ECONOMIC AND SOCIAL RESEARCH FOUNDATION

(ESRF)

Fostering Technological Capacity Building: The Case of Ethiopia and the United Republic of Tanzania

By Samuel M Wangwe

ESRF Discussion Paper Series No. 006

TITLE:

Fostering Technological Capacity Building in Ethiopia and the United Republic of Tanzania

ESRF RESEARCH PROJECT COORDINATOR:

Prof. Samuel M. Wangwe

PRINCIPAL RESEARCHER:

Prof. Samuel M. Wangwe

EXECUTIVE SUMMARY:

The purpose of this contribution is to facilitate discussion in a Workshop to examine and recommend specific modalities for follow-up action needed to foster the technological capacity-building of select least developed countries. This paper covers two such countries: Ethiopia and the United Republic of Tanzania.

KEY WORDS:

Technological Capacity Building, Science and Technology, Private Sector Development, Enterprise

RESEARCH REPORT NO: *ESRF - D 95 - 006*

ISSN: *0856 - 9754*

ISBN Tanzania: *9987 610 05 6*

DATE: *2 May 1995*

NO. OF PAGES: *21*

PRICE:

This discussion paper is an ESRF publication.

51 Uporoto Street (off Ali Hassan Mwinyi Road)
Ursino Estates
P. O. Box 31226
Dar es Salaam.

Desktop publishing by A. A. Kasango and V. N. Mwanukuzi.

TABLE OF CONTENTS.

LIST OF ABBREVIATIONS

CDTT	-	Centre for the Development and Transfer of Technology
GDP	-	Gross Domestic Product
GSP	-	General System of Preferences
IAR	-	Institute of Agricultural Research
IPC	-	Investment Promotion Centre
LDCs	-	Less Developed Countries
MEIDA	-	Metal and Engineering Industries Development Association
NFAST	-	National Fund for the Advancement of Science and Technology
OECD	-	Organization for Economic Cooperation and Development
R & D	-	Research and Development
S & T	-	Science and Technology
SME	-	Small and Medium Enterprises
TNCs	-	Transnational Corporations
TRIPS	-	Trade Related Aspects of Intellectual Property

ACKNOWLEDGEMENTS

This was a discussion paper presented for UNCTAD's (INT/94/A43) project which was designed to foster the Technological Capability Building in the least developed Countries. An earlier version was presented at the "**Workshop on Selected Cooperation Aspects for Technological Capacity Building in Developing Countries**" organized by UNCTAD and which took place in Geneva between 10-11 April 1995.

I would like to thank Ms Gloria-Veronica Koch of UNCTAD and Meine Peter van Dijk of ING Bank International for the very useful discussions on this subject and for their comments on an earlier draft. Ms. Koch was very helpful in providing me with useful background papers on the subject. It has been possible to complete this assignment because of the cooperation I received from my colleagues, to whom I am most grateful. Comments from the workshop participants also proved most useful. I thank you all.

Any errors in the paper are highly regrettable.

Prof. Samuel Wangwe
Executive Director
Economic and Social Research Foundation
Dar es Salaam
Tanzania.

PREFACE

The idea of undertaking a project specially designed to foster technological capacity-building in the least developed countries was born during the formal and informal sessions of the Ad-Hoc Working Group on the Interrelationship between Investment and Technology Transfer. During those discussions, the need to examine the feasibility of science and technology policy reviews "à la OECD" was highlighted as was the need to explore whether such reviews could be carried out by joint teams of experts coming from both the "project committed" donor developed countries, and from the respective "project committed" least developed countries (LDCs).

In January, 1995, the United Nations Conference on Trade and Development (UNCTAD) commissioned the Economic and Social Research Foundation (ESRF), more specifically Prof. Samuel Wangwe, the Executive Director of the ESRF, to undertake a research project specially designed to foster the technological capacity-building in the least developed countries the results of which would be reported to the appropriate intergovernmental machinery of UNCTAD. Prof. S. Wangwe tackled the case of Ethiopia and the United Republic of Tanzania, while Prof. Meine Peter van Djik, the other consultant commissioned by UNCTAD, looked at the case of selected countries in Asia.

Specifically, an action-oriented report on the approaches and specific recommendations for a co-operation project to foster technological capacity-building in the least developed countries was to be prepared. Science and technology aspects were to be discussed with government authorities, chambers of commerce and industry, and specific individual enterprises or institutions which support research and development, as well as technology adaptation in the selected least developed countries and be incorporated into the report. Previous experiences obtained in this field, the present economic and technological challenges to the country and technological co-operation with developed countries, their enterprises and technological, institutions were to be addressed, and the feasibility of reviewing the S&T policy with the support of interested donor countries was to be considered.

It was also expected that the draft of recommendations would also be discussed with the relevant authorities and development agencies in developed countries potentially interested in supporting technological capacity-building initiatives in least developed countries during the project.

So it was that between the 10-11 April 1995 the report was presented during a Workshop on Selected Cooperation Aspects for Technological Capacity-Building in Developing Countries that took place in Geneva. At the Workshop, co-operation options were examined and specific modalities for follow-up action were recommended.

Following the Workshop the results were to be made available at inter-governmental level and distributed to the various actors concerned; the policy-makers, governmental departments, development agencies, R&D and technology development institutions.

1. INTRODUCTION

The purpose of this contribution was to facilitate discussions during the Workshop aimed at examining and recommending specific modalities for follow-up action that will foster technological capacity-building in selected least developed countries. This paper covers two such countries: Ethiopia and the United Republic of Tanzania.

These two countries are among the poorest in the world with an income per capita of $110 per annum in both cases. Even when compared to other countries in Africa they rank among the poorest. Some development indicators are shown in Table 1.

Table 1: Some Development Indicators: Ethiopia and the United Republic of Tanzania

	Ethiopia	United Republic of Tanzania
GNP per capita Atlas dollars 1992	110	110
Population mid-1992	54.8 m	25.9 m
Annual growth of GNP per capita 1985-92	-2.0	1.9
Life expectancy at birth in 1992	49	51
School enrolment - primary (1990)	31	69
- secondary (1990)	13	5
Net ODA per capita 1992 (in $)	22	52
Gross Domestic Investment as a % of GDP (1986-92)	13.3	34.6

Source: World Bank: African Development Indicators 1994-95, World Bank: Washington, D.C., 1995.

Both countries have introduced policy reforms towards a market economy. The process of policy reform is directed towards improving resource mobilization and its efficient utilization with the view of enhancing growth performance and revitalizing development. The implementation of such reforms has become increasingly complex with a shift from narrow concerns with macroeconomic imbalances and stabilization towards more comprehensive institutional reforms. In this regard, the United Republic of Tanzania has gone further (since 1986) than Ethiopia, as the latter introduced policy reforms only in 1991-1992.

In both countries, the deteriorating well-being of the human population has been associated with difficulties in the deployment of resources to meet essential social needs, especially in the key areas of human resource development such as education and health. Yet growth and structural transformation call for higher levels of literacy, educational attainment and a healthy labour force.

In their efforts to implement policy reforms these countries have received assistance from the donor community. However, due to budgetary constraints in most donor countries there has been little improvement in the external resource inflow in recent years and the outlook continues to be uncertain. Over and above facilitating short-term stabilization and adjustment, the external resource inflow will need to be linked more closely to the long-term development objectives. This will also call for improvements in aid coordination and aid quality in order to enhance aid effectiveness in adapting to the special conditions of individual countries. Indeed in both countries strong concerns were expressed for the need to enhance the effectiveness of aid.

The policy reforms in both countries have made a turn around in the rate of economic growth. However, they have not succeeded as yet in promoting structural change and economic transformation. Supply constraints in the productive sectors have largely persisted. Productivity in agriculture, the dominant sector, remains low and dependent on weather and the sustainable diversification of their economies has largely remained elusive. Low productivity in the agricultural sector poses a threat to the living standards of the majority of the population and threatens the competitiveness of exports which are predominantly agriculture-based products.

2. ETHIOPIA

2.1. The Economy

The economy of Ethiopia was opened to the rest of the world after the Second World War with coffee and hides and skins as the major exports. The infrastructure was geared to serving the export-import trade. In the early 1960s Ethiopia began to pursue an industrialization strategy based on import substitution with successively high tariffs being introduced to support the establishment and development of local industry. Agriculture was and remains to be the dominant sector in the economy. To date, however, the agricultural sector is still backward both in the technology it uses and in the level of productivity. Industry has remained small and import dependent.

Early developmental efforts in Ethiopia were mainly devoted to putting in place social, economic and physical infrastructures. The economy grew at an average rate of 4.3 per cent per annum during 1960-1973. Between 1974 and 1991, Ethiopia was basically a commanded economy, with the State attempting to determine resource allocation and distribution of output by administrative fiat. The decision-making freedom of private economic agents was curtailed during this period. From 1974 to 1990 the rate of growth of the economy decelerated to 1.5 per cent per annum. With the population growing at 2.9 per cent this meant a decline of income per capita at the rate of 1:4 per annum. In particular, after 1988-1989 the economy faced a decline in output with the real GDP falling by 1.6 per cent in 1989-1990, 0.3 per cent in 1990-1991 and 10 per cent in 1991-1992 (Survey of Economic Conditions in Ethiopia, January 1993)[1]. Income per capita during those years declined by 4.3 per cent, 3.2 per cent and 12.6 per cent respectively.

After 1991, Ethiopia decided to shift towards a market economy and promote private sector development. This implied that the role of the State in economic management needed to change. The Government was determined to work through the market rather than against it. In 1992-1993, GDP growth recovered to 7.6 per cent over the preceding year. Agriculture grew at 4.9 per cent while industry grew at 12.9 per cent. The industrial sector suffered a slight decline in 1993-1994 partly because of infrastructural constraints such as power interruptions, lack of demand and shortage of inputs and acing machinery. For instance, a road conditions survey of December 1992 showed that 60 per cent of the length surveyed needed periodic maintenance, rehabilitation or reconstruction (Economic Reform Performance Impact Analysis, Vol. 1, No. 4, May 1994).

The Ethiopian economy is dominated by agriculture which accounts for over 45 per cent of the GDP. Between 1992-1993, the agricultural sector's GDP increased by 4.9 per cent. The main factors behind this recovery included good weather, improved macroeconomic stability and liberalization of agricultural markets. The industrial sector contributes 12 per cent to the GDP of which one third comes from handicrafts and small-scale industries. The sector absorbs 3 per cent of the total labour force, of which nearly half is accounted for by those industries.

Survey of Current Economic Conditions in Ethiopia. Inaugural Edition, Vol. 1, No. 1. A Publication of the Policy Analysis Unit, Ministry of Planning and Economic Development, Addis Ababa, Ethiopia, January 1993.

The Investment Code was revised in May 1992 with a view to encourage domestic and foreign private investment. This investment proclamation liberalized both local and foreign private investment. Foreign investors, in particular, are encouraged to invest or participate in areas that facilitate the transfer of technology and know-how (Tadesse, 1995)[2] By the end of 1994 over 1,200 projects had been licensed with a total capital of 8,959.5 million birr (Report on Macroeconomic Development in Ethiopia, December 1994). However, the rate of project implementation has remained low; only 10.5 per cent of licensed projects are under implementation and 7.7 per cent have become operational.

Public sector reform has taken the form of privatization through the sale of assets and through commercialization and an increased autonomy for the management.

Policy reforms were effected in 1992. The stabilization and structural adjustment measures taken include devaluation of the birr from 2.07 to 5 birr per one US dollar. In May 1993 foreign exchange auctioning was introduced as a first step towards a flexible exchange rate regime.

Trade policy reform consisted of liberalization measures including the removal of export taxes and subsidies and the restructuring of tariffs.

Infrastructural constraints are further illustrated by the ageing fleet of trucks. About half the government trucks and three-quarters of the private operators' trucks were over nine years old in mid-1993. Since the end of 1992, however, foreign exchange made available through the ERRP and favourable credit terms extended by the commercial bank have made it easier for private transport operators to import new trucks.

The previous import financing scheme referred to as the Franco-valuta mechanism (scheme of own imports) was operative during 1977-1992 but too few potential investors had access to this facility.

The main development objectives of Ethiopia are:[3]

(i) To replace a command economy by a market economy;

(ii) To enhance popular participation in economic activities and the decision-making process with particular attention to the decentralization of control over resources in favour of regional authorities;

(iii) To effect the transformation of the existing economic structure;

(iv) To bring about a structural transformation in the productivity of peasant agriculture, and to pursue an agriculture-led industrialization strategy based on the use of local resources including labour (using labour-intensive technology).

---

2. Getahun Tadesse. Selected Cooperation Aspects for Technological Capacity Building Ethiopian Scenario. Paper presented to a Workshop on Selected Cooperation Aspects for Technological Capacity Building in Developing Countries. 10-11 April 1995. Geneva. UNCTAD S&T/COOP.28.

3 An Economic Development Strategy for Ethiopia (a Comprehensive Guidance and a Development Strategy for the Future. Ministry of Planning and Economic Development, Addis Ababa, September 1993.

Among other things, the transitional economic policy has stressed the expansion of both the rural road network, and the distribution and use of fertilizers and improved seeds, and the strengthening of extension services for agricultural workers and pastoralists;

(v) To forge links between various sectors of the economy, especially between agriculture and industry;

(vi) To enhance the expansion and diversification of exports.

2.2. Ethiopia: Science and Technology

The transitional Government of Ethiopia has identified S&T development and its utilization as one of the priority sub-programme areas under the Human Resource Development and Utilization Programme. It is recognized that specific measures are required to overcome scientific and technological backwardness in order to pave the way for the realization of the potential for development.

2.2.1. Science and Technology: The Institutional Framework

The S&T policy document is intended to serve as a basis for formulating detailed policies and programmes for specific sectors. A few sectors have already formulated their policies based on the national science and technology policy (e.g. health, industry, natural resources).

According to the S&T policy document, local technological capabilities have to be built up in several areas: R&D; development of traditional technologies; technology transfer, adaptation and application; engineering design and consultancy; S&T manpower training and development; collection and dissemination of S&T information; and popularization of S&T.

The organizational structure of the S&T system in Ethiopia has four functional levels:

(i) National S&T Council: The highest decision-making body for S&T policy and action plans, it is chaired by the Prime Minister and its members include eight sectoral ministers and three prominent professionals.

(ii) The Technical Advisory Committee of the National S&T Council: Composed of scientists and professionals under the Chairmanship of the Commissioner for S&T, this Committee prepares matters to be discussed and decided upon at the Council.

(iii) Science and Technology Commission: A government institution accountable to the Prime Minister, it is the central organ for planning, promoting, coordinating, financing and overseeing S&T activities in the country.

(iv) S&T Operational Institutes and Centres: These are responsible for the actual performance of S&T activities in specific sectors.

As this organizational structure was proposed in the National S&T Policy of December 1993, it is still too early to assess the operational results.

S&T development is coordinated by a national body, the Ethiopian Science and Technology Commission, which was created in 1975. This body has not had supportive institutions at regional and sub-regional levels. It also lacked clear policy guidance as the national S&T policy was only issued recently.

The S&T policy sets out policy guidelines, priority sectors and funding proposals (e.g. recommending that 1.5 per cent of GDP be allocated to S&T).[4] The S&T policy emphasizes R&D activities in areas of basic research and appropriate technologies for Ethiopia's socio-economic conditions and capacity-building in technology transfer, adaptation and improvement of traditional technologies. The involvement of the private sector in the promotion of S&T activities is also emphasized.

The S&T policy document of December 1993 is a considerable improvement over the past situation when no science and technology policy was documented. However, one major gap is notable in the new policy document; it falls short of articulating the linkage of economic policy instruments to the guidelines it contains so as to enhance the realization of the stated objectives. In addition, it does not engage in a comprehensive review of the experiences (positive and negative) of the past with a view to building on the strengths and tackling the weaknesses. The current science and technology policy is a broad statement which is supposed to provide a guide for specific sectors and institutions to formulate their own plan of activities. However, since December 1993 when the S&T policy was produced, only a handful of the specific sectors and institutions have already formulated their science and technology policies. The integration of S&T policy into economic policy has yet to be realized.

The document on Technology Transfer Regulation No.12/1993 aims to encourage, expand and coordinate investment and technology transfer and guide choices of technology (Tadesse, 1995). About 12 supportive service organizations were initiated as autonomous organizations or as departments under sectoral ministries. Some fifty R&D institutes exist under various ministries, or under international and regional organizations.

In the agricultural sector, the Institute of Agricultural Research (IAR) is the principal institution engaged in conducting and coordinating agricultural activities at national level. Its research programme covers 12 research areas and is implemented through its 12 centres located in different agro-ecological zones in the country. Other institutions

---

4 The Transitional Government of Ethiopia. Ethiopian Science and Technology Commission. *National Science and Technology Policy*, Addis Ababa, December 1993.

are the universities and colleges engaged in training and research; the National Veterinary Research Institute; the Rural Technology Centre; and the various organs of the Ministry of State Farms, Coffee and Tea Development. The activities of these R&D institutions are dispersed, and they lack research manpower, facilities, and efficient organizational and administrative systems needed for research activities. The institutional infrastructure for the design and undertaking of R&D activities in the water sub-sector are weak. The recent establishment of the Arba Minch Water Technology Institute should improve the supply of medium and high-level trained manpower in water technology, and thereby contribute to strengthening R&D activities in the water sub-sector.

The energy sector is reported to have great potential but its exploitation has been limited. The absence of a clear policy, the presence of a weak institutional capacity and the lack of coordination have contributed to this situation. The institutions engaged in R&D activities in the energy sector are the Ethiopian Energy Authority, Ethiopian Light and Power Authority, Addis Ababa University and the Ethiopian Geothermal Survey.

In industry there are a few metal and engineering industries that have some capacity to adapt, develop and produce technologies for the economy. But their capacity is generally limited. Organized industrial research along sub-sectoral lines is just being considered. The Industry S&T Policy which was issued in 1994 aims to facilitate local technological capacity building by strengthening R&D efforts, improving support services, promoting an appropriate technology transfer system and strengthening the linkage between modern and traditional sector technologies. Small and medium size industries are given special attention (Tadesse, 1995). The Industrial Project Service offers multidisciplinary consultancy service to industry in the areas of planning, engineering, project implementation, evaluation and rehabilitation studies and organizational studies (Tadesse, 1995).

In construction, R&D activities have been conducted in building materials only but these activities are scattered among different institutions and are not well coordinated.

In mining, the establishment, of the Ethiopian Mineral Research Development Cooperation to develop precious and industrial metallic minerals of commercial importance in 1982 has contributed to the diversification of minerals other than gold and platinum. However, the R&D efforts require adequate resource allocation and a proper legal framework.

The health sector has R&D institutions which are engaged in research either as their major function or as part of their main activities. The Ethiopian Nutrition Institute, the Institute of Pathobiology, the National Research Institute of Health and the Armans Hausen Research Institute have research as their main function. Others such as the universities, the Ethio-Swedish Paediatric Clinic, the Coordinating Office of Traditional Medicine and the Jimma Health Sciences Institute which undertake health research as part of their central activities.

The principal deficiency in the structure and organization of S&T is the lack of vertical and horizontal coordination and integration of S&T efforts. There are over 18 technical and vocational schools and institutes in the country. These are afflicted by quality problems similar to those found in primary and secondary education. In addition there are other specialized institutions. On-the-job technical education is also

offered through apprenticeship, in-house training and other types of formal training by enterprises. These training efforts lack adequate coordination and are so confined to their respective enterprise requirements that they compromise the overall systematic development of technological capabilities.

S&T activities in effect have been rendered less effective by the lack of policy guidance, inadequate manpower training and infrastructural limitations.

The educational system has little S&T contents, the quality of education is low and the quality of teachers and the student-teacher ratio are unsatisfactory.

The S&T sub-programme covers three main components: capacity-building for the formulation of the S&T master plan and the development of technologies for rural needs, development of S&T support services, and the development of selected S&T institutional infrastructure support for industry.

S&T policy planning is most limited at sectoral and regional levels.

2.2.2. The Enterprise Sector: Status and Prospects

Interviews with the business community indicated that there is support for the shift towards a market economy, trade liberalization, action to make relevant changes in the associated policy papers concerned with investment policy, and revising labour laws and the exchange rate. However, there are still problems deriving from the land policy, which allows private agents to lease but not to own land.

The private sector expressed further concern over the paucity of information on technology and the weak link to R&D activities in the public sector. The private sector business community perceive that while there is indeed a weak link between public R&D institutions and public enterprises, the link is even weaker between the R&D institutions and private enterprises. It was pointed out that officials in most public institutions still prefer to deal with public enterprises and that the private sector is still struggling for recognition. While the intention to carry out reforms has been appreciated, in practice it is perceived that the old habits have not changed significantly. Investors continue to face problems of visas and import formalities. In addition, investment procedures are still associated with many bureaucratic hurdles.

Local industrialists in the private sector also referred to the absence of support for transfer of technology and technology innovative efforts.

Local investors noted that it was difficult to gain access to affordable investment finance from development banks and other financial institutions. They expressed concern that the terms of lending were too harsh (high interest rates, too short a grace period) and that venture capital was hard to obtain.

Visits were made to two enterprises. One is an innovative small private sector firm manufacturing rubber parts for other industries. The second is the Engineering Design and Tool Enterprise, a public sector R&D institution, which became a public enterprise in October 1993.

The private sector firm had started very small and had used very simple technology from local sources. The environment of restrictive importation which existed by then had starved the industrial and transport sectors of their requirements for spare parts. This firm started supplying these sectors with a wide variety of the rubber parts they needed. Partly facilitated by import controls and partly because of the limited

investment resources that the entrepreneur had, most of the equipment used was also manufactured in-house. This enterprise has been growing steadily making continuous technological improvements and benefiting from consultations initiated with the local university chemistry laboratories. The technological improvements that this firm has been making have facilitated its survival even in the post-liberalization phase. The entrepreneur behind this successful story, however, admits that the survival of this firm has not been easy and in many occasions he had to struggle against the many aspects of a not-so-favourable policy environment.

R&D institutions in the public sector had been required to go commercial and to rely less on grants from the government. The shift from a government department to a public enterprise has led to a shift in its approach in the direction of adaptations and reverse engineering and away from "reinventing the wheel" and duplication, since the immediate objectives of the enterprise are to develop the technological capability in designing, in the development of prototypes and in the actual designing of tools.

However, trade liberalization has meant that clients have options to import many items. This has contributed to reducing the orders that come from the industrial sector. This suggests that under a liberalized trade regime the pattern of demand from clients is likely to change posing a challenge on suppliers to come to terms with the changing demand conditions. In the event that the unpredictability and volatility in markets are holding brakes on private sector development, the State may also be called upon to manage the markets.

The enterprise in question pursues both R&D activities and purely commercial activities. In the case of the former, some financing is available from the S&T Commission for specific R&D projects.

In its design activities, three possible approaches are adopted depending on the circumstances: customers may bring samples, they may come with their own designs, or they may come with ideas which the enterprise uses to make designs and undertake manufacturing.

3. UNITED REPUBLIC OF TANZANIA

3.1. The Economy

The economy of the United Republic of Tanzania enjoyed a reasonably high rate of growth in the 1960s (5-6 per cent, decelerating to 3-4 per cent per year in the 1970s and stagnating at the height of the economic crisis in the first half of the 1980s. During 1980-1985 the growth of the economy averaged 1-2 per cent per year. Agriculture stagnated (growing at 0.6 per cent per year, while the industrial sector declined by 4.1 per cent p.a. with capacity utilization falling to 20-30 per cent. The effect of the stagnation of export volumes was exacerbated by the deterioration in the terms of trade. The economic crisis took a heavy toll on human resource development, especially as it eroded the capacity to provide basic health and education services.

The structure of the economy is still dominated by agriculture (43.8 per cent of the GDP and 80 per cent of employment in 1993). Industry[5] is still quite small, accounting for 16.2 per cent of the GDP of which 8.9 per cent was accounted for by manufacturing in 1993 (Economic Survey for 1993).

Exports are dominated by traditional primary commodities such as coffee, cotton, tea, cashew nuts and tobacco. These five commodities accounted for about 60 per cent of the export earnings in 1993.

For the past 9-10 years the United Republic of Tanzania has been engaged in reorienting the economy away from reliance on administrative control mechanisms (for resource allocation and distribution) and towards a greater reliance on market forces. The reorientation towards a market economy has consisted of various types of price (foreign exchange, capital and goods and services), fiscal, monetary and public sector reforms.

Economic performance has shown some improvement, with the growth of GDP averaging about 4 per cent during 1986-1993 period up from 1-2 per cent level obtained between 1980-1985. This growth performance may not be sustainable, however, unless policies continue to focus on various institutional reforms necessary for the achievement of socio-economic development; reforms in the financial and public sector, which will promote private sector investment, or trade reforms (especially in agricultural marketing), and which would result in the improvement of the (physical, social or economic) infrastructure.

The effectiveness of this growth performance is being called in question, particularly, as regards poverty alleviation and economic transformation. This raises the broader question of the role of these economic reforms in realizing the country's longer-term development objectives. The long-term objectives given priority by the United Republic of Tanzania consist of the revitalization of the productive sectors and raising their productivity level, trade restructuring; especially of the export sector, and the pursuit to develop her human resources. The role of science and technology and the fostering of technological capabilities are central to the realization of these long-term development objectives.

[5] Industry here is considered to consist of mining, manufacturing, electricity, water, gas and construction.

3.2. Science and Technology: The Institutional Framework

The Tanzania Commission for Science and Technology was established in 1986 as the principal organ charged with the responsibility of advising the Government on all matters relating to scientific research and technology development.

The Commission operates under the umbrella of the Ministry of Science, Technology and Higher Education. The national policy on science and technology, which was first formulated in 1985 and which is currently being revised, is the principal guide for the activities of the Commission. The Commission maintains a system of collaboration, consultation and cooperation with national R&D institutions. Existing R&D institutions are organized sectorally, covering agriculture, livestock, fisheries, forestry, wild life, food and nutrition, building, industry, health and standards.

The Commission has established R&D advisory committees as its principal organs for coordinating the scientific and technological research carried out in the country in the respective fields. The existing R&D seven advisory committees cover agriculture and livestock; natural resources; environmental research; industrial and energy research; public health and medical research; basic sciences; and social sciences. Each R&D advisory committee has the responsiblity to advise the Commission on research policy and priorities; the allocation of research funds; the coordination of research and extension services; human resources development; and on national and international cooperation.

The Centre for the Development and Transfer of Technology is the principal organ of the Commission responsible for matters relating to the transfer, adaptation, development, absorption and diffusion of technology. The long-term goal of the CDTT is to create an enabling environment for the development of self-reliance in technology through technological capacity-building within the United Republic of Tanzania. The functions of CDTT include the facilitation of technology transfers and the development, promotion and commercialization of local technologies. The Centre is also involved in the prospecting and assessment of technology, and technology policy analysis. The CDTT has four programme areas; industrial, rural, energy, and new and emerging technologies. The Centre also envisages offering various services, including industrial and technological information services; technology promotion, and technology advisory services; as well as evaluation services on technology transfer agreements.

The Act establishing the Commission provides for the establishment of a National Fund for the Advancement of Science and Technology whose funds will be utilized in financing scientific research, developing the human resource in the field of science and technology and in financing technological development.

3.3. Science and Technology in Practice: Functions of the Institutions and S&T Problems

The only R&D institutions that existed in Tanzania before 1970 were the agricultural research institutions. These institutions focused on the research of export crops such as cotton, coffee, tea and tobacco. With the establishment of the faculty of engineering at the University of Dar es Salaam in 1973 and a series of other R&D institutions in the late 1970s and early 1980s[6], a broader S&T infrastructure was developed. Most of these R&D institutions are oriented more towards the development of technology than on conducting basic research.

The institutional framework for the development of science and technology has been put in place. In practice, however, the functions of this institutional framework raise several issues of concern. The following are some of the key concerns that were raised during the field visit:

(i) The level of technological capability in the United Republic of Tanzania is low, as indicated by the paucity of technological innovation, the small output of scientific publications, low levels of productivity in all sectors of the economy and the weak state of human resource development, especially in the scientific and technological fields. In particular, enterprises lack a critical mass of qualified human resources needed to produce appreciable results. The situation is aggravated by the inadequate level of managerial capability in some institutions. A major challenge in the development of the human resource is to be found in the educational system. Both primary and secondary educational curricula fail to make sufficient provision for science teaching. The science education offered may need to be reviewed and restructured to cope with the demands of new and emerging technologies. There is also a need to restructure technical and higher education. Given the narrowness of the public sector employment policy, greater encouragement needs to be given to self-employment and other private sector employment opportunities. This shift of attention may call for the reorientation of the educational and training system towards teaching the managerial, business and technical skills needed for the generation of self-employment or private sector development.

(ii) The effectiveness of technology transfer through technology flows from outside the country has been limited, and the technological learning effects from imported technology have been scanty. What effects there have been can be ascribed mainly to the limited technological efforts directed towards the adaptation, absorption and internalization of technologies flowing into the country. This is largely explained by the policy environment which was for many years (since 1967) not conducive to the development of enterprises and especially, to technological innovations. The trading regime was characterized by a overvalued exchange rate, high levels of protection and restrictive import licensing, a pricing system based on cost-plus pricing, and the widespread replacement of market forces by administrative controls in the allocation of resources such as credit, foreign exchange, investment finance, as well as human resources.

---

[6]. These include the Tanzania Industrial Research and Development Organization, Tanzania Engineering Manufacturing and Design Organization, Institute for Production Innovation, Centre for Agricultural and Rural Mechanization and Appropriate Technology and Tanzania Bureau of Standards.

(iii) The system of coordination and cooperation among various institutions and other actors in R&D is not as effective as it is supposed to be. In practice, the Commission remains marginalized from the mainstream of government policy-making and decision-making processes. Moreover, scientists and technologists lack contacts with decision-makers.

(iv) Locally developed technologies have been limited but even those that exist have not been fully utilized and developed commercially. The rate of commercialization and utilization of the few R&D results has been low. This is a reflection of the weak link between R&D institutions and the enterprise sector, which therefore results in the inhibition of efforts to generate and commercialize local technologies. At the same time, managerial and marketing capabilities are on the low side in many R&D institutions and even in producing enterprises.

(v) The flow of industrial and technological information within the country and between the United Republic of Tanzania and the rest of the world is wanting. In particular, the technological delivery system serving the enterprise sector is weak.

(vi) The Investment Promotion Centre has little capacity in terms of personnel and information to analyse the technology aspects of investment projects. The IPC is ill-equipped in terms of human resources and the physical infrastructure to adequately promote transfer of technology and process application from high technology firms. These deficiencies could be reduced through networking with R&D institutions. Such networks, however, have not yet been established. In spite of the efforts at economic reform that have been made over the past 10 years, many industrialists and other private investors still believe that the policy environment is not conducive to investment.

(vii) Industry-oriented associations potentially have an important role to play in the development of technological capabilities. For instance, MEIDA, with close to 200 members all from the metal and engineering sector, organizes training programmes. However, the training offered is considered too general. Although MEIDA has good contacts with its members, it lacks adequate data bases to service them, especially after economic and trade liberalization. Trade liberalization has made it possible for enterprises to have access to imports without having to go through MEIDA and has changed the information requirements of these enterprises. Thus industry-oriented associations like MEIDA need to redefine their roles to cope with the needs of their members in the new environment of liberalization, market orientation and private sector development.

(viii) R&D budgets are too small to allow for ventures into new product lines. The main problem is the absence of financing mechanisms for technological innovation. A National Fund for the Advancement of Science and Technology (NFAST) has been proposed by the Commission but is not yet operative. A Venture Capital Fund was created towards the end of 1993 but this too, is not yet operational.

4. TECHNOLOGICAL CAPACITY IN ETHIOPIA AND THE UNITED REPUBLIC OF TANZANIA

In both Ethiopia and the United Republic of Tanzania and Ethiopia the levels of technological development are low.

In the two countries, the process of building local technological capabilities has been limited by the failure of investment to recover from the low levels and inadequate allocation of resources to science and technology for development, failure to expand and restructure the export sector, the lack of diverse and sophisticated skills to cope with the challenges emerging from recent technological advancements, and the weak linkages which exist between local R&D institutions and the productive sectors.

In both countries it was found that therewais a mismatch between the supply of and demand for human resources. While there is a shortfall of some professions and skills there is a surplus of others. It seems that academic and training institutions do not supply trained manpower in response to the demands of users (e.g. industry). This suggests that there is need to revisit the educational and training system with a view to establishing the new and emerging manpower requirements in the light of the new developments in technology, and the policy reforms.

It was also found that, while training is going on unabated, many graduates are finding it difficult to become absorbed into economic activities while other educated employees are facing retrenchment. This raises the question: what can be done to reduce the gravity of this problem of unemployed educated personnel? The main difficulty is that the government, formerly the largest employer of graduates and other professionals, is under pressure to retrench while the private sector is still too small to provide sizeable employment. This being so, one option would be to turn these educated job seekers and victims of retrenchment into self-employed people. This option may involve the introduction of crash courses and training programmes for these groups to help them to manage the transition into self-employment.

As regards human resource development, special attention will need to be paid to continuous upgrading of various skills. The public and private sectors have a supportive role to play in training all levels, including formal education, technical and vocational training and various forms of enterpreneurial level training. In order to cope with the rapid technological changes, training and learning from experience will need to be a continuous activity at all levels, while closer linkages will need to be forged between the training and institution-building and production sectors. It may even be necessary to structure the educational and training systems in line with the changing requirements of the productive sectors.

The problem of low and stagnating investment has important adverse implications for technology flows. The challenge in this respect is to devise ways and means to enhance policies and make institutional arrangements that are conducive to the promotion of investment and technology flows. Particular attention may need to be paid to the promotion of small and medium-sized enterprises to enable them to engage in the transfer and development of technology.

Given that the role of non-government sectors is being promoted in these countries (e.g. through public sector reform), articulation of the needs and requirements of the productive sectors will be enhanced by closer collaboration between the business community, researchers and the government in policy formulation.

The transfer and adaptation of foreign technology to local conditions is critical to the process of technological capacity-building. Different forms of technology transfer can be adopted in different combinations as a way of developing technological capabilities. Forms of technology transfer include foreign direct investment, importation of capital goods and licensed or informal transfer arrangements. While the various forms of investment flow provide an opportunity for fostering local technological capabilities, most of these investment flows can be realized only if the policy environment is conducive to innovation, investment within a supportive infrastructure, the development of human resources development and the presence of stable macroeconomic policy conditions.

5. CONCLUSIONS

5.1. Science and Technology Policy Reviews

Both countries have science and technology policies stated in official documents. In Ethiopia, the science and technology policy has come in the spirit of making a fresh start following the change of government in 1991. Therefore it does not engage in a comprehensive review of the positive and negative experiences of the past in light of the need to assess and build on the strengths and tackle the weaknesses. The current science and technology policy is a broad statement which is supposed to be a guide for specific sectors and institutions to formulate their plan of activities. However, from December 1993 when the S&T policy statement was produced, the specific sectors and institutions have failed to formulate their programmes of action in connection with science and technology; at the same time, the integration of S&T policy into the economic policy is as yet unrealized. In the case of the United Republic of Tanzania, there was no sudden structural break which necessitated the review that is now in progress. However, although the science and technology policy is under review, this has not been preceded by a comprehensive review of the status of science and technology development in the country. Such an examination would have identified the strengths that needed to be built upon and the weaknesses that require remedy. The formulation or review of science and technology policy in both Ethiopia and the United Republic of Tanzania would benefit from a comprehensive study of the status of science and technology and its relationship with the socio-economic policy environment. This would not only help to instil a broader conceptualization of science and technology policy for the purpose of meeting the basic needs in the two countries, but it would also throw light on the role of the science and technology in enhancing the international competitiveness of selected export activities.

While LDCs need to harness science and technology to enable them to meet the basic needs of the people, they must also develop their international competitiveness in selected export activities. The balance between these two objectives needs to be addressed especially in the context of global liberalization and rapid technological advancement. Nevertheless, neither in the United Republic of Tanzania nor in Ethiopia do the science and technology policies address this balance. Comprehensive S&T reviews would help not only to set the S&T geared towards obtaining a broader development but also the economic policy and hopefully obtain a balance between the two.

5.2. The Changing Role of the State

In both countries official policy has involved redefining the role of the State with a view to entrusting a greater role to the private sector in economic development. However, the activities of the public sector seem to be receding in both Ethiopia and the United Republic of Tanzania more rapidly than the private sector is developing. There is a danger of gaps emerging in private sector development and in the role of facilitation played by the State. The new role of the State has not acquired the promotional characteristics that are necessary for private sector development in either country. While considerable progress has been made in macroeconomic policy stabilization, the link between macro level policy and micro level activities remains tenuous. This link can be strengthened by State's facilitation and building of institutional mechanisms to manage the process of reorientation towards a market economy. At these levels the role of the State and other institutions in facilitating the development of micro level activities

and providing the necessary infrastructural support deserves greater attention. Some of the major elements that need to be put in place are:

(a) appropriate institutional mechanisms for facilitating consultations between the government and the private sector (and other relevant actors in development);

(b) an increase in the capacity of the State to provide the necessary supportive mechanisms including education and training and other technological infrastructure;

(c) new mechanisms whereby non-governmental institutions can be engaged more actively in providing the science and technology infrastructure and related supportive mechanisms.

5.3. Implications of the Uruguay Round

Liberalization in major markets will have the effect of lowering the preferential margins which the LDCs have been enjoying under GSP schemes and the Lomé Convention. This challenges those countries to enhance their international competitiveness with a greater urgency than ever before. In response to this increased pressure to attain international competitiveness, the LDCs will need greater technological and financial assistance to raise productivity in the productive sectors and to improve supportive infrastructure.

The Uruguay Round Agreement provides for LDCs to build domestic capacities in critical areas that would enhance their capacity to benefit from the new trading system. Consistent with article 66 of the Agreement on TRIPS, the developed countries are expected to provide incentives to their enterprises and institutions for the purpose of promoting and encouraging transfer of technology to LDCs to enable them to enhance their technological capabilities. Support for improving investment conditions and strengthening regional and subregional technology and market links would be instrumental in fostering technological capability-building and in enhancing participation in the new trading environment.

The least developed countries are already facing acute constraints on the resources needed to foster technological capability-building. The implementation requirements of TRIPS place an additional burden on these countries in terms of financial and administrative capacities. Incorporating the new provisions in the national legislation and creating an administrative capacity to manage law enforcement and implementation of enforcement procedures will mean stretching the already overstretched financial and human resources even tighter. The challenge that confronts these countries in their endeavour to foster and reward enterprise development, yet at the same time stimulate investment and technology flows, is virtually insurmountable.

5.4. Private Sector Development as a Vehicle for Technology Capability-Building

Developed countries can be partners in this process, building on the existing programmes to develop the private sector. In a number of OECD countries private sector development programmes are already in existence. In recent years a number of donors have developed aid programmes in the area of environment. Support, in the form of subsidies, financing, training and information flow has been

given to the transfer of environmentally sound technologies in particular. Some of these programmes have focused on technological innovation and the diffusion of environmentally-sound or clean technologies. These programmes can be sustainable if they can link partner firms and if the partnering firms find the partnership profitable. The partnership should enhance technological capacity building in this field. The experience of the OECD countries which have implemented development assistance and technological cooperation programmes in these aspects (environmental) of technology would be useful. What is now needed is to broaden the scope of technology capability-building in the existing private sector development programmes, beyond the narrower concerns of environmentally-clean technologies.

(a) Creative partnerships can be envisaged among firms or between firms and the R&D sector involving the blending of various capabilities such as capital, technology, marketing, raw materials. Collaborative arrangements can be envisaged in the improvement of the development process, the enhancement of efficiency in the chain of production, learning through information exchange and collaboration to stimulate innovation. Some donor governments already have programmes for subsidizing partnerships between their firms and firms in developing countries. Experience gained in such programmes should be deployed to design new programmes with a view to enhancing the technological capacity building components of these partnership.

(b) Operations of SMEs in developed countries indicate that pooling efforts (resources, information, complementary skills and technologies) has facilitated innovation and enhanced their competitiveness. As a result the experiences built up could be applied to twining arrangements between LDCs and developed country firms. While traditional transfer of technology has often involved one-way technological cooperation, the new forms of technological cooperation may take the form of longer-term mutual benefits involving two-way technology flows based on joint production and sharing of knowledge. Longer-term technological cooperation arrangements of this kind may include training, the introduction of new management systems and various ways of improving technologies. Such partnering should aim at stimulating innovation and accelerating technology diffusion. In the case of new technologies in the area of biotechnology, the LDCs themselves may be well-placed to promote innovations because of factors such as climate and geography which endow them with genetically diverse raw materials that are not available in developed countries. In this connection, LDCs could make the necessary arrangements to share the commercial benefits from biotechnological pursuits undertaken jointly with developed country firms which may have biotechnological advances to offer. In information technology, the software industry, for instance, offers scope for collaborative arrangements with the LDCs being able to offer specific local information needed to adapt and improve imported technologies/techniques to local conditions.

(c) One possible role for the SMEs of developed countries could be to widen the scope of their technologies so that more labour-intensive and simple technologies are included. The emerging trends in new technologies also indicate that a number of SMEs are actively engaged in developing selected high technologies e.g. biotechnology, computer technology and other aspects of information technology. However, the more limited

managerial and financial resources of SMEs compared with TNCs suggest that the working of technology collaborative arrangements may have to be supported by some kind of promotional arrangements (e.g. financing). The formation of inter-firm linkages or firm-R&D linkages may need to be facilitated by enabling mechanisms such as access to financial and technological resources. Resources may also be required to attract the support of leading international firms.

REFERENCES

An Economic Development Strategy for Ethiopia: a Comprehensive Guidance and a Development Strategy for the Future. Ministry of Planning and Economic Development, Addis Ababa, September 1993.

Brief Summaries of the National Programmes. Addis Ababa, February, 1994.

Country Case Study submitted by the United Republic of Tanzania TD/B/WG5/Misc.19.

Economic Reform Programme Impact Analysis, Vol. 1 No.4 , Addis Ababa, May 1994.

Endogenous Capacity Building in Science and Technology in Africa. Addis Ababa, August 1993.

Ethiopian Science and Technology Commission. *National Science and Technology Policy,* Addis Ababa, December 1993.

Government of Ethiopia, *Survey of Current Economic Conditions in Ethiopia.* Inaugural Edition, Vol. 1, No. 1. A Publication of the Policy Analysis Unit, Ministry of Planning and Economic Development. Addis Ababa, Ethiopia, January 1993.

Informal Discussions During the Second Sessions of the Ad Hoc Working Group on the Interrelationship between Investment and Technology Transfer, Geneva 13-17 December 1993. Summary Report by the UNCTAD Secretariat.

Mytelka, L.K., Rethinking Development: A Role for Innovation Networking in the "other two thirds". *Futures* 1993.

OECD. Reviews of National Science and Technology. Portugal. OECD. Paris, 1993.

OECD. Science and Technology and Innovation Policies. Iceland. OECD. Paris, 1993.

OECD. Technology and the Economy. The Key Relationship. OECD. Paris, 1993.

Performance Review of Science and Technology Policy Institutions in Ghana, Guinea, Kenya, Nigeria and Tanzania. Addis Ababa, January 1990.

Report on Macroeconomic Development in Ethiopia. Addis Ababa, December 1994.

Tadesse, Getahun. Selected Cooperation Aspects for Technological Capacity Building Ethiopian Scenario. Paper presented to a Workshop on Selected Cooperation Aspects for Technological Capacity Building in Developing Countries. Geneva, 10-11 April 1995. UNCTAD S&T/COOP.28.

United Nations. Trade and Development Report, 1994. United Nations. New York & Geneva, 1994.

Trade and Development Board. Ad Hoc Working Group on Interrlationship between Investment and Technology Transfer. Third Session. Geneva, 21 March 1994.

UNCTAD. Transfer and Development of Technology in the Least Developed Countries: An Assessment of Major Policy Issues. UNCTAD/ITP/TEC/12, 17 August 1990.

UNCTAD. Report of the Workshop on the Transfer and Development of Environmetally Sound Technologies. UNCTAD and the Government of Norway, UNCTAD/ITD/TEC. Geneva, November 1993.

UNECA. The Influence of Economic and Development Policies on Science and Technology in Africa. Addis Ababa, February 1994.

UNIDO. Establishment of a National System for Technology Aquisition Internalization and Monitoring. DP/URT/90/027/11-56. Tanzania. Technical Report: Mission in Tanzania. Prepared by C. Aguirre, Bastos and P. Materu. UNIDO. Vienna, 10 December 1993.

United Republic of Tanzania. The Tanzania Commission for Science and Technology Act, 1986.

World Bank. African Development Indicators 1994-95, World Bank. Washington, D.C., 1995.