

# **The Position of Higher Education in the National System of Innovation: The Case of Tanzania**

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# The Position of Higher Education in the National System of Innovation: The Case of Tanzania

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## 1. Introduction

The major objective of this short paper is to describe the Tanzanian National Systems of Innovation, and within it, describe the role of higher education. However before doing this, it is imperative, albeit briefly, to situate Tanzania economically.

Tanzania is one of the poorest countries of the world, with about 50% of the population living below poverty line. It is predominantly agrarian, with agriculture contributing about 50% to the GDP and engages over 80% of the total population. Another significant contribution to the GDP comes from the service sector which contributes about 39.3%. The manufacturing sector which is the most powerful engine of structural change and modernization of the economy contribute only 7.6% to the GDP and contribute less than 1% to export. The technological base of the sector is very weak, with none of the firms having R&D departments, and having very weak linkages with government R&D organizations and universities. A study of 50 randomly selected manufacturing firms in Dar es Salaam indicates that only 2 out of 50 industrial firms have some forms of contacts with universities and R&D Institutes (Diyamett, 2005). On the other hand the agricultural sector which is considered as the back bone of the national economy has been growing by only 3% over the last decade. This growth is considered unsatisfactory because it has failed to improve the livelihood of the rural population hence perpetuating the existing pervasive poverty among the farming communities. Despite the large untapped land resource, Tanzania's agriculture has remained subsistence farming with smallholders who cultivate 85% of the arable land working between 0.2 and 2.0 ha with an average per capita holding of only 0.2 ha per household. The major limitation on the size of land holdings and utilization is the heavy reliance on the hand hoe, which sets obvious limitations on the area of crops that can be grown using family labour (Shetto R.M 2005)

As indicate above, the Tanzanian economic trend is far from being adequate, even for a moderate socio-economic development. There are indications, however, that there are or rather there will be efforts by the government to redress the situation as stipulated in the Tanzanian Development Vision 2025. Quoting one of the major statements of the Vision: "... by then the economy will have been transformed from a low productivity agricultural economy to a semi-industrialized one, led by modernized and highly productive agricultural activities, integrated and buttressed by supportive industrial and service activities - a solid foundation for a competitive and dynamic economy with high productivity will have been laid".

The above vision statement on the structural change in the economy can only be brought about by good and well performing national systems of innovation, where the university has a unique role to play, not only in contributing knowledge for innovation in the productive sector, but also, and above all, contributing knowledge on the dynamics of the national systems of innovation for policy purposes. In the section that follows the current national system of innovation in Tanzania is briefly explained with the view to ascertaining the role of the university in redressing the situation. Section three is devoted to the role of the university in the national systems of innovation. And finally in conclusion, an attempt will be made to project the road ahead.

## 2. The state of the Art of the Tanzanian National Systems of Innovation (NSI)

### 2.1 General Concept of NSI

The word innovation goes beyond a mere generation of a new idea or invention, to actually include the process of putting the new idea into the market place. The central actor in the innovation process is therefore the firm or farm. However the firm or farm is only, but one of the many actors to successfully bring the new idea to the market place - innovation is basically a multi actor field! This is the basic foundation of the literature on the national systems of innovation. According to pioneers of the concept, NSI is that system which is constituted by **elements** and **relationships** in which the *production, diffusion, use* and *transformation of new and economically useful* knowledge takes place. The concept of elements here basically refers to two major components of the system, **organizations** and **institutions**. Institutions include things like policies, rules, regulations and norms. On the other hand organizations are formal structures where things happen. Examples of organizations include, industrial firms (producers and suppliers), farms and farmers associations and other economic and social agents, universities, S&T policy organizations, regulatory bodies, R&D organizations and financial organizations.

Each of the above organizations has a crucial and specific role to play in a given national systems of innovation. The NSI concept in the innovation process basically emerged as result of the realization that innovation is basically a collective endeavour and is largely facilitated by the interactive learning between different actors, as against the traditional linear model of innovation where innovations are believed to be triggered by basic research in science, resulting into widespread use of new processes and products. The NSI concept emerged as a result of the total failure of the linear model - experience the world over has shown that it is not enough to train a lot of scientists and equip laboratories well, hoping this will automatically produce a sound socio economic development. A network of actors, where scientists constitute only part, is required! For the poor developing countries, the NSI concept is also an attempt to move away from the **production system** policies of the 1970s that emphasized short term increase in the production volumes at the expense of interactive learning between and among economic agents with impacts that are most desirable, long term and sustainable. In the system of innovation approach, interdependencies and interactions between the system elements is one of the most important characteristics; innovations are not only determined by the individual elements of the system, but also by the relations between the elements which are enhanced by appropriate institutions. Specifically, in shaping and directing innovative activities of economic agents, institutions have the following functions:

- To reduce uncertainty
- To manage conflicts and cooperation
- To provide incentives (Edquist, 2002)

Experience elsewhere indicate that without proper functioning of the national systems of innovation it is impossible to attain any meaningful socio-economic development -there is a general consensus on the concept of techno-economic development. An organic relationship between the socio-economic system, and the science and technology system which is largely responsible for much of the development observed in more developed countries is vital for the achievement of meaningful development and sustaining it. Science and technology institutions and organizations have been created as demanded by the socio-economic system

to the extent that there is now an appreciable integration of socio-economic systems and science and technology systems.

On the other hand, in most developing countries, especially Sub Saharan African countries, the system is made up of islands of socio-economic and science and technology institutions and organizations. Much of the S&T infrastructure has been developed in response to pressures and motives outside the requirement of the social and economic system and specific country environments. For instance, most of the Science Councils or Commissions existing in most African countries are, to a large extent, an imposition from international organizations such as UNESCO.

It is also important to note that the system of innovation is context specific. Much as there are some general common characteristics globally, most of the system elements, their relative importance and the way they interact are unique for each country. This is also true for various sectors in the same country.

## **2.2 State of the Art of the Tanzanian NSI**

The state of the National Systems of Innovation (NSI) in Tanzania is partly reflected by the state of the national economy discussed in the introductory section. The state of affairs in the agricultural and manufacturing sectors to a large extent portray the extent to which the NSI in Tanzania is underdeveloped. In terms of basic infrastructure, however, viz. existence of organizations and blue print policies, the system appreciably developed, but very weak in terms of linkages which are a very crucial characteristics of any system. The following is a brief state of the art of the Tanzanian NSI.

Research and development activities in Tanzania date back to the year 1892 when the German colonial administration established the first agricultural institute at Amani in the Usambara Mountains. The main objectives of agricultural research at that time was to support the development of the plantations of export crops (sisal, coffee, tobacco and ground nuts, etc) grown either by foreign companies or individual settler farmers (Liwenga 1988). By the late 1990s the R&D system had expanded to 62 research institutes and/or centres spread throughout the country and had become more diverse, covering agriculture including livestock and forestry (28), industry (4), medical (11), wildlife and fisheries (4), and 5 universities and/or higher learning institutions where R&D is being undertaken ( COSTECH statistics). In terms of funding, the total R&D funding is estimated at 0.35 per cent of GDP, down from around 0.5 per cent in 1984. More remarkable is the fact that, R&D is conducted almost entirely in the public sector (Wangwe, S.M, Diyamett, B.D and Komba A (2003).

As earlier pointed out the major weakness of the Tanzanian Innovation system is lack of linkages between the R&D organizations, including the Universities and the productive sector. Apart from some few isolated initiatives at the universities and some R&D organizations, the systems in general exist as isolated islands. Notwithstanding the above, however, there is an appreciable difference between sectors and sub-sectors. A study of three sectors, viz. agriculture, industry and health indicates that there are better linkages within the health sector followed by agricultural sector, especially the cash crops sub-sector sector. The situation in the manufacturing sector is worst - there is virtually very little connection between R&D and the manufacturing industries (Wangwe, S.M; Diyamett, B.D; and Komba A (2003)). The large scale industries are not interested in the products of the R&D. This is apart from few which collaborate with the universities and some R&D organizations only in

terms of consultancies. On the other hand small scale industries consider R&D organizations as their competitors. This is because with the advent of economic liberalization and government budget cuts, most of the industrial R&D organizations have been left alone in terms of funding for their R&D activities. In order to survive, such R&D organizations have had to somehow turn themselves into small scale manufacturing firms. However, as it will be discussed in section three; there are currently some initiatives by the University of Dar es Salaam to assist the small scale industries in terms of technology development.

### **2.3 The Role of Higher Education in the Development of the National Systems of Innovation**

As earlier explained, higher education organizations such as universities are one important actor in the NSI. Universities have, since time in memorial, collaborated with the industry as part of fulfilling their basic functions. The role of this actor is increasingly becoming more important, or crucial, and the nature of the collaboration is changing as the world gets more globalized. Universities and other higher learning organizations are key players in domesticating knowledge and diffusing it into the national economy. As frontiers of technology rapidly move and competition between industrial firms and nations becomes fierce, the industries have, therefore, tended to turn to higher education for assistance to keep abreast with the frontiers of knowledge. On the other hand, the universities in the developed world, are increasingly gaining monies for research from the industry and thereby becoming more competitive themselves. This is the typically the phenomena in Europe and the US, where more than 50% of the research funds come from the private sector. But how can such relationship and cooperation be optimized for the mutual benefit between the industry and academic institutions? The Business and Industry Advisory Committee to the OECD has proposed the following principles within which these two actors can cooperate in the future:

- Each academic organization, just as is the case for companies, must identify the niche area where it can achieve excellence in respect of some or all of its research and teaching functions.
- Where collaborations between universities and industry are valuable and have become more substantial than in the past, these serve to extend and enhance, not replace the distinct primary roles that players exist to perform.
- Partnership will add value by combining strengths and overcoming individual weaknesses, and equal partners will expect to know what the other seeks to achieve and how this will happen. No long-term benefits can be expected by encouraging collaboration that do not build on strengths, that permit hidden agendas, or that require numerous players to work together on tasks that are better done by one or two (OECD, 2003).

The above principles are based on the environment of the OECD countries where technology employed in most industrial firms is to a large extent science intensive. Will the same principles be applicable to poor developing countries such as Tanzania? For instance, is it correct to talk of equal partnership between the universities and small scale firms which have at least turned to the universities for some help; especially because these firms can not pay for the consultancies? On the other hand, will the scientists at the universities be interested in the work of the firms which employ a very low level of technology? These are very crucial questions to raise as we embark on the long term and sustainable collaboration between the universities and small scale industries.

According to some anecdotal information, the challenge in the OECD countries is more likely to come from the fact that the universities tend to pay less attention to their traditional roles, and concentrate more on the requirement of the industry. This seems to be contrary to the situation in the poor developing countries where universities seemed to be more comfortable with their traditional roles than work for the industry, largely because of the dichotomy that exist between science and technology.

### **3. The Tanzanian University System**

#### **3.1 General**

A university is an institution of higher learning, a place where peoples' minds are trained for clear thinking, for independent thinking, for analysis and for problem solving at the highest level. The three major functions of a university as follows:

- To transmit advanced knowledge from one generation to the next so that it can serve either as a basis of action, or a springboard to further research;
- To provide a centre for the attempt to advance the frontiers of knowledge; and
- To provide through its teaching for the high level manpower needs of the society.

A university, whether of science and technology or otherwise, is thus characterised by its ability to advance knowledge and search for new frontiers of knowledge. University training imparts knowledge and understanding of methods, principles and concepts, and emphasizes research, including basic research and scientific thinking. The University being the collector, distiller, repository and dispenser of knowledge is an important partner to the government in applying this knowledge to the objective analysis of the national challenges in terms of policies, governance, socioeconomic development, sustainable growth, prioritisation and sequencing of development actions; and providing objective prescriptions and predictions.

Tanzania has about ten universities 5 of which are public while the remaining 5 are private. The University of Dar es Salaam (UDSM) is by far the largest and oldest, with a student population of 15,000 which is more than 70% of the total population of university students in the country. UDSM also offers the largest variety of training programmes in the country. With effect from this year (2005), all universities in the country, public or private, are governed and regulated by the new Universities Act No. 2 of 2005. Whereas public universities receive subvention from the Government, private universities are owned and financed by private organisations, religious groups and even individuals.

The government has invited to contribute to the revitalisation of university education by:

- Opening quality universities that offer courses which are relevant to Tanzanian's social and economic priorities;
- Financing research and awarding contract consultancies to our own universities;
- Practising corporate philanthropy through award of scholarships and funding of professorial chairs;
- Establishing student loan schemes and education endowment funds; and
- Striking a healthy and mutually supportive working partnership with local universities.

Since 2004, there is also a Higher Education Students Loan Board Act which has established a Students Loan Board for the purpose of administering loans to higher education students in public and private institutions of higher learning.

### **3.2 The University of Dar es Salaam**

In a speech to the community of the University of Dar es Salaam, in 1999, the President of Tanzania challenged universities in the country to play a pro-active role in redefining the mission of their institutions, and revitalising their programmes and activities by:

- (i) Formulating, implementing, monitoring and evaluating their strategic plans;
- (ii) Making optimal use of existing facilities throughout the year in order to enhance enrolment rates, and to generate more income;
- (iii) Taking maximum advantage of the governments' resolve to use universities for contracted research or consultancies in order to raise more funds while at the same time contributing to internal capacity building;
- (iv) Increasing teaching and research capacities in selected academic spheres that are vital for Tanzanians; and
- (v) Reviewing and updating the curricula offered so that it becomes relevant to the changing economic, technological and labour market needs of Tanzania.

As far as UDSM is concerned, the Corporate Strategic Plan which was approved by its Council in 1994 has defined the mission of the University of Dar es Salaam as:

- a) To endeavour to excel in knowledge and human resource capacity building without either sacrificing quality against quantity, or falling prey to elitism;
- b) To build its distinctive characteristics and trade mark under the label of "scientific professionalism", to be acquired through the prime principle of integration of research, teaching and consultancy at the immediate subject area;
- c) To further an image of the University of Dar es Salaam as a centre of excellence in terms of knowledge creation, skills development, effective entrepreneurship and formation of a responsible attitude for the betterment of the society and as an example of good management;
- d) To be the main supplier of key policy makers, experts and personnel in charge of all key positions in industry, public institutions, government, private institutions and NGOs;
- e) To endeavour to hold the top rank nationally and regionally with assurance of a well recognized rank internationally in terms of quality, relevance and reputation.

The Strategic Plan contains the following objectives for the University of Dar es Salaam:

- To preserve, transmit and enhance knowledge;
- To stimulate and promote intellectual, cultural and technological developments; and
- To create a sense of public responsibility in the educated and to promote respect for learning and pursuit of truth.

## **4. Cases Illustrating the Role of the University in the NSI**

### **4.1 The College of Engineering and Technology**

#### ***4.1.1 The Set-up and Objectives of CoET***

The CoET set-up has been designed to be more responsive to the needs of the Tanzanian society and able to serve it better than ever before, through its three main pillars, namely: (1) the three Faculties of CEBE, ECSE and MECHE; (2) the Technology and Transfer Centre (TDTC); and (3) the Bureau for Industrial Cooperation (BICO). Both TDTC and BICO are virtual units which depend on manpower from the 3 faculties and hence the need for close coordination of these three pillars of CoET. In addition, there is a close linkage between BICO and TDTC in offering some of the community services since both are outreach units.

In line with the CoET set-up, the strategic functions of the three pillars of CoET have been formulated such as to address the following inter-related strategic issues:

- Motivation and retention of CoET staff to ensure sustenance of achievements made to-date and further development towards realization of its vision and mission;
- Stimulation and promotion of enhanced innovativeness and competitiveness of firms and farms in the country;
- Stimulation, catalyzation and promotion of national sustainable growth and poverty reduction;
- Enhanced support of needs of local entrepreneurs for technology management, innovation and business creation;
- Provision of think-tanks to direct and spearhead national sustainable development.

In order to realize its vision it has been necessary for the CoET to formulate clear strategic direction to follow. The same has been done in line with the strategic direction of the University and after carefully evaluating the external environment. The strategic direction is characterised by specific strategic objectives in the areas of Teaching and Learning; Research and Publications; Consultancy and Services to the Public; Organisation, Management and Culture; Optimisation of the Utilisation of Human and Physical Resources; National and International Linkages; Mobilisation and Management of Financial Resources; and Marketing and Public Relations.

In summary, the basic objectives of the CoET are:

- To supply the country with sufficient middle and high level engineering human-power as agents of development and change, thus contributing to the indigenous development of infrastructure, industry and trade;
- To perform research in the interest of suitable exploitation and local processing of natural resources in Tanzania, ultimately leading to the innovation of technical products and production processes for the local industry; and
- To provide expert professional services in the form of consultancy to industry as well as public and private organisations and institutions.

Achievement of these objectives hinges on the synergic interaction of the three pillars of CoET, namely; the three Faculties, TDTC and BICO.

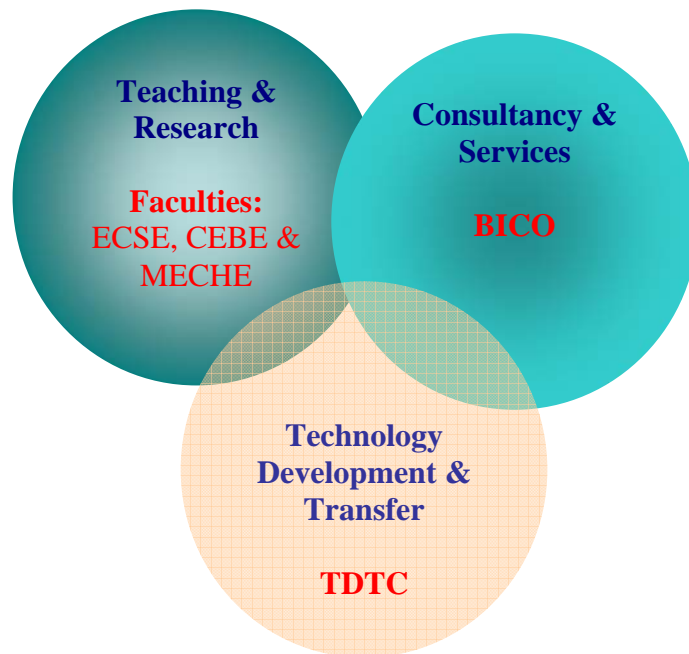


Figure 3: The synergistic interaction of the 3 pillars - the Faculties, TDTC and BICO

**(i) The Faculties**

The three Faculties of CoET, viz. Civil Engineering and the Built Environment (CEBE), Electrical and Computer Systems Engineering (ECSE), and Mechanical and Chemical Engineering (MECHE) are responsible for academic training and research through the 12 academic Departments. All academic staff members and most technical staff members belong to academic Departments. All laboratories and most workshops belong to teaching Departments. Thus the three Faculties are the custodians of most of the techno-ware and human-ware available at CoET.

Among the main outputs from the Faculties are BSc, Masters and PhD graduates. Thus, the Faculties through their respective academic Departments are solely responsible for the realization of Basic Objective (ii)(a) above. The Faculties are also solely responsible for research up to when technology development is evident as an outcome of the respective research activity. Otherwise the most obvious outputs from Departmental research are the publications on the activities and the results.

**(ii) The Technology Development and Transfer Centre (TDTC)**

Research, in the widest sense, is the basis for the development of any society. It has an important role of advancing and defining knowledge and providing solutions to problems facing the society not only in the local, but also within the wider international context. If a society lacks the indigenous capacity for research for development or the capacity to manage technological change, it becomes totally dependent on the outside world. Development in science and technology (S&T) is therefore not only an important determinant of a country's level of development, but also enhances its international competitiveness and its position in the world economy.

It has been strongly argued in some international circles that the generation, dissemination and application of knowledge will have to become a principal function of leading Africa's universities if the continent is to survive and thrive in the knowledge society of the twenty-

first century. The economic importance of access to and ability to benefit from modern, research-based technologies in recent years cannot be over-emphasised.

Research based technologies can both be locally developed and brokered from elsewhere. In the former case, research capacity is necessary for the development of the technology while in the latter case the same is required for the proper selection, adaptation and further development of technologies acquired from elsewhere.

The CoET recognizes its role towards achieving national socio-economic advancement through the proper selection, adoption, adaptation and further development of technological solutions as well as development of appropriate and sustainable technologies. It is thus intended to involve all academic disciplines of the College in prototype development and technology transfer. All technology (prototype) development by College staff, technology brokerage as well as the subsequent transfer to industry is being coordinated by the Technology Development and Transfer Centre (TDTC).

It is felt that a broker approach to innovation and technology transfer has the potential of significantly increasing the impact on socio-economic development in the country. Next to developing indigenous technology, it is imperative to ensure efficient absorption and adaptation of imported technology appropriate to national priorities and resources. This entails that the College makes arrangements for technology information exchange with, at least, some leading international technology transfer centres.

TDTC aims primarily to impact on the development of SME's and on the lives of the general public through the development and dissemination of technologies that have direct relevance to the Tanzanian society.

### **(iii) The College BICO**

BICO was established in July 1990 to fulfil the following objectives, among others:

- (a) To enhance the capability of CoET to contribute effectively in the industrial development of Tanzania through the provision of consultancy, expert professional services and professional advancement (or development) of engineers and technologists;
- (b) To enable the College generate funds to subsidise grants from the government and other donors for the College to meet its financial needs;
- (c) To enable the staff in the College supplement their income and thereby enhance staff retention in the College;
- (d) To optimise the use of the College expertise and resources to solve societal engineering and technology related problems;
- (e) To provide means for academic and other College staff to gain professional experience that shall be transferred to students and thereby improve quality of outputs;
- (f) Make available College training facilities to the general public through short term and medium term courses for the purpose of ensuring that engineers keep abreast with the rapidly advancing technology;
- (g) To acquire knowledge on new developments and needs in the trade and adjust curriculum accordingly;
- (h) To provide expert technical support to existing industrial operations and facilitate developments of new industries;

- (i) To facilitate establishment and enhancement of contacts and relations between College staff and industries; and
- (j) To provide a platform through which the College staff can transfer their knowledge and skills to industry, to the society.

#### ***4.1.2 The Innovation Systems and Innovative Clusters Initiative***

Innovations in the form of new products, services and processes or improvements thereof are the basis for sustainable growth and prosperity in a knowledge-based society. The fundamental factors necessary for the development of innovations include skills, exchange of knowledge and opportunities for mutual learning as part of the interaction between business, research institutions and political bodies. Research produces new knowledge, but in order to promote growth it must be translated into innovations, which produce new and/or improved products, services and processes for which there is clear demand.

It has been argued that firms that operate close to related firms and supporting institutions are often more innovative and therefore more successful in raising productivity than firms that operate in isolation. The innovative cluster approach is thus an appropriate and established tool for analysis of industrial dynamics and for policy initiatives to foster innovations, growth and economic development. The challenge embodied in the innovative cluster approach is how to best organize and manage clusters in order to exploit their maximum potentials. Currently *cluster initiatives* are being launched, in nearly all regions of the world. An understanding of the concept and the salient features of innovation systems and innovative clusters, and the critical factors for building and improving them are important prerequisites for Africa to become part of this global initiative.

Arising from consideration of the facts mentioned above, the Faculties/College of Engineering at three Universities in Eastern Africa namely; the Faculty of Engineering at Eduardo Mondlane University, the Faculty of Technology at Makerere University and the College of Engineering and Technology at the University of Dar es Salaam have to date organized two Regional Conferences on Innovation Systems and Innovative Clusters in Africa. The first Regional Conference was held in February 2004 with a view to creating awareness among African participants about concepts of innovation systems and innovative clusters, appreciating the state-of-the-art of innovation systems and innovative clusters and their effectiveness in stimulating industrial and socio-economic development in Africa, and affording participants the opportunity to brain-storm on what could be adopted and adapted to speed up industrial and economic growth in Africa. The second one was held in March 2005 building on the successes of the first conference and confirming the importance of getting Africa to join other regions of the world and adopt the innovative cluster approach.

One of the important outcomes of the first Conference was an Action Plan towards promoting the development of innovation systems and innovative clusters to speed up industrial and economic growth in Africa. The Conference also facilitated the creation of more awareness, among the various actors, about issues related to innovation systems and innovative clusters, and management thereof.

After the regional conference, each participating country held a national stakeholders workshop in which issues pertinent to the particular country were discussed before the second regional conference was held in Uganda in March 2005. One of the key resolutions of the

second regional conference was to initiate and spearhead the establishment of an Innovation Systems and Clusters Programme in Eastern Africa (ISCP-EA).

#### **4.1.3 Collaboration with Tanzania Gatsby Trust (TGT)**

Tanzania Gatsby Trust (TGT) is a charitable organization, established in 1992, committed to the support of Small and Medium Scale Enterprises (SMEs) and alleviation of poverty in Tanzania through credit provision, marketing development training and technology transfer. TGT receives funding from the Gatsby Charitable Foundation and the Ashden Trust of the United Kingdom. CoET and TGT started collaborating in the field of technology development and transfer (TDT) in 2001. To this end, a Memorandum of Understanding (MoU) was signed between TGT and CoET in 2001.

The specific objectives of the CoET-TGT collaboration include the following:

- To assist SMEs access various technologies developed or brokered by CoET ;
- To provide assistance to a select group of CoET students in developing final year 'projects' of direct relevance to identified SMEs;
- To facilitate the development of business plans for specific SMEs using members of the University units mentioned above;
- To carry out research and development of new prototypes for SMEs.

To-date the following activities have been undertaken as part of the CoET-TGT collaboration:

- ☞ Student projects that have relevance to SMEs;
- ☞ Country-wide survey of SMEs status and needs in Tanzania;
- ☞ Establishment of a National Technology-based SME Incubator Programme;
- ☞ Establishment of SME clubs (Gatsby Clubs)
- ☞ Feasibility study on shelter/housing in Zanzibar, Rukwa, and Mtwara regions and house construction in Zanzibar.

##### **(i) Student Projects**

Some of CoET's students are now doing final year projects with SMEs, and some of the graduates are engaged in solving real problems of such SMEs. So far, a total of 55 student projects have been executed, 10 projects in 2002 and 15 each year since 2003. In 2002, all the projects were in the food processing area. From 2003, however, the scope was widened to cover other disciplines while emphasizing stronger SME collaboration.

##### **(ii) SMEs' Survey and Sectoral Mapping**

The performance of SMEs in the country have been known to be low with most of the enterprises being in financial difficulties. However, specific problems that these SMEs are facing and what should be done to solve them were not specifically known. Thus it was resolved to conduct an SME survey, which would provide the information needed. CoET with the support of TGT conducted the survey and now there is reasonably sufficient information to design solutions to deal with the observed problems.

The survey has also provided information on a sectoral distribution of SMEs in the country which will facilitate the intitation of the establishment of SME clubs and the development of

innovative clusters. Clusters are defined as geographical and sectoral agglomeration of enterprises. The distribution of SMEs in different regions of Tanzania has been developed from the information obtained from the study, where it was seen that in most regions, carpentry or wood work is the dominant sector, followed by metal work and then food processing.

From the survey, the major findings can be summarized as follows:

- The majority of SMEs are not satisfied with the performance of their enterprises mainly because of underperformance of their equipments and lack of market for their products;
- The source of capital needs to be diversified, many are depending on personal funds, which are limited;
- Technology and machinery are among the first items that SMEs would like to change if they had an opportunity to do so. This therefore is a challenge for CoET to respond;
- Most SMEs were not aware of the existence of the then IPI, FoE-UDSM and FoE-BICO, and now pCET, College TDTC and College BICO, etc. There is a need to create more awareness of the existence of such institutions among the SMEs;
- Most SMEs feel that the move by TGT to support the link between CoET and SMEs is noble. The challenge now remains for the respective parties to make the link effective and useful.

### **(iii) Technology-cum-Business Incubation**

Technology/business incubation and brokerage are amongst the most effective strategies for technology transfer and hence the realisation of practical applications of research results. The CoET-TGT collaboration programme has technology incubation as one of the areas to be addressed. The Carnegie Corporation of New York is also financing part of the project.

COET technology incubator activities are carried out at three localities which have shown good potential, including response by the local actors, namely; Kibaha, Morogoro, and Lushoto. Each of the localities has a Local Coordinator. Teams have been formed and assigned to each of the localities. The activities being undertaken include:

- Analysis of the respective local economy;
- Assessment of the prevailing technology levels;
- Social-cultural analysis of the target area;
- Specification of basic incubator design features;
- Assessment of available support for alternative incubator options;
- Detailed characterization of the target group;
- Preparation of business plans for both the incubator and tenants.

It is expected that the three incubators will be operational by the end of this year, 2005.

### **(iv) Establishment of SME/Gatsby Clubs**

One of the ways through which the TGT-CoET project can deliver the services to SMEs is through incubation as described above. However, the number of SMEs, which need services, is quite large and the process to establish incubators is quite lengthy. Furthermore, even when the incubators become operational, only a few of the SMEs will be accommodated. An alternative to this is the establishment of SME Clubs through which all kinds of support and

services may be channelled. Establishment of the SMEs Clubs will also facilitate networking, and the dissemination and acquisition of various technological innovations as will be required by the SMEs. Thus, in 2004 among other things, the following activities were implemented towards the establishment of SME Clubs.

- (i) Organisation of study visits for TGT club/clusters members to learn best practices of similar clubs in Uganda and link clubs/cluster and members to TGT credit lines.
- (ii) Identification of technologies to be developed and disseminated and linkage of the same to SMEs for acquisition through special TGT credit lines.
- (iii) Establishment of a link between clubs/clusters and the incubators to be developed so that clubs can also benefit from the incubator services. The clubs then can serve as “satellite” incubators with links to “Mother” incubators in the few areas that have been identified (Mother-satellite relationship)

It envisaged that the take-off of clubs will accelerate technology delivery to SMEs, and thereby strengthen the University-Industry linkage further.

## **4.2 The Faculty of Science**

Just like COET, the Faculty of Science has also been involved in research programs or activities that have direct relevance and impact to the society around. The case of research in mushrooms, which is increasingly a growing business in Tanzania, is instructive. The Faculty, in collaboration with farmers has been able to identify types of mushrooms with medicinal value and other uses. However much of the Faculty’s research has tended to use a technology push or rather science push approach to produce knowledge that is extremely useful for the Tanzanian Health Sector, but very little has gone outside the doors of their laboratories.

For more than two decades the Faculty of Science of the University of Dar es Salaam has actively been involved in research on the Tanzania indigenous plants for natural chemicals that have medicinal potential. A number of scientific discoveries have been made from this research, particularly focusing on bio-molecules that have anti malarial properties. Among some of the discoveries are antimalarial and trypanocidal compounds (ability to kill parasites that cause sleeping sickness) (Nkunya (2003)). Surely this is a very relevant research outputs in the context of a country that is disease stricken such as Tanzania. However, very little, if any, has gone outside the doors of the laboratory. Reasons for this are many, but the most obvious is the conspicuous lack of visionary business leaders and entrepreneurs who can turn these into viable pharmaceuticals. That is, capabilities for investments into pharmaceuticals are very weak. What a country like Tanzania needs therefore is spin off companies that are led by researchers themselves. This however should not be taken as a panacea- For the development of new technology based firms, experience elsewhere (developed countries for that matter) has shown that there is no short cut to the rules of the game. It is normally a result of a great deal of tenacity, hard work and courage! In terms of time, the formation of a high tech industrial venture will take at least some decades, and the requisites are strong research base, smart people (a well educated labour force), visionary entrepreneurs and a community of high-tech business leaders and smart capital (ITAC, 2002).

## **4. The Road Ahead**

As argued in this document, Tanzania remains a poor and non-industrialized country; heavily relying on agriculture which itself is well underdeveloped. Although there are some isolated

good cases, the S&T system as a whole is not optimized to influence innovativeness in firms and farms; above all there is very weak linkage between R&D organizations and the productive sector. Most of the research conducted, especially from the Faculties of sciences are not put into practice. How can this situation be redressed? What would be the role of the universities? Important in this is the balance between traditional roles of the universities and new and emerging roles in response to the society needs. This is especially important for the faculties of natural and engineering sciences, as there is a big problem of dichotomy between science and technology in countries such as Tanzania. While science is global, technology is local, and unfortunately at a very low level.

The above raised issues are big issues and have largely arisen from the cases from only one university. It is possible to respond to them only when all well established universities in Tanzania have been surveyed in terms of their changing roles, and how they are addressing issues related to knowledge production and transfer for socio economic development. In relation, it is imperative to also look into universities such the Sokoine University of Agriculture (SUA), University Colleges such as University College of Lands and Architectural Studies (UCLAS) and Muhimbili University College of Health Sciences.

Apart from inquiring into the university relation with the productive sector, attempt will also be made to look at the relationship between universities and R&D organizations. We feel university has a role to play in assisting R&D organizations to respond to the needs of the potential users of their research output. It is important to raise questions such as: What relationships currently exist between the universities, R&D organizations and the end users? What should be the desirable institutional arrangements in this case?

The road ahead will also look into the perception of the society at large on the universities.

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