

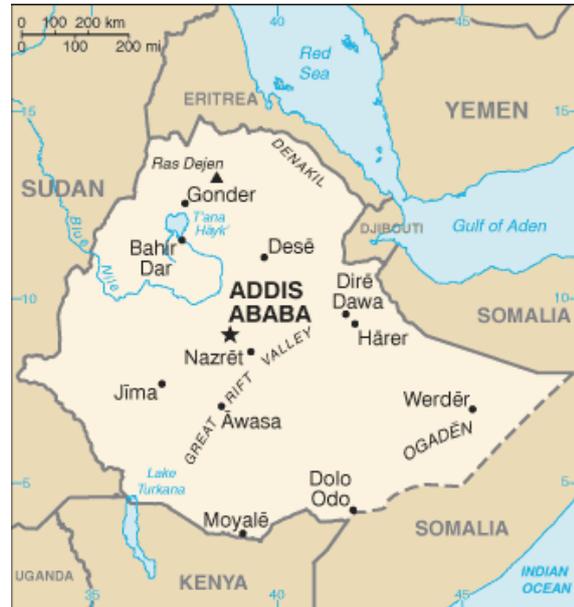
# THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA

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## Introduction

This report looks at the science, technology and innovation system of the *Federal Democratic Republic of Ethiopia* and is structured in three main parts. Section 1 briefly deals with the national political environment; Section 2 looks at the key country characteristics including the economic, demographic and health, education and information and communication technology infrastructure. Section 3, which forms the main part of the report, gives an overview and analysis of the science and technology system. This section is divided into seven thematic subsections covering the governance of the science and technology, science and technology landscape, S&T human resources, funding, research outputs, technological innovation and lastly international co-operation and networks activities.



## Section 1: The political environment

Ethiopia, officially the Federal Democratic Republic of Ethiopia, (also historically called Abyssinia and Italian East Africa), is the oldest independent country in Africa (at least 2000 years old) (CIA Fact book), and the second-oldest official Christian nation in the world after Armenia. It has long been at the intersection of the civilizations of North Africa, the Middle East and Sub-Saharan Africa.

It is the second-most populous nation in Africa with an estimated population of 75 million inhabitants (CIA factbook 2006). It covers a total land surface of 1 127 127 sq km of which 1 119 683 sq km is land and 7 444 sq km is water. Ethiopia is a landlocked country, (the entire coastline along the Red Sea was lost with the de jure independence of Eritrea on 24 May 1993), it shares its border of 5 328 km with five countries. It is bordered by Eritrea to the north (912km), Djibouti to the northeast (349 km), Somalia to the east (1600 km), Kenya to the south (861 km), and Sudan to the west (1 606 km).

Unique among African countries, the ancient Ethiopian monarchy maintained its freedom from colonial rule during the Scramble for Africa in the 1880s and during the 1900s, except for a five-year period (1936-41) when it was under Italian occupation during World War II. There was no colonization during this period, however, as only a few key cities and major routes were occupied. The Italian period was thus an "occupation" and not colonial rule. From 1930 Emperor Haile Selassie I undertook rapid modernization of Ethiopia. His reign ended in 1974 when a pro-Soviet Marxist-Leninist military junta, the "Derg", deposed him and established a one-party communist state. Because of several bloody coups, uprisings, wide-scale drought, and massive refugee problems, the regime was toppled in 1991 by a coalition of rebel forces: Eritrean People's Liberation Front (EPLF) in the far north and elsewhere by the Ethiopian Peoples' Revolutionary Democratic Front (EPRDF), a loose coalition of rebel forces mainly

dominated by the Tigrean People's Liberation Front. In 1993, the province of Eritrea became independent from Ethiopia, following a referendum and ending more than 20 years of armed conflict. Ethiopia adopted a constitution in 1994 that led to the first multiparty elections in the following year with the constitution becoming effective on 22 August 1995. The first President was Negasso Gidada. The EPRDF-led government of Prime Minister Meles Zenawi has promoted a policy of ethnic federalism, devolving significant powers to regional, ethnically based authorities. Ethiopia today has nine semi-autonomous administrative regions that have the power to raise and spend their own revenues. Under the present government, Ethiopians enjoy greater political participation and freer debate than ever before in their history, although some fundamental freedoms, including freedom of the press, are, in practice, somewhat circumscribed.

In May 1998, a dispute over the undemarcated border with Eritrea led to the Eritrean-Ethiopian War that lasted until June 2000 with a peace treaty in December 2000. This war hurt the nation's economy, but strengthened the ruling coalition. Zenawi's government was re-elected in 2000 in Ethiopia's first multi-party elections.

Ethiopia has been a member of international organisations: it became a member of the League of Nations, signed the Declaration by United Nations in 1942, founded the UN headquarters in Africa, was one of the 51 original members of the United Nations, and is the headquarters for and one of the founding members of the former OAU and current AU.

## **Section 2: Country characteristics**

### *2.1 Basic economic outlook*

Ethiopia's economy depends on agriculture, accounting for half of GDP, 60% of exports, and 80% of total employment. The agricultural sector suffers from frequent drought and poor cultivation practices. Many other economic activities depend on agriculture, including marketing, processing, and export of agricultural products. Production is overwhelmingly of a subsistence nature, and a large part of commodity exports are provided by the small agricultural cash-crop sector. Principal crops include coffee, pulses (e.g., beans), oilseeds, cereals, potatoes, sugarcane, and vegetables. Exports are almost entirely agricultural commodities, and coffee is the largest foreign exchange earner.

Coffee is critical to the Ethiopian economy with exports of some \$156 million in 2002, but historically low prices have seen many farmers switching to qat to supplement income. As the major agricultural export, coffee provides 65%-75% of Ethiopia's foreign exchange earnings. According to current estimates, coffee contributes 10% of Ethiopia's GDP. More than 15 million people (25% of the population) derive their livelihood from the coffee sector. Other exports include live animals, hides, gold, pulses, oilseeds, and khat (or qat), a leafy shrub which has psychotropic qualities when chewed.

Ethiopia's livestock population is believed to be the largest in Africa, and as of 1987 accounted for about 15 percent of the GDP. The war with Eritrea in 1998-2000 and recurrent drought have damaged the economy, in particular coffee production. In November 2001, Ethiopia qualified for debt relief from the Highly Indebted Poor Countries (HIPC) initiative, and in December 2005, the International Monetary Fund voted to forgive Ethiopia's debt to the body. Drought struck again late in 2002, leading to a 2% decline in GDP in 2003. Normal weather patterns late in 2003 helped agricultural and GDP growth recover in 2004-05. In addition to being plagued by periodic drought Ethiopia, also has to deal with soil degradation caused by overgrazing, deforestation, high population density, high levels of taxation and poor infrastructure (making it difficult and expensive to get goods to market). Yet agriculture is the country's most promising resource. A potential exists for self-sufficiency in grains and for export development in livestock, grains, vegetables, and fruits. As many as 4.6 million people need food assistance annually.

Since mid-1991, the economy has evolved toward a decentralized, market-oriented economy, emphasizing individual initiative, designed to reverse a decade of economic decline. In 1993, gradual privatization of business, industry, banking, agriculture, trade, and commerce was underway. However, Ethiopia is not fully privatized. Under the land tenure system, the government owns all land and provides long-term leases to the tenants. The system continues to hamper growth in the industrial sector as entrepreneurs are unable to use land as collateral for loans. The ruling EPRDF controls more than fifty large business enterprises in Ethiopia. Some of the enterprises are Ambasel, Guna, Tikur Abay, Dinsho, Mega, etc. Many government-owned properties during the previous regime have now been transferred to these EPRDF owned enterprises in the name of privatization. Furthermore, the Ethiopian constitution defines the right to own land as belonging only to "the state and the people," but citizens may only lease land (up to 99 years) and are unable to mortgage, sell, or own it.

Gold, marble, limestone, and small amounts of tantalum are mined in Ethiopia. Other resources with potential for commercial development include large potash deposits, natural gas, iron ore, and possibly petroleum and geothermal energy. Ethiopia has access to the ports of Djibouti, connected to Addis Ababa by rail, and to a lesser extent, Port Sudan in Sudan. In May 2005, the Ethiopian government began negotiations to use the port of Berbera in Somaliland. Of the 23,812 kilometres of Ethiopia's all-weather roads, 15% are asphalt. Mountainous terrain and the lack of good roads and sufficient vehicles make land transportation difficult. However, the government-owned airline is excellent. Ethiopian Airlines serves 38 domestic airfields and has 42 international destinations.

Dependent on a few vulnerable crops for its foreign exchange earnings and reliant on imported oil, Ethiopia lacks sufficient foreign exchange. The financially conservative government has taken measures to solve this problem, including stringent import controls and sharply reduced subsidies on retail gasoline prices. Nevertheless, the largely subsistence economy is incapable of supporting high military expenditures, drought relief, an ambitious development plan, and indispensable imports such as oil and, therefore, must depend on foreign assistance.

**Table 1: Ethiopian trading partners**

| <b>Trading Partners</b> <a href="https://www.cia.gov/cia/publications/factbook/geos/top">https://www.cia.gov/cia/publications/factbook/geos/top</a> |  |
|---|--|
| <b>Exports</b>  | \$562.8 million (2004)   |
| <b>Export - Commodities</b>   | Coffee, qat, gold, leather products, live animals, oilseeds  |
| <b>Main partners</b>  | Djibouti 13.6%, Germany 9.7%, Japan 9%, Saudi Arabia 6.5%, U.S. 5.4%, Italy 4.9%, UK 4.3%                        |
| <b>Imports</b>  | \$2.104bn (2004)   |
| <b>Imports - Commodities</b>  | Food and live animals, petroleum and petroleum products, chemicals, machinery, motor vehicles, cereals, textiles |
| <b>Main Partners</b>  |  |

The following table displays the trend of Ethiopia's gross domestic product at market prices. It is estimated by the International Monetary Fund with figures in millions of Ethiopian Birr. (<http://www.imf.org/external/pubs/ft/weo/2006/01/data/dbcselem.cfm?G=2001>)

**Table 2: GDP from 1980 – 2005 (in US dollars)**

| Year                          | 1980      | 1985      | 1990      | 1995      | 2000      | 2005      |
|-------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|
| <b>Gross Domestic Product</b> | 14,665    | 19,476    | 25,011    | 47,560    | 63,924    | 96,676    |
| <b>US Dollar Exchange</b>     | 2.06 Birr | 2.06 Birr | 2.06 Birr | 5.88 Birr | 8.15 Birr | 8.65 Birr |

In 2004, the CIA estimated Ethiopia's GDP per capita at \$800. This placed it as rank position 73 in the world. The Current GDP per capita of Ethiopia shrank by 43% in the Nineties. (<http://earthtrends.wri.org/text/economics-business/variable-638.html>)

## 2.2 Demographic profile (including health, education and ICT indicators)

Ethiopia's population is highly diverse. Most of its people speak a Semitic or Cushitic language. The Oromo, Amhara, and Tigreans make up more than three-fourths of the population, but there are more than 80 different ethnic groups within Ethiopia. Some of these have as few as 10,000 members. In general, most of the Christians live in the highlands, while Muslims and adherents of traditional African religions tend to inhabit lowland regions. English is the most widely spoken foreign language and is taught in all secondary schools. Amharic was the language of primary school instruction but has been replaced in many areas by local languages such as Oromifa and Tigrinya.

**Table 3: Current demographic data)**

| Total Population       | 2006 (Data from CIA)   | 2004 (Data from Worldbank) |
|------------------------|--|----------------------------|
|                        | 74,777,981 (CIA est. (2006) <sup>1</sup><br>74,777,981 CSA est. (2005)( Central Statistical Agency Ethiopia) | 69,961,000                 |
| Age structure          |  |                            |
| 0-14 years             | 43.7% (male 16,373,718;<br>female 16,280,766)  | 45 %                       |
| 15-64 years            | 53.6% (male 19,999,482;<br>female 20,077,014)  | 52%                        |
| 65 years and over      | 65 years and over: 2.7% (male 929,349; female 1,117,652) (2006 est.)   | 3%                         |
| Population growth rate | 2.31% (2006 est.)  |                            |
| Birth rate             | 37.98 births/1,000 population (2006 est.)  | 40                         |
| Death rate             | 14.86 deaths/1,000 population (2006 est.)  | 19                         |

<sup>1</sup> Note: The latest census for which figures are available was performed in 1994; this figure is the July 2006 estimate, which take into account the effects of excess mortality due to AIDS; this can result in lower life expectancy, higher infant mortality and death rates, lower population and growth rates, and changes in the distribution of population by age and sex than would otherwise be expected.

Table 3 Continued

| Total Population      | 2006 (Data from CIA)   | 2004 (Data from Worldbank) |
|-----------------------|--|----------------------------|
| Age structure         |  |                            |
| Net migration rate    | 0 migrant(s)/1,000 population (2006 est.) <sup>2</sup>   |                            |
| Infant mortality rate | 93.62 deaths/1,000 live births (2006 est.)   | 110                        |
| total population      | 49.03 years  | 42 years                   |
| male                  | 47.86 years  | 42                         |
| female                | 50.24 years (2006 est.)  | 43                         |
| Total fertility rate  | 5.22 children born/woman (2006 est.)   | 5.4                        |
| Religions             | Christian 61.6% (Ethiopian Orthodox 50.6%, Protestant 10.1% (P'ent'ay and Ethiopian Orthodox Tehadeso Church), Catholic 0.9%), Muslim 32.8%, Traditional 5.6%. |                            |
| Literacy              |  |                            |
| definition            | age 15 and over can read and write   |                            |
| Total population      | 42.7%  |                            |
| Male                  | 50.3%  |                            |
| Female                | 35.1% (2003 est.)  |                            |

Sources: <http://devdata.worldbank.org/genderstats/genderRpt.asp?rpt=basic&cty=ETH,Ethiopia&hm=home2>

<http://devdata.worldbank.org/genderstats/genderRpt.asp?rpt=capability&cty=ETH,Ethiopia&hm=home2>

<http://devdata.worldbank.org/genderstats/genderRpt.asp?rpt=NCPIA&cty=ETH,Ethiopia&hm=home3>

Results from the EDHS indicate that 1.4 percent of Ethiopian adults age 15-49 are infected with HIV. HIV prevalence levels rise with age, peaking among women in their late 50s and among men in their early 40s. HIV infection levels increase proportionately with education for both women and men and are markedly higher among those with a secondary or higher education compared to those with less education. Employed women and men are also more likely to be HIV infected than the unemployed. Knowledge of HIV prevention is lower in Ethiopia than in neighbouring countries. Considering the size of the population and the corresponding high proportion of population affected by HIV/AIDS the government has put the national HIV/AIDS policy in place to create an enabling environment to fight the epidemic.

<sup>2</sup> Note: repatriation of Ethiopians who fled to Sudan for refuge from war and famine in earlier years is expected to continue for several years; small numbers of Sudanese and Somali refugees, who fled to Ethiopia from the fighting or famine in their own countries, continue to return to their homes (2006 est.)

**Table 4: Ethiopian education statistics**

| Variable                                 | Amount / description | Rank                       |
|--|----------------------|----------------------------|
| Duration of compulsory education         | 6 years              | [146 <sup>th</sup> of 171] |
| Duration of education > Primary level    | 4                    | [156 <sup>th</sup> of 181] |
| Duration of education > Secondary level  | 8                    | [6 <sup>th</sup> of 181]   |
| Education spending (% of GDP)            | 4.6%                 | [68 <sup>th</sup> of 132]  |
| Female enrolment share > Secondary level | 39.7%                | [150 <sup>th</sup> of 170] |
| Grande 1 intake rate                     | 25.7                 | [104 <sup>th</sup> of 114] |

Sources: UNESCO Institute for Statistics; CIA World Factbook; Human Development Programme; UNESCO; World Bank

**Table 5: Ethiopia Selected ICT Indicators**

| Growth Competitiveness Index (Technology) | Rank out of 25 African countries | Rank out of 102 countries |
|---|----------------------------------|---------------------------|
| Ranking overall                           | 24                               | 101                       |
| Quality of competition in the ISP sector  |                                  | 102                       |
| Laws relating to ICT(2003)                |                                  | 101 (out of 102)          |
| Internet users (2001)                     |                                  | 102 (out of 102)          |
| Telephone lines (2002)                    |                                  | 76 (out of 102)           |
| Internet servers per 1000000 (2001)       |                                  | 96 (out of 102)           |
| Personal computers (2002)                 |                                  | 102 (out of 102)          |
| Cellular phones (2002)                    |                                  | 101 (out of 102)          |
| Government prioritisation of ICT(2003)    |                                  | 86 (out of 102)           |

Source: WEF, Global Information Technology Report (2003-2004)

### Section 3: Science and Technology system

#### 3.1 Governance of science and technology

In 1975, the Government created the Ethiopian Science and Technology Commission (ESTC) with the mandate to plan, encourage, guide, coordinate, select, approve and support research programs and projects of importance to national development. A key task was to distribute the very limited national research funds. In the middle and late 1970s, ESTC established eight research councils to be responsible for the following research sectors:

- Food and agriculture
- Industry and technology

- Natural science
- Natural resources
- Health
- Construction, housing and urban development
- Education and manpower development
- Science and technology popularization

In the early 1990's, it was clear that the prevailing conditions for effective research and S&T management in Ethiopia, and especially the lack of a clearly articulated S&T policy, prevented research from contributing to national development. The then transitional government commissioned the formulation of an S&T policy for Ethiopia that was finished in 1993. The specific goals listed in this policy document were:

- To build a national capability to generate, select, import, develop, disseminate and apply appropriate technologies for the realization of the country's socio-economic objectives.
- To improve and develop the knowledge, culture and scientific and technological awareness of the people of Ethiopia.
- To make science and technology activities in Ethiopia more efficient and development oriented.

### 3.1.1 *A new governance structure for S&T*

However, the basic strategies and planned initiatives of the 1993 Policy document were never implemented fully. One of the main reasons for this was the political instability caused by the border war with Eritrea between 1998 and 2000. More recently, ESTC was renamed as the Ethiopian Science and Technology Agency (ESTA) and was asked to instigate a review of the 1993 policy document. This culminated in June 2006 in a new draft and revised S&T policy document. In this document, a new governance structure for science and technology is proposed that will have the following four functional levels.

- A. National STI Council
- B. Technical Advisory Committee of the National STI Council
- C. Ethiopian Science and Technology Agency
- D. S&T operational Institutes and Centres

The Agency shall be the Secretariat of the National Science and Technology Council.

#### A. *National Science, Technology and Innovation Council (NSTIC)*

According to the revised policy document, the NSTIC will be the highest decision making body for STI policy and plan of action. Based on the National STI Policy, it will establish and direct the general framework and strategy for STI development and determine the role of STI in the national economy. The Council shall be chaired by the Prime Minister with the General Director of ESTA as its Secretary. The Council shall have the following members: The Prime Minister (Chairman); Minister of Finance & Economic Development; Minister of Agriculture & Rural Development; Minister of Health, Minister of Water Resources, Minister of Trade and Industry, Minister of Mines and Energy, Minister of Education, Minister of Federal Affairs, S&T Advisor to the Prime Minister, President of the Ethiopian Chamber of Commerce, Three Prominent Scientists and Technologists and the Director General of ESTA (Member & Secretary). The Prominent Scientists and Technologists will be nominated by the

Director General of the Ethiopian Science and Technology Agency (ESTA), to be appointed by the Council.

*B. Technical Advisory Committee (TAC) of the National STI Council*

The Committee is to be composed of renowned and experienced scientists and engineers drawn from different branches of S&T; chairpersons and secretaries of the sectoral Science and Technology Councils, the Director General ESTA and three professionals who are also members of the National STI Council. The Committee will be chaired by the Adviser to the Prime Minister. Its main objective is to undertake the necessary preliminary work and consolidate matters that will be submitted to the Council and to advise the Council on any technical matters. The NSTIC may also be assisted by sub-Committees, Technical Committees, Advisory Panels, Expert Panels and Consultants, as required.

*C. The Ethiopian Science and Technology Agency (ESTA)*

The Ethiopian Science and Technology Agency is a federal government institution, headed by a Director General and governed by its own regulations. The Agency is accountable to the Office of the Prime Minister. It is the central organ empowered with responsibilities and mandates to plan, promote, coordinate, finance and oversee STI activities of the country. It is also responsible to advise the government on issues of STI implement the government's STI policy and follow up the appropriate and immediate application of Research and Development (R&D) results. The Agency shall have the mandate to organize different sectoral and/or thematic STI Councils composed of renowned professionals and representatives from the relevant economic and service sectors, to assist in the formulation and implementation of STI policies and priorities and to screen projects that are eligible for grants. The Sectoral/thematic Science and Technology Councils will be chaired by the elected members of the Councils with the Department Heads of the Agency acting as secretaries.

*D. Science and Technology (S&T) Operational Institutes and Centres*

As in most science system, research institutes, technology centres, design enterprises, and various S&T support services in various sectors and higher educational establishments undertake the actual performance of S&T activities.

ESTA will also establish under it science and technology support services, centres and Research and Development (R&D) units as deemed necessary particularly in areas requiring special attention.

*3.1.2 S&T Priority areas*

The new draft S&T policy also contains a rather long list of priority areas. One could distinguish between two kinds of S&T priorities: priorities around specific science domains and (crosscutting) priorities related to the national management of S&T. We list them with a brief explanatory note in each case:

*3.1.2.1 Priorities with regard to science domains*

- Agriculture: Focus will be given to supporting the generation, transfer and utilization of affordable agricultural technologies to enhance agricultural production, productivity, processing and marketing at both household and commercial levels.
- Commerce and Industry: Promotion of competitive knowledge and technology based trade for local consumption and export through supporting technology transfer and generation efforts of the industry, research centres and the public and private enterprises will be given due consideration.

- **Education and Human Resource Development:** Focus will be on the development of adequate human resource required to generate and apply science and technology based on the felt needs of the socioeconomic sectors and the society. Strengthening the capabilities and linkages of universities and enterprises and cultivation and nurturing of a culture of science and technology in all sections of the society are also among the priority areas.
- **Energy:** Attention will be given to research and development activities aimed to increase energy efficiency of the existing technologies, and to come up with new technologies that enable to tap the existing and new sources of energy; and promotion of affordable and environmentally friendly energy technologies.
- **Environment:** Research, technologies and measures aimed at protecting, conserving and proper utilization of the country's biological diversity for sustainable development will be encouraged and supported.
- **Health:** Concerted efforts will be made to support science and technology activities, which are focused on understanding the major health problems, and to improve the overall national health through application of indigenous knowledge and practices. Developing the capacity to ensure safety of application of new medicines; and medical equipment and techniques will also be emphasized.
- **Mining:** Mapping and exploration of the mineral wealth of the country and investigation and verification of alternative uses of the proven mineral reserves of the nation will be encouraged and supported.
- **Tourism:** Support will be provided for relevant innovative ideas, initiatives and activities to identify, record and conserve natural and historical resources that influence ecotourism.
- **Water:** Understanding of the availability and accessibility of both the surface and ground water resources of the country; and generation, adoption and adaptation of appropriate technologies for water lifting, transmission and storage are therefore the strategic issues requiring attention by all stakeholders. Building a consolidated water research and development capacity is among the priorities to enhance utilization of our water resources.
- **Transport and communication:** Science and technology activities aimed at enhancing the transport and communication sector through utilization of local knowledge, technology and materials will be highly encouraged together with adaptation of appropriate technologies from abroad.
- **Nuclear Science and Technology:** Nuclear knowledge and technologies are currently being applied in support of various activities to improve agricultural production and productivity, human and animal health, water resources management, and non-destructive testing. Emphasis will therefore be given to developing the required trained work force and building the basic infrastructural capabilities that enable to nationally master, promote and safely apply the technologies.
- **Social sciences:** Focus on encouraging and supporting social science research that reinforces science and technology culture and ensures the development and absorption of technologies that are culture friendly. Research and study on policy, organizational, institutional, legal, fiscal, monetary, historical, anthropological, linguistic, literature, administration and management; testing and application of the results thereof will be the major concerns in this sector.
- **Meteorology:** The national capacity in meteorological research and development with a focus on improving its contribution to agricultural production, aviation, environmental and natural resources conservation will be strengthened taking into the agro-climatic diversity of the country.

### 3.1.2.2 *Priorities regarding the national management of S&T*

- Science and Technology Information: Areas that need further development are data communication systems such as the internet. In this regard, development of ICT that will facilitate the exchange of scientific and technological information through an integrated national information system and ensuring its sustainable use in terms of work force, hardware, network and software will be supported.
- Media and Extension Services: The extension network of S&T needs to be developed to the level whereby it can adequately diffuse information on S&T. Hence, the involvement of media, extension networks, policy makers, leaders of the productive sectors and other stakeholders in the promotion of S&T will be encouraged and supported.
- Intellectual Property Rights (IPR): Promotion of uptake of new knowledge, technology, soft wares, etc through the protection and use of intellectual rights will be encouraged and supported.
- Safety in the generation and application of science and technology: Ethical and safe practices in all development and application of science and technology activities will be instituted and applied.
- Basic and applied research: Basic and applied research on new and emerging technologies such as biotechnology, materials science, space applications and microelectronics will be encouraged with a view to enhance knowledge and technology led development in the country.
- National Quality and Standards: The design, development and commercialization of internationally competitive products and services by developing and enforcing national standards in line with the requirements of the International markets will be encouraged and the capacity to achieve this will be strengthened.

## 3.2 *Science and technology landscape*

Our discussion in this section is presented under two main headings:

- S&T agencies
- R&D performers

### 3.2.1 *S&T Agencies*

Under this heading, we discuss three kinds of S&T agencies: regulatory, technical (service) agencies and laboratory and infrastructural agencies.

#### 3.2.1.1 *Regulatory Agencies*

##### A. *Quality and Standards Authority of Ethiopia (QSAE)*

Although the product certification schemes of Quality and Standards Authority of Ethiopia (QSAE) are voluntary in nature, on consideration of public health, safety, and consumer protection the Government of Ethiopian has enacted Regulation No. 13/1990 for the mandatory certification of some 104 products. Hence, one aspect of QSAE's mission is to enforce this. Regulation in which different types of inspection and licensing schemes are employed and several companies are thus licensed. So far, up to the end of 2001, 306 licenses have been issued to 243 companies. The licenses relate to some 50 Ethiopian standards in the fields of construction materials and building, textile and leather, chemical, agriculture and food technologies. The regulatory service undertaken by QSAE is largely based on ISO/IEC Guide 28, which provides general rules for third party certification system of determining conformity with product standards through: Initial testing and assessment of factory quality control system and its acceptance; and Surveillance that takes into accounts

the factory quality management system and the testing of samples from the factory and the open market.

#### *B. Ethiopian Intellectual Property Office*

The National Science and Technology Policy identify the protection of intellectual property as one of the strategic elements that promote creativity and the dissemination of technological innovation. Realizing the need for and advantages of bringing the administration of the different components of intellectual property under one umbrella, the government established the Ethiopian Intellectual Property Office on April 8/2003 by Proclamation No. 320/2003. The Office is devoted to the promotion of intellectual property as a tool for national development and economic growth, in collaboration with responsible government agencies, industry, universities, research organizations and other concerned institutions.

The legal framework for the protection and enforcement of intellectual property rights is constituted of the Proclamation concerning Inventions, minor inventions and Industrial Designs issued in 1995, the Copyright and Related Rights Proclamation of 2004, the Trade Practice Law of 2003 which deals with unfair competition, the Trademark Directive issued in 1986 and a wide range of civil and criminal remedies for the infringement of copyrights and industrial property rights included in various Ethiopian laws.

Although the above measures involve significant leap in the country's IPRs regime, the state of IPR protection in industry, universities and research organizations is in its rudimentary stage. These institutions do not have intellectual property rights policy designed to promote the creation, acquisition, protection and exploitation in inventive and creative works. The institutional environment for researchers to protect the intellectual property that they create for their benefit as well as preserve the interests of the institutes and the public is lacking. The linkage between research and academic institutions with industry is very weak and there are no standard agreements for consultancy services, transfer of knowledge and for research contracts.

Ethiopia's membership of the Convention Establishing the World Intellectual Property Organization (WIPO) in 1998 and the ongoing process towards membership of the WTO are measures taken by the government to avoid marginalization of the country in an increasingly integrating world. Ethiopia is also a party to the Nairobi Treaty for the protection of the Olympic symbol that was signed in 1982. This Treaty is administered by the WIPO.

#### *C. Creation of National Systems for the Protection of Safety, Health and the Environment*

Research and development (R&D) activities among others include generation of innovative ideas, techniques, process and products that have beneficial impact on social and economic development of a given society. In the process of conducting and applying innovative techniques, processes or products, it is however, likely to induce harmful effects that can negatively affect human health and the environment. This implies that a country should have a system in place to regulate and control R&D activities and its application to protect safety, human health and environment.

Ethiopia has actively participated in the negotiation of the Convention on Biological Diversity (CBD), Cartagena Protocol on Biosafety and the African Model Law on biosafety. It has signed and ratified the Cartagent Protocol on Biosafety. The protocol aims at ensuring adequate levels of protection in the safe development, use transfer, handling and use of Genetically Modified Organisms (GMOs) resulting from modern biotechnology that may have adverse effects on the conservation and sustainable use of biological diversity, taking into account the risks to human health and environment.

With the support of the UNEP/GEF, a National Biosafety Framework (NBF) is in preparation in accordance with the relevant provisions of the Cartagena Protocol on Biosafety. The main elements of this framework are a regulatory system; and administrative system; a decision making system that includes risk assessment; and mechanisms for public participation and information. The final output of the NBF will be a national Biosafety Law in line with the Provision of the African Model Law on Biosafety. As it stands now, a national regulatory system to implement and thereby to comply with the Cartagena Protocol on Biosafety has not been put in place. None of the institutions undertaking biotechnology activities have an Institutional Biosafety Committee.

### 3.2.1.2 *Technical services agencies*

We discuss five agencies that have specific S&T mandates:

- National Variety Release Committee (NVRC)
- National Seed Testing Laboratory
- Ethiopian Mapping Authority
- Rural Energy Promotion and Development Centre
- Institute of Biodiversity Conservation

*National Variety Release Committee (NVRC):* Prior to the release of improved crop varieties to the end users, the variety undergoes a variety release process. To this effect, a standing National Variety Release Committee (NVRC) and various ad hoc-technical committees drawn from different institutions do existing in variety release and evaluation. NVRC is composed of professionals from different institutions such as breeder, agronomist/physiologist, entomologist, pathologist, economist and extension staff.

The general objective of the NVRC is to test, approve or release, register and notify all users about the new variety or hybrid (including clones). In order to assure the high standard and quality of improved varieties and to safeguard the interests of farmers and other users the NVRC is the responsible organ to also announce the withdrawal of obsolete varieties. The NVRC is currently operating under the auspices of MoARD.

Varieties are subjected to extensive trials at national or regional levels before they are proposed for release. Before submitting an application to NVRC, research institutions carry out a minimum of two years national or regional trials in at least three to five locations at different agro-ecological zones. Varieties are compared with standard improved and/or local checks for yield, diseases and other important agronomic characters. A new variety must show significantly better performance in a sufficient number of tests in comparison with the standard cultivar grown in the ecological zone, where it is to be use.

*National Seed Testing Laboratory:* The importance of having a crop variety registered has been recognized for a long time in Ethiopia, but only received due attention in 1997 when the exercise of preparing the crop variety register was started by the National Seed Industry Agency (NSIA). The first issue that was released in September 1998 contained all varieties (obsolete ones as well as those in production) of all crops known to have been recommended/released until 1998. Limited variety descriptors and other relevant agronomic data available were included as part of the register.

Since 1999, crop variety registers have been released every year. The registries include information on agronomic practices, year of release and breeder/maintainer for newly released varieties and variety name, as well as year of release and breeder / maintainer for those varieties already under production.

The seed system in Ethiopia consists of three components, namely the formal seed sector, the farmers' seed system (informal) and the emergency seed programmes often implemented by NGOs and other relief organizations. Seed inspection and certification are important components of seed quality control. The Agricultural Input Quality Control Department of MoARD administers seed certification procedures and enforces quality control measures and provides seed quality standards to all seed dealers. The department has two units dealing with quality control activities viz inspection and laboratory units.

Seed laboratory testing is being decentralized using the National Seed Testing Laboratory and the newly constructed eight Regional Seed Testing Laboratories. The laboratories carry out seed germination, purity, moisture content and seed health in conformity with the Ethiopian Standards Laboratory standards are set for pure seed, other crops, weed seed, infected seed, inert matter, germination percent and moisture content.

Seed certification for field, forage and horticultural crops is compulsory. The regulatory body had started certifying hybrid maize and will gradually continue to cover all crops as per the regulation with priority being given to wheat and maize seeds.

*Ethiopian Mapping Authority:* The Ethiopian Mapping Authority produces information on land to various sectors of agriculture such as land use, water resources, forestry, soil conservation, environmental monitoring, resettlement, regional planning etc. The Authority compiles multipurpose topographic maps, aerial photographs and satellite data covering most parts of the country making information readily available for development programs.

The technology development and promotion service is undertaken by about 10 regional technology and development centres that are found in the different regional states. The centres have the objective of developing/adopting and promoting, different technologies appropriate to the rural areas including improved agricultural equipment and technologies and small seed equipment and technologies and small scale rural energy technologies.

The *Rural Energy Promotion and Development Centre* is responsible, among other things, to carry out national energy resources studies, data collection and analysis, rural energy policy formulation, technology research and development, promotion and development activities. Recent activities of the Centre is limited to biomass technologies, developing improved stoves, improved charcoal making technologies (efficient kilns, charcoal making using new species of wood such as eucalyptus, and charcoal making from agricultural residues) activities on other technologies (biogas, solar) is limited to technical support (consulting regional bureaus on utilization or renewable energy resources, technical design etc., when requested) to developers. The Centre provides some technical (evaluation of the feasibility of the electrification project, advise potential areas of renewable energy that can be used for same and further indicate specific sites for development) and financial support to renewable energy developers.

The *Institute of Biodiversity Conservation* has the objective of ensuring appropriate conservation research, development and coordination of research development and sustainable utilization of the country's biodiversity. It promotes the collection, characterization, evaluation and documentation of scientific information on germplasm/biological resources to be used by the national breeding programs. Many accessions of plant species have been collected from different agro-ecological zones of the country. It is also empowered to issue permits for collecting, dispatching, importing or exporting any biological specimen or sample. The Institute has multiple functions. It is a gene bank, research organization, and regulatory and co-coordinating body. The tasks that are entrusted to it presuppose the existence of S&T capability as well as capacity to deal with a number of policy and legal issues. The Institute to date seems to have technological capacity in conservation of biological resources but lacks

capacities in the areas of policy and legal issues. There is thus a need to effectively use the technical capacity and enrich it further by establishing working relations with academic and research organizations in the country that have also built some technical capacity.

### 3.2.1.3 *Laboratory and infrastructural agencies*

Research support services encompassing administrative services; centre management; information and documentation; operation and maintenance of vehicles, equipment and facilities; and computer services are essential components of any R&D system. The quality and quantity of support staff and services available to researchers and the programs largely determine the output of the research. Science and technology (S&T) facilities are one of the many institutional requirements needed for the effective and efficient science and technology system. Laboratory facilities in addition to R&D undertakings are rendered by the following national infrastructures.

The *National Soil Laboratories* rendering scientific information services are housed either in the research system or in development organizations. The soil service laboratories that are distributed in different parts of the country provide soil, water, plant and fertilizer analytical data and interpretations essential for proper development of natural resources, application of fertilizer to all public and private organizations. The laboratories also render training for laboratory technicians in soil and plant analytical methods and agricultural extension agents in soil and water management. The soil reference profiles collected from representative soils of Ethiopia accompanied by database on chemical, mineralogical and physical characterization of the soil properties.

The *Regional Veterinary Laboratories* collect and provide information to the users, among others on studies in relation to prevalence, distribution, seasonal occurrence and mode of transmission of major livestock diseases. In addition the laboratories are engaged in testing of animals for introduction in new farms and assist field animal health staff in exchange of ideas on how to collect, preserve and dispatch samples. In order to monitor the pollutant load of effluents and to check that the limit is in conformity to the set environmental standard, a laboratory is established to regularly undertake environmental audit.

The *National Herbarium and Zoological Museum at AAU* is a depository of the Ethiopian flora and fauna. The data base and the large number of plant collections (over 78,000) that exist in the Herbarium provides baseline information needed for future studies in taxonomy, ecology, forestry, biodiversity conservation and medicinal plants. The collection comprises the national repository of plant specimen. The Herbarium offers plant identification services to various governmental and nongovernmental institutions. The library attached to the National Herbarium is the major source of botanical literature for postgraduate students. As part of its routine activities, the Herbarium sends and receives specimens on loan for study by its members and other researchers.

The *Geological Survey of Ethiopia (GSE)* works primarily in two areas, namely, mapping and mineral exploration. Basic geological maps make bases for any earth science evaluations directed to socioeconomic development endeavour. The Regional Geology and Geochemistry Department of the Survey has been carrying out the basic geological mapping at a scale of 1:250,000. The GSE explores mineral resources, delineate the potential areas and assess the viable reserves for further development. The major activities are on precious, base and ferrous metals, industrial minerals, groundwater, hydrothermal resources, hydrocarbons, and basic exploration activities for petroleum promotion.

The *Central Geological Laboratory (CGL)* services include chemical analysis of geological, hydro-geological and geothermal fluids, petroleum and natural gas samples using "wet

classical" analysis methods (i.e. gravimetry, colorometry, volumetry, electrogravimetry, etc). Mineralogical and petrographic methods for mineral identification, physical tests of industrial and construction minerals are also carried at the CGL. The main facilities at the Central Geological Laboratory include atomic absorption; XRF, emission spectrography, microscopes and equipment to carry out complete chemical and physical analysis of samples.

A *National Isotope Hydrology Laboratory* has been established at the Faculty of Science, AAU with the purpose of building a local capacity to undertake isotopic and other hydro-chemical analyses that are essential for sustainable water resources management and hydrological research and studies. The laboratory is envisaged to render analytical services on liquid scintillation counter, tritium enrichment unit (with oven and refrigerator, ion chromatograph, and atomic absorption spectrophotometer. The use of the major equipment is for the analysis of the environmental isotopes (mainly tritium) and numerous major and minor ions and trace elements that are found in water.

The *Geophysical observatory, located in Science Faculty, AAU*, is a research centre of the Faculty engaged in monitoring the Geophysical environment of Ethiopia. Its current activities include mainly geomagnetism, seismology, geodesy and gravity. The observatory is running five seismic stations in the country namely, Addis Ababa, Furi, Dessie and Alemaya. The Geophysical Observatory has been active in several areas of geophysical research. The research fields that the observatory is engaged include Seismological analysis of existing data, Earthquake hazard study and vulnerability, Earthquakes site-specific and study, Geodynamics and natural hazards, Geodesy and gravity, Geomagnetism, Applied Geophysics, and Astronomy and space science and technology.

The *National Scientific Equipment Centre*, a semi-autonomous body, under the Ethiopian Science and Technology Agency was established as one of the science and technology support services. The centre provides functional service on maintenance, installation and calibration of medical and scientific instruments and equipment, training of operators and in-house service technicians and engineers, consultancy services on the selection and procurement of scientific and medical equipment and in the setting up of laboratories. One of the serious Problems in the Ethiopian research system is found in the area of maintenance and repair of laboratory equipment. Available information shows that quite a good number of laboratory equipment, purchased in a big amount of foreign currency are out of operation due to lack of either maintenance or spare parts.

In addition to the above-mentioned facilities, there are important core scientific equipment located in different high learning institutions and others. For instance, NMR spectrometer provides analytical services to researchers at national and regional levels. Besides, there is highly useful equipment such as universal tensile strength testing machine, electro microscope, etc. found at Technology and Science Faculties of A.A.U. respectively.

### 3.2.2 *R&D performing institutions*

Fully-fledged full time research activities in Ethiopia started with the establishments of the Pasteur Institute, which was merged with the former Nutrition Research Institute, and formed the present Ethiopian Health and Nutrition Research Institute (EHNRI); and the former Institute of Agricultural Research (IAR) in 1966. Following the full recognition of the role of research and development activities towards the realization of the socio-economic development aspirations of the country, a significant number of research undertakings in both higher learning and national research institutions have subsequently been established. Our discussion commences with government and other public R&D institutions, followed by a focus on the main university-based research activities.

### 3.2.2.1 Government and public R&D institutions

#### *Agricultural R&D*

Although, there are no available data exactly showing the number of R&D establishments in the country, the agricultural research system is better organized, staffed and financed than any other sector in the country. The Agricultural sector is the sector where considerable efforts have been made to execute the National Agricultural Research Policy. Accordingly, the Agricultural Research Policy identified research priority areas, and 17 major research programmes. The current national agricultural research system in Ethiopia is composed of the Ethiopian Agricultural Research Organization (EARO), Regional Agricultural Research Institutes, Higher learning institutions, Government and Non-Governmental organizations, and the private sectors. Although the agricultural research system is better organized than any other economic or service sectors in the country, none of the agricultural research centres, so far, has attained a level of centre of excellence. Moreover, studies have shown that “all research centres are not well equipped “(Dept. Agriculture, ESTC, 2005).

Until recently, research and development activities have remained within the ambit of the Federal Government institutions. Today, regional governments are also involved in region specific R&D development activities by establishing their own research institutions. The participation of the Regional States in R&D, although only in agricultural sector so far, is of particular importance to the promotion and expansion of science and technology activities across the country. The National Agricultural System (NARS) has generated different technologies and knowledge from the various research endeavours and transferred them to users mainly farmers.

The Ethiopian Agricultural Research Institute is the apex body for the Ethiopian Agricultural Research System having 13 Agricultural Research Centres and several sub-centres established in different agro-ecologies of the country undertaking basic/applied research focusing at national level. On the other hand, five Regional Research Institutes centre mainly on regional problems. However, the federal; and the regional centres and the universities also work collaborative research.

#### *Health R&D*

Health research In Ethiopia goes back to the beginning of the 19th century when colonial scientists began the first health related research in Ethiopia. Most research conducted since then by both foreign and Ethiopian researchers focused on studying disease prevalence (magnitudes) for planning and policy recommendations, identification of risk factors underlying a given disease but with few experimental studies on traditional medicine and pharmacy.

Health R&D in the public sector are done mostly within two national research institutes: the Ethiopian Health and Nutrition Research Institute (ENHRI) and Armauer Hanssen Research Institute (AHRI), which are statutory institutions and accountable to the Federal Ministry of Health. Apart from, these two institutes, the higher learning institutions with a mandate of health and medical sciences teaching are also involved in health research and development activities. In this regard, the involvement of the Institute of Pathobiology, Medical Faculty of Addis Ababa University, Faculty of Health of Jimma University, Gondar University Faculty of Health Sciences, Faculty of Health of Alemaya University, College of Health Sciences of Mekele University, College of Health Sciences of Debube University, can be mentioned. Again, there is no statistical data on the number of scientists and researchers involved in the health research system.

- *Ethiopian Health and Nutrition Research Institute (ENHRI)*

The EHNRI is mandated to conduct research on health and nutrition, traditional herbal drugs and medical practices along with modern drugs, and to provide high-tech referral diagnostic services. The institute's research program is broadly focused on infectious disease (HIV, Malaria & TB), food science and nutrition, Traditional Medicines (safety efficacy and quality of traditional medicines used to treat community priority diseases) and other main services on epidemiological studies (referral laboratory diagnosis/ analysis, production of anti rabies vaccine, production of laboratory animals QC/QA services for regional and other laboratories and consultancy).

- *Armauer Hanssen Research Institute (AHRI)*

Armauer Hansen Research Institute obtained its name from the Norwegian physician, Gerhard Henrik Armauer Hansen, who first described the leprosy bacillus (*Mycobacterium leprae*) in Bergen, Norway. AHRI was founded in 1969 as an international biomedical research facility with the objective of researching the immunology of leprosy, through the initiative of the Norwegian and Swedish Save the Children organizations seconded by the Ministry of Health (MoH) of Ethiopia that exempted the institute from paying taxes.

AHRI is located about 30 minutes from the capital's centre on the campus of a hospital, All Africa Leprosy Rehabilitation and Training Centre (ALERT). The idea was that a combination of patient care, field control, research and training would make a dynamic composition. In later years, both AHRI and ALERT have had an increased research and patient focus on tuberculosis and other related diseases. In 2002, these two institutions were consolidated under one umbrella, the Ethiopian Ministry of Health, thus making AHRI a national institution. In 2004, AHRI was formally integrated into the ALERT structure. The rationale for a shift in ownership is to offer ALERT/AHRI an opportunity to expand research, training and capacity-building activities in a sustainable manner as well as reassess their research portfolios and updated them to the current research needs of Ethiopia.

AHRI in 2005 had five senior scientist positions, including the Director, seven research assistants and two African Fellowship positions. Two senior scientists and a Post-doctoral fellow were under recruitment according to AHRI's application with the target of hiring two female scientists. AHRI senior staff devote about 75% of their time to research and 25% to teaching and supervision of Master and PhD students (engages a handful students) from AAU as well as regional Universities.

Besides SIDA that provides 3 million Swedish kroner annually, the funding partners are Ethiopian Ministry of Health (provision includes salaries of staff), NORAD (provides 3-4 MSEK to AHRI core budget) and various other funding agencies such as the WHO, EU and Bill and Melinda Gates Foundation (provides approximately 30-45 MSEK over a five-year period) who finance on a project basis.

#### *Other*

History has shown that the agenda of science and technology development is highly correlated with advances in the industrial sector of a country. In the Ethiopian context, the industrial R&D is at the stage of infancy. In a country of over 73 million people, there is not any single institute involved in industrial R&D. For historical and other reasons, research and development activities in the industrial sector are neglected. Of course, it does not mean that there is no any R&D activity pertaining to industrial application. Indeed, there are a number of R&D projects with industrial application. Different institutions undertake these projects at higher learning institutions and institutions affiliated to the Ministry of Trade and Industry.

Industrial R&D in developed countries is generally strong since there is inseparable linkage between university, industry and government. In the case of developing countries, on the contrary, particularly in Ethiopia, industrial R&D activity is weak with considerable impact on the production system. There is lack of appreciation irrespective of capital constraints on the usefulness of R & D technological innovation and in some cases the ready availability of international technology, which may or may not be the needs as determined by the government.

Like the industrial sector, there are a number of critically important areas, which are not adequately addressed in relation to science and technology matters. In this regard, research and development activities in the area of water, energy and geosciences can be mentioned. Only some departments at the Universities of Addis Ababa, Arba Minch, Bahir Dar, Jimma, Mekele, Southern, are to some extent involved in R&D activities. Involvement of the various organizations in R&D capacity building and undertaking is very low. Even R&D departments established under some of the organizations are not engaged in R&D in proper. The situation at the Geological Survey of Ethiopia and the National Meteorological Services Agency are clear indications of this. The former has relatively good number of trained research personnel (at MSc and PhD levels), modest analytical laboratories and enormous database while the Survey is engaged only in routine mapping and exploration activities.

#### 3.2.2.2 *Higher Education R&D*

##### *Addis Ababa University (AAU)*

The first step to establish higher education in Ethiopia was made in 1950 with the creation of Trinity College, soon renamed the University College of Addis Ababa (UCAA), where classes started with 70 students and 9 staff. It was renamed Haile Selassie I University in 1962 and then Addis Ababa University in 1975.

With the humble start in 1950, the AAU now boasts of over 46,000 students<sup>2</sup> in the academic year 2005/06, mainly due to the recent reform's expansion initiative, of which females constitute 26%. However, at the graduate and post-graduate level<sup>3</sup>, there are only 5,700 students (12% of total student population) enrolled 2005/06 and 10% of whom are female students. The research and education at AAU are organised in 24 faculties, institutes and schools. The faculties of AAU consist of more than 70 departments and cover more or less all disciplines but Agriculture, which is organized as a separate faculty at Haramaya University. The highest authority at the University is the Board, which consists of representatives from various ministries<sup>4</sup> as well as the AAU President (Vice Chancellor). The board is the head of the administration of the University; it selects candidates for the post of President and Vice-President and adopts strategic and development plans for AAU. The University Senate presides below the Board and can be considered as the council of the university leadership. Recently an office for International Affairs was created at AAU to manage the relationships with the foreign donors.

In the academic year 2005/06 there were reportedly 1,275 full-time teaching staff at AAU, whereof 10% are women and 10% are expatriates. Most of the teaching resources are located in the Faculties of Medicine and Technology. Notably, at the undergraduate level, it is the College of Education that enrolls the largest number of the student population but it is the students from the Science Faculty that largely continue on to post-graduate studies. The number of support staff is around 4000.

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<sup>2</sup> Includes post-graduate, degree and diploma students.

<sup>3</sup> There is no distinction in the student enrolment statistics between graduate and post-graduate (doctoral) students.

<sup>4</sup> Ministries of Education, Revenue, Health and Investment Commission as well as House of Federation.

The first MSc programs were launched by AAU in 1979 and the first PhD program in 1987. The Associate Vice President for Research and Graduate Programs (AVPRGP) has the central role at AAU for research management and dissemination and is responsible for the coordination of the university's research programs. The office of the AVPRGP, together with the Office for International Affairs, is key in organizing and negotiating with multilateral and bilateral partners in research and higher education at AAU. The reform work at AAU aims precisely at master and PhD level studies. The aim is:

- to move from a largely undergraduate university to a graduate university;
- to transform the graduate programs into multi-disciplinary ones that are in tune with the needs of multiple stakeholders;
- to synchronize research to development needs and move it away from individual projects into more collaborative approaches;
- to promote student-centred education and to increase the overall student intake capacity.

In 2005, there were three primary sources of funding in the AAU budget. The Ethiopian government provided approximately \$20 million, tuition fees generated about 46 MSEK and external sources were listed at \$9-10million. The single biggest external donor is SIDA/SAREC that furnished approximately \$3 million. The funding by SIDA/SAREC started in 1980 and is continuing. It is estimated that they have funded research at AAU to the value of more than \$40 million over this period.

Over the recent past, AAU has established - mostly with overseas donor support (and predominantly from SIDA/SAREC) - a number of prominent research centres and facilities.

The most prominent of these are:

- *Ethiopian Flora Project*: The Flora Project has, since its initial support by SIDA in 1975, been one of the flagship projects at AAU. The aim, to build a National herbarium staffed by professionals and technicians capable of producing a modern Flora for Ethiopia, was deemed critical for the better understanding, conservation and use of the rich plant biodiversity of Ethiopia. The project has produced various outputs: 7 of the 8 volumes have been published while the last volume (on ferns) is now being written on the extended grant, a large number of MSc students and at least 6 PhD's have graduated (5 in Uppsala, 1 in Lund) from the project. Four of these are now staff at AAU; one is in the United Kingdom and one in the USA.
- *Butajira Health Surveillance Project*: To provide baseline and longitudinal community based demographic, socioeconomic and health related data; to use this information for monitoring and improving the health of the communities and strengthening health service delivery; to provide a field laboratory for health services training and research; and to provide a framework for inter-sectoral collaboration to improve health. Surveillance of vital events has been running in the Butajira Rural health programme since 1986, with support from SIDA/SAREC. About 10 PhDs and 20 Masters candidates have undertaken their projects within the study base during the years.
- *Energy Research Centre* in the Faculty of Technology devoted to solar thermal research and water resources management research.

#### *Haramaya University (HU)*

The campus of Haramaya University is situated by a lake that the university is named after, about 510 km from Addis Ababa. The foundation of what is now Haramaya University were laid around the same time as AAU was established in the capital in the early fifties. HU were

upgraded to a full-fledged University of Agriculture in 1987. The University has not limited itself to training agriculturalists. HU now offers four other disciplines<sup>5</sup> of which two were added since 2002. In addition, it has a School of Graduate Studies, Continuing Education Diploma Program as well as different in-service programs<sup>6</sup>. Although HU is now a multi-disciplinary university, it has still maintained an agricultural training and research focus. Currently the number of regular students is about 10,000 and there are some 6,000 students in the in-service programs. There is a significant increase in the regular student population; in 2001, there were only 3,000 students. In all the programs combined, 19% of the student population was females during the academic year 2003/04 - a significant improvement from 2001 when the proportion of females was less than 3%. However, of the graduate and post-graduate students, only 7% were female. As of 2004/4, there were 346 academic staff and 741 administrative staff. About 10% of the teachers were women and 20% were expatriates.

HU has the national mandate of training agricultural professionals of the Ethiopian Agricultural Research Organization, a national institute for applied agricultural research. In 2003/04, there were 14 various agricultural M.Sc programs, engaging over 200 students. Currently there are two PhD programs in plant breeding and pathology and about 24 various research projects conducted by both PhD and master students with a focus on plant sciences.

### 3.3 *Human capital for S&T*

Ethiopia's vision is to become a middle-income country by 2020. In this process, various human resource development strategies have been formulated. The Rural Development Strategy, the Capacity Building Strategy, the Industrial Development Strategy, as well as the Education and Training Policy and Strategy clearly indicate the need for large number of knowledgeable, skilled and civic human resource for the success and sustainability of achieving their stated goals. To transform the agricultural sector, to develop the rural economy and livelihood, to make the country competitive in the global economy or market, and to build overall capacity it is imperative to have large number of qualified human resource. Such a human resource needs to be capable, skilled, knowledgeable, as well as committed and dedicated to transform the country towards its mission and vision.

The main responsibility of higher education is to satisfy the demand for higher-level trained human power requirements of the country. Cognizant of this fact, a rapid expansion of higher education has recently been undertaken. In addition to the then existing two (Addis Ababa and Haramaya) universities, six additional universities (Mekelle, Jimma, Bahir Dar, Debub, Gonder and Arbaminch) have been established. This expansion has taken into account equitable distribution of the higher learning institutions among the different regions of the county.

As a result of the new expansion and upgrading of the existing ones, the intake capacity of the government higher education institutions has increased from 9,067 (Diploma 4,246 and undergraduate degree 4,821) in 1996/97 to 31,997 (undergraduate degree program) in 2004/05. The total enrolment in higher education institutions (both government and private) has increased from 42,132 in 1996/97 to 172,111 in 2003/04. This indicates that the total enrolment has increased by approximately 309%. However, Ethiopia's tertiary level gross enrolment rate (GER) is 1.5 %, which is still low even compared to the 3% Sub-Saharan average. The student population per 100,000 inhabitants is estimated to be only about 125-150, indicating that there is a critical shortage of highly trained human resource in the country.

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<sup>5</sup> Faculty of Education (second largest after College of Agriculture), Health Sciences, Law and Veterinary Medicine.

<sup>6</sup> Entails extension, summer and distance programs.

The government is also encouraging private investors in tertiary education. Currently, there are 71 diploma and 34 degree offering private institutions, which are pre-accredited and accredited by the Ministry of Education. The enrolment in these institutes also has reached to 39,125, accounting for 23% of the nation's higher education students in both diploma and degree levels. However, if one considers the undergraduate degree level enrolment, the share of private institution is about 11%. The share of female students in private institutions is high, as most of the students are enrolled in diploma programs, but low in degree programs both in private and public institutions. Therefore, concerted effort is needed to improve the share of female students in degree programs.

The existing eight universities will be expanded to have capacity accommodating 8-10 thousands additional students. Thirteen new higher education institutions, which will ultimately grow to universities, will be established. These institutions will be established in Dessie/Kombolcha, Debrebirhan, Debremarkos, Nekemt, Bale-Robe, Nazareth, Sodo, Dilla, Mizan/Tepi, Jijiga, Semera, Diredawa and Axum. At the end of the planning period, each of these new institutions will have a capacity to enrol 9-10 thousand students. From the existing universities, a college will be selected to serve as an Ethiopian Open University enrolling not less than 10 thousand students annually.

To meet the demand for qualified teaching staff, the enrolment in the graduate (Masters and Ph.D.) programs will be further expanded. By the end of the planning period (i.e. by 2009) enrolment for the post-graduate level will reach 26 000 by strengthening existing and opening new programs in all universities. As the undergraduate program has been expanding the last few years, reaching an annual intake of about 32 000 in 2004, there will be sufficient number of candidates to employ and enrol in the graduate programs.

The rapid expansion in tertiary education has brought about an increase in the number of academic staff from 1,835 (1,718 Ethiopian and 117 Expatriate) in 1996/97 to 4,803 (4,218 Ethiopian and 585 Expatriate) in 2003/04. Improvement is also noted in the percentage of female teachers, increasing from 5.83% in 1996/97 to 9.5% in 2003/04. Attempts have also been made to produce large numbers of staff for existing and newly established institutions. Masters and Doctoral program have been expanded in seven universities.

### *3.4 Financial resources (funding)*

S&T development requires a clear funding commitment from the government. Although the national S&T policy stipulates that the Government of Ethiopia be committed to allocate up to 1.5 percent of the GDP annually for S&T activities in the country, no mechanism has been developed to earmark a national budget chapter for the implementation of national S&T programmes and projects. The absence of any system to prioritise and allocate resources for S&T activities at national level is in fact one of the most significant gaps observed in the implementation of the policy.

The active R&D institutions, EARO, and EHNRI, are accountable to their respective line ministries, without any reporting responsibility to the National Council. On the other hand, the National Council has no role in approving neither the programmes nor the budget for these institutions. The other major research undertaking departments of the university system have no obligations to bring their research programmes and/plans to the attention of the National Council. In this regard, it may be worthwhile to note that the university system is accountable to the Ministry of Education, while the Ministry is not represented in the National Council.

Lastly, there is no 'hard' data available on the level of expenditures on research and development in Ethiopia. Surveys of the private sector indicate that the perception in the

Ethiopian business community is that there is very little spending on research and development taking place (IKED, 2006:14).

### 3.4.1 *National Financial Resources*

The Local Research and Development Grant is the research and development fund that is earmarked by the Government of Ethiopia for various research and development activities undertaken by young researchers. The Ethiopian Science and Technology Agency (ESTA) administer the fund in a competitive way based on criteria set for the selection and evaluation of proposals. The research grant is mainly used for research and for application of research results in service, development and production sectors and for other related scientific and technological activities. Applying for the local research fund is therefore open to all public and private organizations that have the potential to undertake R&D.

Specific criteria and percentage ranking for Local Research Grant sponsored projects. Proposals that satisfy the general evaluation criteria cited above will again be reviewed in accordance with these specific criteria:

|  |     |
|--|-----|
| 1. Addressing National Objectives                                    | 30% |
| 2. Methodology and Technical Viability                               | 20% |
| 3. Area of Research (New, Applied, Neglected)                        | 18% |
| 4. Benefit and Beneficiaries (Project making range of applicability) | 15% |
| 5. Institutional Capability  | 12% |

No information is available on the number of grants made or the monetary amount awarded since this grant scheme was introduced.

### 3.4.2 *International donor funding*

SIDA is one of the few, if not the only, foreign agency that supports ESTA and channels its research support through the organisation. SIDA is one of the major foreign contributors to research and capacity building at the Addis Ababa University representing 30-40 % of the foreign support and approximately 15% of the total governmental contribution. The Swedish contribution to Alemaya University is around 6 MSEK while the governmental research allocation is around 1.5 MSEK. Sweden is together with Norway the only core support contributors to AHRI apart from the Ethiopian Ministry of Health. The Swedish contribution represents 40 - 50 % of the external core support. Given the continued and disproportionate amount of funding by one international donor agency, it is appropriate to focus more on the nature of SIDA's involvement in Ethiopia over the past 25 years.

#### 3.4.2.1 *SIDA/SAREC support to Ethiopia*

Research and capacity building support to Ethiopian institutions (ESTA, AU and HU) dates back to 1979 when support for Masters Programs in Science at Addis Ababa University commenced. This constituted the *first phase* of SIDA/SAREC research and capacity-building support and lasted until 1986 when the transition to PhD support of various kinds were introduced.

The *second phase* of support focused on two kinds of programs: Project-tied PhD training and the Sandwich model of collaborative training. The Project-tied Model provides PhD training where student register in, and are awarded their PhD's, at universities principally in Sweden (but occasionally elsewhere as in the UK and South Africa). In this sense, these programs are similar to other programs in which a student undergoes training in a foreign country. The difference is that the training is a capacity-building component, tied to a research project in

Ethiopia implemented mainly through the collaborative efforts of Ethiopian and Swedish university departments. The candidates carry out research on Ethiopian problems emanating from the research projects. In this sense the training is similar to the Sandwich model as it involves the trainee spending part of his or her time in Ethiopia doing field and laboratory work. This training modality has been used since 1979.

The Sandwich model is a collaborative training program conducted jointly by Ethiopian and foreign universities (mainly Swedish universities). In this model, the candidates register for their PhD's at Ethiopian universities (AAU or AUA) and work under the guidance of Ethiopian and Swedish advisors. The candidates spend part of their time at the foreign universities taking required theoretical courses and learning the latest experimental and analytical techniques. The trainees return to their local universities to conduct research on relevant Ethiopian problems or topics. Ethiopian universities award the degrees. SIDA/SAREC has supported the sandwich programs since the 1986/87 (AAU) and 1998/99 (HU) respectively.

According to a 1999 evaluation study a total of 34 PhD students were supported under the Project-tied training model (at AAU, HU and Awasa College of Agriculture) and a further 21 PhD students under the Sandwich Model. Not all of the students who were enrolled at the time had graduated yet. At the time of the report (1999), 37 students (out of the 65) had graduated successfully.

The "second phase" of support was suspended in 1998 with the advent of the war between Ethiopia and Eritrea. It would only be towards the end of 2001 when discussions were again reopened with the Ethiopian institutions that a new agreement for the period 2002 – 2004 was signed effectively heralding a *third phase* of support.

The purpose of SIDA/SAREC support during this third phase was to continue to strengthen the national coordination of research, to strengthen the Addis Ababa University (AAU) and Haramaya University (HU) as postgraduate institutions, and strengthen the Armauer-Hansen Research Institute (AHRI) as a national medical research centre. Further, it aimed to continue the ongoing process of building capacity at university and faculty level focusing on PhD training of staff on a sandwich basis in collaboration with Swedish Universities. Initially there were management problems within the program but joint efforts of cooperating partners and SIDA have led to improvements and the start of an administrative reform program.

The agreement on research cooperation during this period had been established with the Ministry for Finance and Economic Development (MOFED), which delegated the implementation and coordination of the program to the Ethiopian Science and Technology Agency (ESTA). In addition, oversight of the financial and activity reporting and nationwide activities included in the program, such as library support, were handled by ESTA. Apart from capacity building, an important part of the program has been ICT infrastructure development mainly at the Addis Ababa University accompanied with training of ICT professionals. Support was also allocated to strengthening the management capacity at both ESTA and AAU.

A *fourth phase* was entered in mid-2005 with an additional grant being awarded for a period of 18 months until the end of December 2006. In June 2005, SIDA invited the Ethiopian Science and Technology Agency (ESTA), to submit a proposal for continued research cooperation for a period of 1.5 years. The aim with the invitation was to allow for a final contribution to the ongoing program and to support university reforms while preparing for a possible new program. The suggested support included: Academic and administrative reforms AAU ongoing research and research capacity building at AAU and AU, a nationwide prescription to electronic journals, strengthening of the coordination capacity at ESTA, and core support to (AHRI). The support to university reforms is in line with the nation wide expansion in higher education, the Ethiopian Governments aspiration to transform AAU into

research based graduate universities and AAU's revised strategic plan. The current expansion of higher education in Ethiopia has created somewhat different conditions for research and research training as compared to the earlier program periods.

The research cooperation between Ethiopia and Sweden has now been in existence for nearly 25 years. Over the period 1980 to 2005 a total of approximately 330MSEK (approx. \$50 million) has been disbursed to four Ethiopian institutions: Addis Ababa University, Haramaya University, AHRI and ESTA. This translates into an average annual amount of approximately \$2.5 million.

### 3.5 *research output*

Total output as recorded in the ISI web of science for the period 1994 – 2004 is 1896 papers. Of these, 1493 (or nearly 80%) was produced by an author or authors affiliated to Addis Ababa University. The value or significance of Swedish support to Ethiopia is also illustrated by the fact that 207 papers of the total output were co-authored by a Swedish scientist. The output per year (Table 6 below) shows a steady production of approximately 200 papers per year over the past 7 years.

**Table 6: Output per year in ISI-indexes**

| Year | Papers |
|------|--------|
| 1994 | 15     |
| 1995 | 112    |
| 1996 | 119    |
| 1997 | 157    |
| 1998 | 202    |
| 1999 | 255    |
| 2000 | 236    |
| 2001 | 204    |
| 2002 | 226    |
| 2003 | 151    |
| 2004 | 219    |

The Figure on the next page presents a “map” of co-authorship patterns and identifies the major producers of research papers as well as collaborating institutions.

### 3.6 *Technological innovation*

The national science and technology system is expected, among other things, to create competitive and attractive environment to S&T activities through incentive mechanisms. To this effect, the national science and technology policy stipulates that awards and prizes would be prepared for outstanding innovations and productive achievements in the fields of science

and technology. Based on this provision, the Government introduced a National Award System for best performers in science and technology. The award system was instituted as per the decisions of the first meeting of the National S&T Council that was chaired by the Prime Minister of the Transitional Government of Ethiopia in 1995.

In the Ethiopian situation institutionalized support and policy back ups have no long history. Better understanding of their important role in the economy has been in the making in the last two to three decades. The establishment of the Federal Micro and Small Enterprises Development Agency (FeMSEDA) is a milestone for the promotion of micro and small enterprises for commercial and entrepreneurial supports in collaboration with similar interest groups. FeMSEDA provides training and consultancy on project design, micro financing and marketing information services. Other training concerns include basic management principles, business take off and improvement methodologies, general entrepreneurship equipment erection & product and building designs.

### 3.6.1 *Technology balance of payments*

No information available.

### 3.6.2 *Patents*

No information on number of patents filed with the EIPO.

Table 7 summarises the annual number of patents filed with and granted by the European Patent Office and the United States Patent and Trademark Office, respectively. The reference period is the years 2000 to 2005. As the data show, only a very small number of patents were filed and granted over this period, demonstrating the lack of technological innovation in Ethiopia.

**Table 7: Number of patents filed and granted by the EPO and USPTO, 2000-2005**

| Country | European Patent Office (EPO) |         | United States Patent and Trademark Office (USPTO) <sup>7</sup> |         |
|---------|------------------------------|---------|--|---------|
|         | Filed                        | Granted | Filed  | Granted |
| 2000    | 0                            | 0       | 0  | 0       |
| 2001    | 0                            | 0       | 0  | 0       |
| 2002    | 0                            | 0       | 0  | 0       |
| 2003    | 0                            | 0       | 0  | 0       |
| 2004    | 0                            | 0       | 0  | 0       |
| 2005    | 1                            | 0       | 0  | 0       |

Sources: [www.epo.org](http://www.epo.org) & [www.uspto.gov](http://www.uspto.gov)

<sup>7</sup> According to information available from the USPTO 6 patents in total have been granted to Ethiopian inventors. All of these six grants were granted in 1976 and 1977 with no indication of any subsequent applications for grants.

### 3.6.3 *Innovation strategies*

The International Organisation for Knowledge Economy and Enterprise Development has produced a report on innovation and growth in Ethiopia in 2006. In the report, potential strategies to kick-start innovation in Ethiopia are discussed (IKED, 2006:23-25):

- A strategic and immediate challenge for Ethiopia will be to create more autonomy and room for specialisation in universities, to improve conditions for entrepreneurship, and to enhance the network and mobility linking different capabilities and actors in the innovation system through mechanisms and institutions that allow them to interact in a mutually rewarding manner. This implies working towards a system where pluralism of initiatives is cultivated. Conditions must be put in place for the key actors to fulfil their roles, without top-down intervention.
- Academic researchers should not only be in a position to focus on science and education but they, along with government officials, need to have a better understanding of entrepreneurship. Entrepreneurs, on their part, should be more able to work with universities. There need to be fora for academic and industrial researchers to meet, and where government institutions can take on a variety of roles to facilitate and foster a dynamic interface. Agricultural productivity represents one such area where research and business links can make significant advances through joint, interrelated efforts. For these advances to be useful to, and for them to reach, small-scale farmers in remote areas, the public sector can make important contributions through the provision of infrastructure, reforms of conditions for micro credit and the registering of new firms, etc.
- The national strategy recognizes the important role that universities can have in fostering science and technology, in adapting advanced technologies to solve local problems, and in supporting economic development more broadly. However, in the right circumstances, the universities could take a stronger lead in encouraging innovation in ways that are conducive to economic development. Their role could potentially extend from providing educated workers and entrepreneurs and undertaking research, to enhancing integration, cross-fertilization and collaborative action between academia, private sector and government. The undergoing expansion of the number of universities could inject such impulses in different regions, industries, and social spheres.
- In order to fulfil such roles, universities need to adapt and adjust to specific structures and circumstances. They need to specialize and prioritize their roles, and be able to build local connections as part of a striving to excel in their special areas of expertise. They need to use scarce human and financial resources strategically, and develop specific competences instead of spreading their efforts thin across multiple areas. Regional features do, in fact, already constitute more of a focus in university expansion in Ethiopia. In order to advance further, however, universities need to meet with stronger driving forces that promote appreciation among their constituents for social alliances and impacts, along with the perfection of traditional academic merits. In order to achieve this, there is a need of adjustments to the mechanisms for funding universities, so to become more performance-based and responsive to the whole range of relevant performances.
- If universities are to become more dynamic, governments and businesses must be induced to play a role in the interface, and assist in the formation of linkages in the triple helix from their end. In terms of realms for action, a “laundry list” of functions to consider includes:
  - Reviewing the direction and selection criteria for research funding, so as to promote pluralism, specialization and the range of relevant performances;
  - Participating actively in the build-up of science parks and incubators, and ensure that they are able to accumulate competences, and meet with objectives, that orient their efforts to fulfilling a bridging role;

- Providing a knowledge-base (perhaps through intermediation with other actors abroad) for science and technology challenges specific to Ethiopia – water, disease control, etc.;
- Eliminating excessive bureaucracy, reducing red tape and putting in place tax incentives and better mechanisms for the diffusion of venture and seed capital, so as to remove impediments to the establishment of new firms, and strengthen the incentive for informal business to enter the formal economy;
- Using ICT, notably cellular technology, for demanded and currently undersupplied services to be better articulated and mobilized, to spur and commercialise innovations in for Ethiopia instrumental areas, such as the provision of informal capital and micro-credit, health, sanitation, ecological sustainability, education, and so on;
- Developing and maintaining alumni- and other networks in order to broaden human linkages between the spheres of the triple helix;
- Strengthening links with academic institutions abroad;
- Expanding linkages with migrant networks abroad, put in place mechanisms that ensure safe remittances, to provide an interface that can exploit complementary pools of skills and help increase market access, and funding.

### 3.7 *International co-operation and networks*

One of the strategic objectives as formulated in the new revised S&T policy document (2006) is to “Ensure bilateral, regional and international scientific and technological Cooperation”. Under this heading, the following specific initiatives are foreseen:

- Cooperation in S&T at sub-regional, regional and international levels shall be accorded due consideration for the mobilization of resources, exchange of information and experience as well as to carry out joint S&T programmes.
- Sustainable S&T cooperation shall be enhanced with developing countries particularly with neighbouring countries with a view to exchanging appropriate technologies and for the sharing of resources for collaborative research programmes.
- Sustainable S&T cooperation shall be pursued with developed countries to build national S&T capability and foster its application for development.
- An effective Science and Technology (S&T) cooperation shall be promoted between Ethiopia and the United Nation (UN) system and other multilateral agencies.
- Mechanisms will be created to ensure that regional and international S&T cooperations initiated locally as well as externally are based on mutual understanding and international frameworks.

Ethiopia has established cooperation with regional and international organizations and research programmes since the establishment of higher learning institutions and when a full-fledged research institute established in the 1960s. The collaborative work with international institutions include the Swedish Universities, the Norwegian Universities and the U.S Land Grant University which focused on human resource development and on generation of knowledge in areas of central importance and relevance to national development. The collaborative efforts with such organizations at times may also extend to either share available expertise or mobilize financial and material resources. Collaboration with International Atomic Energy Agency (IAEA) has resulted in commencement of such important research projects in HIV/AIDS vaccine development scheme studies on drug resistant Tuberculosis and Malarial diseases etc using isotope techniques.

From this research collaborative programme, a significant number of PhD and M.Sc students. In addition, the national research system has collaborative research programs with WHO,

UNIDO, UNAIDS, International Agricultural Research Centres of the Consultative Group of the International Agricultural Research (CGIAR) that had regional or national programmes. For example, CIMMYT programme on maize and wheat; ICARDA programme on pulses, barley and durum, wheat CIAT on beans, ICRISAT on sorghum, CIP on potatoes, ILRI on livestock and pastures etc.

Ethiopia has maintained fruitful collaboration with donor organizations and has received generous donor support principally among others from IAEA, EEC, IDRC, Sweden, Russia and many other countries. Considering Ethiopia's needs, both bilateral and multilateral organizations will continue to support the country to achieve its national development agenda of food security and sustainable development. The collaboration contributed to the generation of useful improved high yielding varieties, animal breeds, and technologies and knowledge based agricultural production practices.

In spite of this, Ethiopia benefited from a range of regional research activities it had participated even though many of the programmes phased out. The country has a collaborative work within the Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA) that is a sub-regional organization to enhance and mobilize resources for agricultural research in ten Eastern and Central African countries. ASARECA has networks, programmes and projects made up of various commodity and sector research networks in the region. In the field of trypanosomiasis and tsetse research, there are regional institutions and projects operating collaboratively in the region to contribute effectively to trypanosomiasis and tsetse control.

In the area of new emerging technologies, a BioEARN regional programme is in place since 1999 to build the capacity of the network partner countries namely, Ethiopia, Kenya, Tanzania, and Uganda in biotechnology research, biosafety and biopolicy. So far, 20 PhD students trained in the region and core scientific and laboratory equipment and facilities acquired with the ultimate goal of establishing biotechnology centre of excellence in the region.

The four areas of NEPAD to harness science and technology to fight poverty, improve human health, protect the environment, promote industrialization and help advance global science and innovation for development are ICT, Geosciences, Environmental Sciences and Biosciences. The Bioscience Facility for Eastern and Central Africa will pave the way for a network of African Centre of Excellence. The establishment of the Bioscience Eastern and Central Africa Will provide a focal point for the African Community for fruitful interaction at the regional and international levels in which researchers and institutions cooperate to exchange experiences, benefit from each other's strength and create a critical mass of joint contributions. Inversely, regional and international programmes can contribute to capacity for research in collaborating countries. In addition to the international and regional collaboration, the federal research centres undertake research of national interest in collaboration with research centres organized under the local agricultural research institutes, higher learning institutions and animal health laboratories.

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