*

Most of this book has been devoted to the study of the informal sector in the South where we ended up with what we in Figure 14.1 venture to term a process of convolution towards a *localised, artisanal putting out system*. And in Section 14.2 above we did indicate that we primarily find out-sourced fordist production systems in the free trade or export processing zones.

The previous fordist factory systems in the South are moving into the free zone settings. The previous fordist factory systems in the North are also moving into the free zone settings.

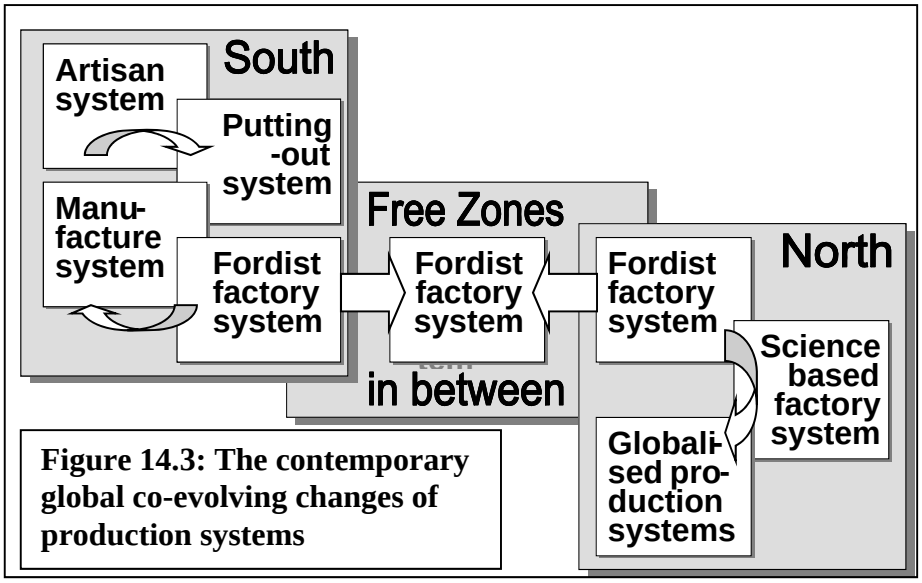


Figure 14.3: The contemporary global co-evolving changes of production systems

Concluding this global perspective, we thus find 3 co-evolving production systems as illustrated in Figure 14.3.

We thus identify three main co-evolving technological trajectories as illustrated in Figure 14.4. In the North we find the globalised, science based system; in the South we find the localised artisanal putting-out system; in between we see what can be called a regionalised, fordist free-zone system. All three are of course heavily dependent and interlinked with the others. None would be feasible without the others.

Seen in a global perspective – and without the conventional but intriguing comparative perspective – what we initially did term convolution should really be conceived as evolution; however a ***different*** evolutionary path or trajectory than ***'the'*** technological evolution experienced in the North.

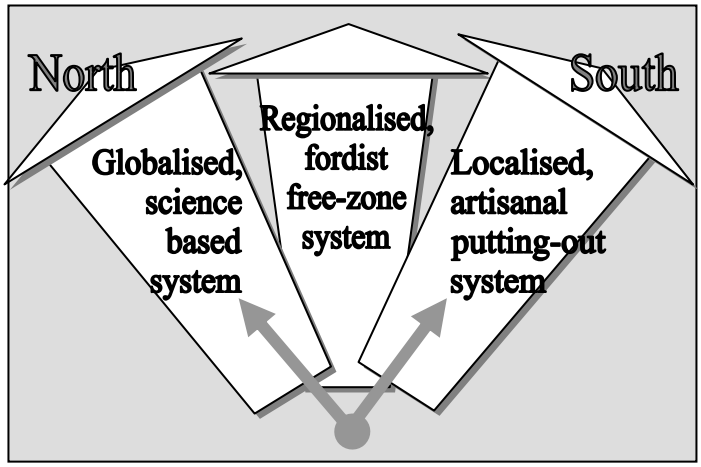


Figure 14.4: Globally diverging technological systems trajectories

In other words, what we referred to in the introduction as the global 'technology divide', usually conceived in a uni-liniar perspective, should be conceived as a three tier globally ***co-evolving*** transformation process.

At least we can conclude to have demonstrated that the technological transformation in the South is following ***AN OTHER PATH*** than in the North.

Part V: Conclusion

In the Introduction we indicated that some changes are underway in past times euro-centric conception of technology in the South, and in Chapter 1 we pointed to the need to abandon the detrimental role of the colonial scientist. The focus in this book has therefore been to introduce a holistic technology concept, and to demonstrate its application to a number of social and political concerns in the South.

The purpose, as initially stated, has been to highlight the significant social and productive potential in the informal sector that hitherto has been misconceived in conventional development research and by policy makers. Throughout we have indicated *what* local socio-technological transformations are taking place, *how* these are occurring, and *why* they apparently are relatively successful.

Of course we are aware of the limited applicability of the 3 tier case study approach used, starting with selected rural artisans in Tanzania, broadening it to include the informal manufacturing sector in the whole of Tanzania, and finally sketching a picture of what appears to happen in the South, as said, primarily in Africa and Latin America.

The final question is of course now: **so what** may be the usefulness of this analysis?

15. Befit for change

Jens Müller

The concluding statement in the previous chapter, illustrated in Figure 14.4, where we indicate that AN OTHER and different technological transformation PATH is taking place in the South than in the North, of course raises the very tricky question: To what extent are the Southern and/or the Northern paths politically, socially, economically and environmentally sustainable?

First it must be said that the picture of course is highly generalising. Looking closely at the Northern path we find all kinds of diverging directions, e.g. the technological trajectories lately emerging in nations like China and India appear to move in somehow other directions than in Europe or USA.

And of course, the Southern path has also numerous differing features depending – with reference to Figure 3.4 – on the particular overall socio-political setting, social relations of production, natural resource environment and not least the historical & cultural background of the nations in question. E.g. what detailed transformation that happens in Tanzania is of course different from what happens in Nicaragua.

By the way, so far, the regionalised fordist free-zone path appears not internally to be differing as much as the other paths.

However, no one of the paths is probably sustainable in the longer time perspective. Seen from the outlook of the globally emerging environmental, economic and political crises, a much closer *link* between the various paths than we find today must eventually be established. This link would not be along the lines of the conventional 'catching-up' prescription, we may rather talk about some kind of a *'catching-in'* solution.

Many recent authors have voiced the need for a radical change in the global socio-technological scenery, e.g. as Hart (2007: 247) tells us:

> "We desperately need a third way, one promised on a combination of global interdependence, sustainability, local self-reliance, and bottom-up entrepreneurship".

In this chapter we try to give some indications of how this may happen. We start out 'from below' with some relatively concrete suggestions for actions that may facilitate the above mentioned link; then follows a discussion of the national policy changes that will be needed; finally we touch upon an other global scene setting than we find today and that eventually has to be established for the catching-in to materialize.

15.1 Reconciling the national systems of innovation

In order to mobilise the technological dynamism in the South in general, and in the informal sector in particular, the *area of interaction* shown in Figure 13.3 between the formal/exogenous and the informal/endogenous segments of the national systems of innovation has to be widened. In essence, the challenge is to realize by what means an *intra*-national transfer of technology can be facilitated, mainly between segment [1] and segment [4] of Figure 13.4. Everybody would benefit:

- Informal sector enterprises would get information about technological innovation options for enhancing their capacity for the benefit of themselves, their local customers, and the national economy at large.
- The formal sector, including not least public research and development organisations, would get essential feedback about the need and real demand for technological transformations in the informal sector.
- International technology transfers would stand a greater chance of being dynamically assimilated, if foreign suppliers are getting essential feed backs about the contextual conditions of their recipients.

This is also to say that there is an urgent need to establish *coherent* national systems of innovation. As Johnson & Lundval (2003: 24) put it: "A need to include all sectors both low and high tech and finding ways to utilize local knowledge".

As said before, a crucial assumption is of course that the technological capacity in the informal sector is explicitly recognized, and that their conditions of operation are *fully* understood. The human resources are there ready to be mobilized. The rural craftsmen/women are already mobilizing these resources to some extent on their own initiatives, but they may need some assistance for doing so more expediently for the benefit of themselves and the rest of the society.

More concretely speaking, support from at least 4 types of actors or groups of actors, including Public Private Partnerships (PPPs), as mentioned in Section 10.3, will be needed. In general terms these actors must be charged with the following missions:

1. Research in and development of endogenous technologies, taking point of departure in the current and envisaged problems of the informal sector micro and small scale enterprises (MSEs). Apart from doing its own basic research, the actor of this type will have to take stock of relevant international research and development outcomes.
2. Mediation and diffusion of the research and development results from (1) above to the MSEs, as well as facilitating other both intra- and international transfers of technologies. The actor of this type must also assist in the establishment of new enterprises by ensuring communications with relevant public regulatory entities.
3. In close co-operation with (2) above the actor here must ensure and facilitate co-ordination and implementation of a national vocational training policy, including curricula development and reforms that are relevant for the need of the MSEs. One particular assignment could be to establish a relevant trade test certification.
4. In line with (3) above the actor here must implement a vocational training programme that takes into explicit consideration the existing forms of training in the MSEs in their varied

geographical settings. This will entail numerous local training facilities and intimate dialogues with the MSE operators.

Such arrangements are of course very difficult to provide, but a number of initiatives – including proposals for its possible funding – are underway in various national and international settings (Friis-Hansen & Egelyng 2007).

Formal-informal VET provision

As is well known, however only reluctantly admitted in formal sector circles, the informal sector operators are providing essential skill formation. The problem is that these informal private VET providers officially are regarded as unskilled and ignorant, i.e. only a few have the officially recognised trade test certificates. However they are capable of making all kinds of ends meet.

These informal VET providers, e.g. village blacksmiths, boat builders or pottery makers, in their widely scattered workshops are inculcating endogenous, local time and place specific knowledge to their apprentices. On the other hand, the formal VET providers are primarily offering extraneous and theoretical knowledge, mainly applicable for exogenous technologies. These two set-ups are institutional incompatible and represent contrasting learning systems.

As already indicated in Box 11.1, these two learning systems would mutually be benefiting if they could be made to interact. Ideally, the MSE masters and the formal VET instructors could from time to time team up, and so could the apprentices and trainees: The instructors with some of their trainees could benefit from visiting selected artisan workshops and learn about what employable skills are in demand, how products are adapted to customers demand, and what informal institutional setting there is in the local area. On the other hand, the masters and their apprentices could benefit from visiting formal VET training centres to get ideas of new products and processes, knowledge about formal entrepreneurship requirements, and the formal trade test certification conditions.

However, it needs to be said, that there is no reason what so ever to indulge in *craftsmanship nostalgia*. The technology of the urban and rural craftsmen is extremely labour demanding and cumbersome. Labour relations are not complying with generally accepted standards (ILO 2002; Scrase 2003). Some of the technology systems are also not ecological sustainable. On the other hand, the innovation potential of the informal technologists could be the 'just-in-time' backbone of future technology transformation processes**.**

15.2 Changing the socio-political scene

We are well aware of the many pitfalls of trying to make specific policy proposals in the present era of tumultuous globalisation, where economics are still replacing politics (Mittelman 2000; Klein 2007). We therefore content by making a brief review of recent global socio-political changes that may be relevant.

Hart (2008: 7) reminds us that:

> "under the neo-liberal imperative to reduce the state's grip on 'the free market', manifested in Africa as 'structural adjustment', national economies and the world economy itself were radically informalized".

The 1990's critique of the consequences of the WB and IMF promoted neo-liberal 'structural adjustments' therefore saw a return to an increase in the role of the state. E.g. in Latin America this did emerge under the so-called 'neo-structuralist' model. Neo-structuralism is here juxtaposed with 'endogenous industrialization' (Sunkel & Zuleta 1990; Gwynne & Kay 2000).

A central question has been how to formalize the informal. De Soto (1989: 246) answers the question by saying, "not to abolish the informal activities but to integrate, legalize and promote it". This would eventually lead to *The Other Path,* as was the title of his book.

Throughout we have been inspired by and have quoted that book. However, in his follow up study *The Mystery of Capital* (De Soto 2000) he concludes that this other path, he was describing, is one that eventually would lead towards a fully developed capitalist market economy:

> "Only capital provides the means to support specialization and the production and exchange of assets in the expanded market. It is capital that is the source of increasing productivity and therefore the wealth of nations" (De Soto 2000: 221).

His call for formalizing the informal is essentially an argument for the creation of a "good legal property system" (ibid: 232) that is presently attempted introduced in many nations, e.g. in Tanzania, as mentioned in Section 10.1. Slightly implicit we take this call as an argument for a neoliberal policy of privatisation of all assets.

Here we just quote comments from a few selected authors. Standing (1991: 37) notes:

> "A popular view, associated with De Soto, is that if only the State would remove all restrictions, notably tax and labour legislation, then the informal economy would become the leading source of economic growth".

And Cross (1994: 2) tells us:

> "De Soto uses a simplistic model in which broader economic factors are ignored, and state regulation is seen as the only limiting factor on growth. On the other hand, he completely ignores super-exploitation and the lack of worker benefits within the informal economy – precisely the types of evils that state regulation is designed to cure."

Apart from the property registration issue, 'micro-credit' and 'entrepreneurship' schemes are being widely promoted (Vincent 2004), and even 'micro-insurance' (ILO 2010). Such schemes are on the one hand based on neo-liberal and almost repetitive assumptions that 'the poor are poor because they do not have enough money'; and on the other hand they by and large overlook the existing entrepreneurial capabilities of the informal sector artisans, as presented in this book.

Mihanjo (2010: 7) tells us:

> "The realities (in Tanzania) of the new 2000's credit and entrepreneurship policy like other previous policies since independence are that they fail to revolutionize community development… Communities are overburdened, and enter into mass poverty, social differentiation and polarization. Interest, debt and overworking disintegrate social cohesion and security".

And formalizing the informal private enterprises – i.e. making them enter what is usually referred to as the 'private sector' – is not necessarily providing socio-economic sustainability. Mills (2010: 11) reminds us that:

> "Africa's people are poverty stricken not because the private sector does not exist or was unwilling to work in sometimes difficult settings … (but) the private sector is often not 'private' at all, but rather an elite-linked system of rent seeking. Even where there is a degree of independence, government attitudes towards private businesses range from suspicion to outright hostility".

We go with Pisani (2000: 1) where he states:

> "The informal sector should be nurtured now to assist millions in improving their lot in life as well as improving the health and national economies. To nurture this sector means to revolutionize economic development schemes".

Thus, formalising the informal must go alongside with a flexibly designed state (Portes et al. 1989). And Pearce (1998) holds that neo-structural adjustments without an effective state is detrimental, and criticises the new NGO'ism that just attempts to fill in the gap between the state and civil society.

Re-formalising the state

In other words, there is an urgent need to *re-formalize* the state. The question is then how and *by what formula*?

As much as we would have liked to answer this question, we have to content with making a few references and providing a methodological hint for further research.

Hart (2008: 9) tells us that:

> "our task is to build a 'solidarity economy' through new institutional combinations and with new emphasis. This means combining the equal reciprocity of freely self-organized groups with the redistributive powers of the state".

This would require enhanced socio-political theoretical paradigm shifts. According to Evans (1996: 1033):

> "Narrowly focused theories fail to incorporate the importance of informal norms and networks that make people collectively productive. They also distract attention from 'soft technologies' of institutional change, which can produce results well out of proportion to the resources required to implement them".

Further, Mills (2010: 13) reminds us that:

> "The top-down imposition of states and borders on Africa's rich ethnic and sectarian tapestry by colonial powers has helped to institutionalise weak governance structures".

Thus, as much as we have to do away with the colonial scientists discussed in Chapter 1, it is also necessary to dispose of the still prevailing colonial organizational culture. This issue relates to psycho-cultural factors as Mihanjo (2010: 4) describes:

> "Institutional and staff personal behaviour is mostly a result of colonial legacy, and the African traditional subsistence economy and kinship affiliation play a major role in the economic results that Africa achieve today. State institutions are not simply weak, but they also condone colonial practices in governance".

Even the physical setting of public offices in Tanzania is in most places reminiscence of old colonial architecture, certainly in the rural areas. E.g. entering a district office is through long, narrow corridors with a row of doors with numbers and names. When you finally find the District Commissioner's office, you get to a small room with a narrow desk and are often asked to take a seat next to other visitors. When you finally are called in to the 'boss' you find a very large room with a big visitors table, and even very comfortable low seated chairs; and you have sign up in guestbook before you can get to the point of your visit.

Box 15.1: Example of physical architecture setting in public offices in Tanzania.

Certainty it also needs to be said, that getting to more detailed pictures of what the needed reformulated state should look like depends on the particular national scenario in question, e.g. on 'intangible' conditions like social values, culture, tribalism, sexism, kinship and even prejudice (Mills 2010).

Here we again refer to the major framework depicted in Figure 3.4 including the social relations of production, the overall socio-political setting, the natural resource environs and the historical & cultural background, all which, as said, drastically differ from place to place around the world.

Outline for further research

At the more detailed national level we recommend that social- *and* technology-scientists get together and take point of departure from the jigsaw puzzle in Figure 2.2, and primarily look at the diverging formal and informal contextual conditions of technology outlined in Table 14.1.

The research questions would be to get to grips with *how* and *why* are the formal and informal contextual conditions diverging? And *what* needs to be done in order to harmonize the formal and informal settings?

Not an easy task since, as said, none of the contextual jigsaw conditions are independent of the other contextual jigsaw pieces. E.g. harmonizing the state regulations will influence the market conditions; or changing the social division of labour conditions will impact the labour relations; etc.

And all along, the possible changing contextual conditions will have repercussions for the technology bits and pieces in question.

Anyway, the outcome could be the much needed closer link between the formal and the informal systems of innovation, and thus between the hitherto diverging technology transformation paths.

Another way to explain this would be to make the formal sector (1) and the informal sector (2) turn in opposite directions of what was shown in Figure 14.2, so that they may one day merge and fully overlap each other as indicated in Figure 15.1.

We hope by this book to have indicated that the human resources in the rural informal sector, in its widest sense, are there – ready to be mobilised – and BEFIT FOR CHANGE.

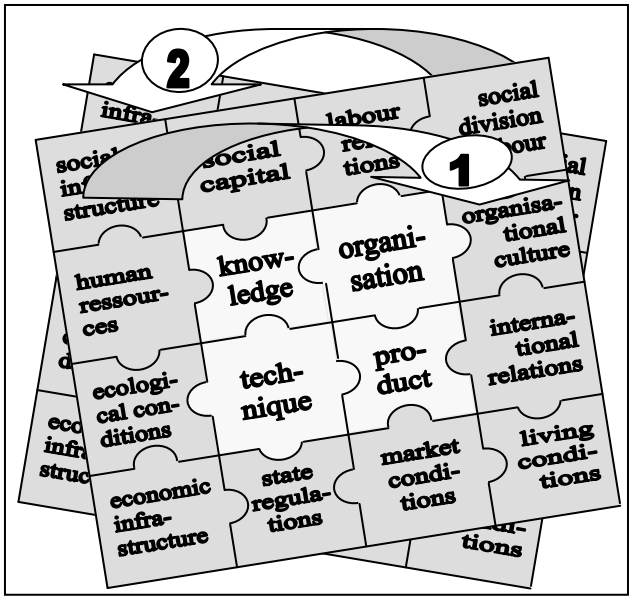


Figure 15.1: Formal sector (1) and informal sector (2) settings merging together

15.3 A post-pessimist outlook

The outlook may seem grim since

> "relatively few companies with worldwide connections dominate the four intersecting webs of global commercial activity on which the new world economy largely rests: the Global Cultural Bazaar; the Global Shopping Mall; the Global Workplace; and the Global Financial Network - - The driving force behind each of them can be traced in a large measure to the same few hundred corporate giants" (Barnet & Cavanagh 1994:15).

Therefore we find that the call of Hines (2000: vi) makes sense:

> "to protect the local, globally … which involves a move away from acquiescence to the theology of globalisation towards considering the possibility of its replacement with a localism that protects and rebuilds local economies worldwide".

As regards the international or supra-macro level, and related to the presently globalising so-called market mechanism – or what may even could be termed 'market terrorism' – we end by quoting Mittelman (2000: 128):

> "at present, a counterthrust to neoliberal restructuring is emerging in what might be called the stirrings of *transformative regionalism*, i.e., a regionalism grounded in civil society, more as a future prospect than as a current phenomenon".

And Amin (1997: 102) points to the present crises management of the world capitalist system, and states that:

> "we cannot escape the crisis and the risks of regression to fascism without breaking categorically with the logic of neoliberal globalization";

and in reflections on a counter-project he suggests:

> "a new conception of regionalization, different form that encapsulated in the present framework of power relation" (ibid: 105).

In any event, we need to do away with the prevailing 'Afro-pessimism' (Bourenane 1992) and what we may term 'Latin-America-pessimism'.

Such pessimisms are inter alia nurtured by the governments in power. Squeezed as they are by demands for budget cuts, they have to tell their peoples to pay for most of the public social services. Moreover, the more they ignore the contributions to the GNP from the informal sector, the poorer they *statistically* appear; this then reinforces their arguments for foreign assistance and debt relief. Parallel to this, the overstated poverty records are also maintained by the development assistance industrial complex, as well as by the world media consortia.

Not because there is any reason to be optimistic on the part of the craftsmen in the informal sector. We know too much of what is happening there. But the pessimism creates a sense of defeat, is fatally hindering clarity, and is an expression of lack of creative imagination. Our records and studies of the informal sector fortunately gave us the necessary inspiration to mobilise our imagination and to abandon this pessimism.

For as Jevtusjenko, a Russian writer, recently said in a TV-interview:" The optimist has too little information" (about what is going on), but "The pessimist has lost his imagination" (about what might still happen).

The records and studies in this book of the informal sector hopefully give the necessary inspiration to mobilise our imagination and to abandon the prevailing pessimist outlook.

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