



Strathmore
UNIVERSITY

SCHOOL OF HUMANITIES & SOCIAL SCIENCES
BACHELOR OF ARTS IN DEVELOPMENT STUDIES & PHILOSOPHY
END OF SEMESTER EXAMINATION
BDP 3104: TECHNOLOGY IN DEVELOPMENT

Date: Thursday 5th November 2020

Time: 13:30-15:30

Instructions

1. This examination consists of **FIVE** questions.
2. Answer **Question ONE (COMPULSORY)** and any other **TWO** questions.

Q 1 (Compulsory)

- A. The theories of ‘technological determinism’ and ‘social construction’ can influence society’s approach towards technology. Illustrate how this could happen, giving examples. (15 m)
- B. You have been invited to a government ‘think tank’ that is examining a draft national technology policy (see attached *in the section below*).
 - I. Suggest a better structure (section headings only) for the policy document (5m)
 - II. Explain at least 2 strengths of the current draft (4m)
 - III. Explain at least 3 weaknesses of the current draft (6m)

Q 2. Technology has shaped human society and development from the earliest times. Using two example of ancient technology that have lasted until modern times, state and explain your opinion of how human society would be today without these technologies. (15 m)

Q 3. The invention of the internet in 1990 by Tim Berner-Lee heralded a technological revolution. Justify the characterization of the internet as a ‘revolution’ using different examples from daily life. (15 m)

Q 4. The ‘technologies of population’ have been at the centre stage of social discourse since the publication of ‘The Population Bomb’ a best-selling book written by Stanford University Professor Paul R. Ehrlich and his wife, Anne Ehrlich. What role do technologies of population play in society today and why is Ehrlich’s book considered an important trigger? (15 m)

Q 5. Automation, artificial intelligence and algorithms are terms associated with new disruptive technologies. Using real illustrations, explain the ways in which these new technologies are likely to affect the future of society. (15 m)



BACKGROUND TO THE TECHNOLOGY POLICY

1.1 Rationale for the Technology Policy and Its Formulation Process

1.1.1 The Existing Policy Environment

Tomonia has since 1994 been involved in formulation of a national Technology Policy through several stakeholder consultations on technical processes. The current draft policy document was reviewed in 2001 and 2006 to take into account new developments in science, technology and innovation (STI). However, Government has not formally adopted a national Technology Policy to date. Therefore, Tomonia currently does not have a comprehensive and overarching national Technology Policy to facilitate development of the sector. The country's STI system is currently managed through a constellation of macro and sector policies that lack STI specific indices of development. This has resulted into growing public concern, especially among the scientific and research community, about the near relegation of STI as a development priority; and the ad hoc and often uncoordinated responses to STI demands at both sector and national level.

1.1.2 National Development Initiatives

There are a number of national development policy initiatives such as the National Development Plan (NDP) which is a successor to the Poverty Eradication Action Plan (PEAP), the Plan for Modernization of Agriculture (PMA), the Industrial Development Strategy, the Medium Term Competitive Strategy (MTCS) for private sector development, and the Millennium Science Initiative (MSI), (Box 1) that are relevant to the STI sector through vertical and horizontal linkages.

Box 1: Recent Key National Policies Affecting the STI Sector

Constitution of the Republic of Tomonia, 1995
The Poverty Eradication Action Plan, 2004/05-2007/08
The National Development Plan, 2010/11-2014/15
The Plan for Modernization of Agriculture, 2006/07
The Health Policy, 2001/02
The Science Education Policy, 2005
The National Agricultural Research Policy, 2004
The National Environment Management Policy, 1995
The Information and Communication Technology Policy, 2003
The National Forestry Policy, 2001
The National Gender Policy, 1997

1.1.3 Regional and International Commitments

Tomonia is party to a number of regional and international agreements on STI (Box 2), especially under the United Nations, the Commonwealth, the African Union, and the New Partnership for Africa's Development (NEPAD).

1.1.4 Importance of Technology to Development

The Government recognizes that Technology is critical to Tomonia's socio-economic growth and transformation. The Government further recognizes the key role that STI play in fostering research and development and in building the human capital that Tomonia requires for the future knowledge-based economy.

1.1.5 STI Stakeholders

The Government also recognizes the multiplicity and diversity of STI stakeholders whose interests, roles and responsibilities require defining and coordinating. These include the central government, SETIs, local government, private sector, NGOs and CBOs, academia, researchers, science and technology professionals, policy makers and implementers, development partners, farmers, artisans, consumers of products of STI activities, and the general public.

1.1.6 Policy Formulation Context and Process

Having recognized the importance of science, technology and innovation in development, in light of the wider national development initiatives and, deriving from the Tomonia National Council for Science and Technology (TNCST) Statute No.1 of 1990 (CAP 209 of the Laws of Tomonia) provisions on Technology Policy formulation, the Government of Tomonia through the TNCST initiated the Technology Policy formulation process in 1994 and conducted subsequent policy reviews in 2001 and 2006 as part of the strategic undertaking for integrating science, technology and innovation in the national development process. The Council involved various stakeholders in the national STI system in identifying major issues of policy concern; and continuous debates on both the content and strategic direction of the current version of the Draft National Technology Policy.

The policy formulation process more recently capitalised on Government efforts to reform the science and technology sector that were initiated in FY 2004/05. Government conducted comprehensive situation analyses of the status of STI in Tomonia as part of the process of revitalizing the STI sector. The Country STI Profile and other empirical studies established the sector requirements for effective development and contribution to the national economy. Several consultative stakeholders' forums were convened during financial year 2004/2005 to enrich the draft Technology Policy. Consequently, the current Technology Policy document is reflective of the empirical findings of the sector studies, stakeholder aspirations as well as government commitment to science and technology development.

The Policy therefore, consolidates previous efforts and provides new strategic directions for sustainable development of the STI sector and the national economy at large. The Policy acts as a foundational platform for Tomonia's transformation, and prioritises strategic areas of action. It sets targets and defines organisational and management requirements for a fully operational national science, technology and innovation system. The policy will build Tomonia's STI capacity in various aspects, especially in the area of technology generation, transfer and application. It will nurture STI as a productive sector; improve productivity in all economic sectors; and facilitate implementation of Tomonia's regional and international obligations.

1.2 Opportunities and Constraints in the Technology Sector

1.2.1 The Status of Technology Development in Tomonia

1.2.1.1 STI Infrastructure and Services

Tomonia's science and technology infrastructure currently stands at 27 Universities with only 6 offering science and engineering courses; 33 science-related vocational and technical institutes (NCHE 2005); 20 active R&D institutes, 2 national museums; 1 functional public library and 5 private laboratories (TNCST, 2007). The national expenditure on science and technology services increased from £. 49.2 billion in fiscal year 2002/2003 to £. 77.1 billion in fiscal year 2005/2006. This signifies a modest improvement in activities concerned with R&D and contributing to the generation, dissemination and application of scientific and technical knowledge. Overall this level of STI infrastructure is inadequate to facilitate STI-driven development.

1.2.1.2 Human Resources Development

Tomonia's human resources in science and technology of 0.5 researchers (FTE) per 1000 members of the workforce is far inadequate as compared with over 5 per 1000 for the developed world (TNCST, 2005). At the same time, the ratio of 1.0 R&D personnel (researchers, technicians and other S&T support staff) per 1000 of the labour force is considerably lower than that of the OECD countries that ranges between 5-18 R&D personnel per 1000 of the labour force.

The current education system emphasizes theoretical academic work with little depth of applied science, engineering and technical skills which are central to technological innovation. Presently, there are 27 public and private universities in Tomonia of which only 6 Universities offer science related programmes. The ratio of arts to S&T graduates at these Universities is 5:1. An analysis of post-graduate training has revealed that graduates at masters and doctoral levels in science and technology fields are relatively low: less than 10 PhDs in S&T per annum. Apart from Makerere University which was ranked 54th in Africa in 2007, the overall ranking of other Tomonian Universities and specialised STI institutions is extremely low, compared to counterpart Universities in the developing world.

1.2.1.3 Research and Development

Tomonian Universities and Research and Development Institutions have a weak research capacity. Only 91 scientific publications were produced in internationally recognized scientific journals in 2001 (USPTO, 2001; TNCST, 2005). Given the limited research capacity, the bulk of research work is of basic nature with limited potential for industrial development. In situations where applied and development research exists, it is rarely transformed into feasible technological packages for the production of goods and services.

The majority of high quality scientific research activities in the country are carried out in a small number of research institutes especially in the fields of agricultural and medical sciences. World-class discoveries have been made in HIV/AIDS prevention and vaccine trials, cassava mosaic eradication, and development of clonal coffee. These are supported mainly by foreign sources of funds.

Tomonia's government expenditure on R&D as a percentage of GDP amounted to 0.3% in 2005/06. This is below the recommended 1% for the nations of Africa (AU, 2006). There are 724 researchers involved nationally in R&D activities, of which 38% are female. Fifty three percent of the researchers work in the government, 36% in the higher education sector, 8% in the business enterprise sector and 3% in the private non-profit sector (TNCST, 2006).

The national expenditure on research and development fluctuated between £. 39.8 billion in 2002/03 and £. 34.5 billion in 2005/2006. This implies relatively unpredictable funding for research and development largely due to dependence on foreign sources.

1.2.1.4 Investments in Technology Development

Government is aware of the need for stronger capacity in science and technology for addressing the goals of the Poverty Eradication Action Plan (PEAP) and for promoting Tomonia's industrialisation efforts. S&T as a percentage of government expenditure has increased from 3.3% in 2004/05 to 3.7% in 2005/06. During FY 2005/06, government spent £. 138 billion on S&T of which R&D accounted for 25%, S&T education and

training 19%, and S&T services 56% (Table 1.1). This is indicative of significant government commitment to the STI sector that should be enhanced and sustained over the long term.

TABLE I.1 : TECH SECTOR FUNDING FY 2005 / 2006

| Item | Recurrent | Capital | Total | Donor Contribution to - Budget | Breakdown of Donor funding |
|----------------------------|-------------------|-------------------|-----------------------------|--------------------------------|----------------------------|
| R&D¹ | 5,423,710 | 29,107,342 | 34,531,052 (25%) | 19,630,248 (56.8%) | 52.7% |
| STET² | 10,053,201 | 16,179,500 | 26,232,701 (19%) | 11,497,500 (43.8%) | 30.8% |
| STS³ | 35,430,876 | 41,717,500 | 77,148,376 (56%) | 6,132,000 (7.9%) | 16.5% |
| S&T (1+2+3) | 50,907,787 | 87,004,342 | 137,912,129 (100.0%) | 37,259,748 (27%) | 100.0% |

| | |
|--------------------------------|------|
| R&D as % of GDP | 0.3% |
| R&D as % of Gov't. Expenditure | 0.9% |
| S&T as % of GDP | 1.2% |
| S&T as % of Gov't. Expenditure | 3.7% |

1.2.1.5 Product Development and Innovation

Innovation is the driving force of a nation's economic development and the improvement of competitiveness of its enterprises. The innovation capability of firms in Tomonia is still very low: According to the S&T innovations survey conducted by TNCST in 2005, only 57 percent of firms were found to have introduced at least a new product or service or improved on an existing one in the market over the last five years. Besides that, most of these products/processes were in firms engaged in agriculture and agro-processing.

The Government established a Science and Technology Innovation Fund in fiscal year 2003/2004 for local innovations as an ongoing mechanism to supporting and facilitating the national innovation system. Some of the measures envisaged to address the various challenges within the national innovation system (NIS) include the sensitisation of local innovators, establishment of institutional mechanisms for promoting innovations, and integrating S&T innovations within the National S&T Policy. The Innovation Fund is currently under review and its sustainability uncertain.

1.2.1.6 Legal and Regulatory Framework

Tomonia has developed regulatory frameworks for STI such as the Patents Act (2002), Research Registration and Clearance Policy and Guidelines (2007), National Guidelines for Research involving Humans as Research Participants (2007), and the National Environment Regulations (2005). Instruments to regulate application of the frameworks are embedded in provisions of sectoral laws that relate to broader areas such as agriculture and environment. As a result, various institutions implement elements of STI as stipulated within their mandates. However, this has in some instances, led to duplication of effort, conflict of interest and disjointed coordination of regulation aspects of science, technology and innovation.

1.2.1.7 IPR Protection – Patenting of Innovations

The number of Patents held by citizens are good indicator of the technological capacity of a nation. Records at the Tomonia Registration Bureau Services (URBS) indicate that by the year 2004, a total of 26,198 trademarks had been registered, and of these, only one-third were local. In the case of patents, very few applications are received annually. According to recent TNCST survey data, only 40 patents have so far been granted for local inventions and usually less than 3 patent applications are submitted in any given year. The low number of patent applications is largely attributed to the low innovative activities, the low percentage share of spending on R&D to GDP and the small number of scientists and engineers actively involved in R&D activities.

1.3 Challenges Facing Tomonia's Technology Sector

1.3.1 Institutional Challenges

1.3.1.1 The Policy Framework:

The Tomonia National Council for Science and Technology (TNCST), which was established by Government in 1990 as the overall sector coordination agency, has developed and reviewed the national science and technology policy which the Government has not yet formally adopted. The absence of a comprehensive and overarching national Technology Policy has resulted in under development and near relegation of STI as a development priority.

1.3.1.2 The Institutional and Legal Framework:

Tomonia's STI system is fragmented. It is governed by a combination of sectoral ministries and numerous autonomous institutions (Councils, Commissions, and Authorities) whose mandates, in some instances, with regard to S&T development appear to overlap rather than complement and enhance each other. The existence of a plethora of SETIs often with somewhat parallel mandates complicates the national STI coordination function of government. Moreover, the TNCST Statute No.1 of 1990 (Cap 209 of the Laws of Tomonia 2002) does not explicitly spell out the TNCST regulatory functions or adequately empower it to undertake the co-ordination function for effective execution of its mandate. The Council, therefore, uses guidance and advice approaches rather than the more effective legal and regulatory approaches in management of science and technology development.

1.3.1.3 The Financial Resources Base:

There is currently no sustainable provision for financing of STI and, especially R&D, which has so far been put in place. As a result, sector support for STI is inadequate and scattered across various economic sectors. Consequently, the system is under funded to the extent that over 50% of R&D funding is from external sources. The modest financial resources that are availed to the public funded science, technology and engineering institutions (SETIs) have limited the scope and magnitude of their programs and constrained institutional development in terms of S&T infrastructure, human resources and programs.

1.3.1.4 Institutional Infrastructure and Human Resource Capacity:

Due to the above-mentioned financial challenge, SETIs find it difficult to acquire and maintain infrastructure for R&D and administration. Similarly the SETIs face human resource capacity challenges largely due to uncompetitive pay levels, nonconductive work facilities and conditions.

1.3.2 Sector wide Challenges

1.3.2.1 Institutional Capacity:

Several demands by stakeholders on the STI system have further outstretched the limited financial and human resources available for science and technology development. At the sector level, the prevailing labour situation cannot support the required expansion of industry, which requires more engineers, technicians and artisans.

1.3.2.2 Financing:

Limited financial resource base for the sector resulting from the competing demands on the limited national resource envelope and other unforeseen circumstances such as compelling needs for changes in national development priorities.

Science, technology and innovation by its nature is not favoured by the current funding modality of the medium term expenditure framework (MTEF) because of the long time lags between research and product development which are characterized by a high degree of uncertainty and a minimum likelihood of immediate direct contribution to GDP as required under the MTEF. STI requires a somewhat different funding arrangement that entails sustained long term financing commitments.

1.3.3 Global Challenges

These challenges are a result of globalisation by which the world has become a global economy driven by information, technology and knowledge. Like many other developing countries, Tomonia is currently afflicted by both the digital and economic divides between developed and developing economies that tend to exacerbate the challenges of underdevelopment. These divides threaten to further exclude Tomonia from participating in or benefiting from cutting edge technological advances. The digital divide is typified by the relatively low level of penetration of information and communication technology, while economic divide is typified by Tomonia's co-existence with relatively economically advanced economies in a trade relationship where Tomonia is a net importer and market for technology intensive and high value products from developed economies. The economic divide is exacerbated on one hand, by Tomonia's low productive capacity and bargaining power in the global market, and on the other, by the inability to cope with the rapid pace of technological advancements in the developed world.

Furthermore, the global trade and intellectual property policies also tend to disfavor countries that are still in their infancy in terms of technological advancements. This stifles opportunities for technology transfer and local innovation leading to, among others, technological terms of trade and balance of payments favourable to the relatively advanced economies.

The budding local scientific innovation and product development is variously affected by unfavourable global terms of trade and intellectual property policies. The local commodity market for nationally produced products is open to competition with commodities produced at an advantage of scientific knowledge and economies of scale. The foreign highly protected markets are almost impenetrable for the locally produced commodities. The opening of foreign markets through international and regional trade initiatives could provide an opportunity for Tomonia to develop local innovation and product development capacity.

1.4 Contribution of STI to Development

Technology are critical to sustainable socio-economic growth and transformation of Tomonia. The Government recognizes the key role technology plays in fostering research and development and in building the human capital that Tomonia requires for the future knowledge-based economy. There is ample evidence to illustrate that the ability to compete in the provision of high quality products and services largely depends on the level of investment in STI. Developed and emerging industrialized countries spend 2% to 3% of their GDP on research and development; the estimated figure for Tomonia is averagely 0.2-0.3% of R&D. It is, therefore, essential to provide high priority to scientific and technological development needs in the overall socio-economic development strategy of the country. STI are envisaged to contribute effectively to diversification of the economy and sustainable use of natural resources. Some of the contributions of STI include:

1.4.1 Economic Growth:

Industrialized countries have grown faster than developing countries over time, because of higher investments in STI that has led to increased firm level productivity resulting in high GDP growth rates.

1.4.2 Employment Creation:

Technological progress leads to increased factor productivity, and firm expansion, increased labour absorption capacity and employment.

1.4.3 Technological Progress and Export Promotion:

Technological progress leads to cost reductions and increase in productivity. Innovating firms are able to cut down the costs of production and thus increase output for both local and foreign markets. The higher quality and lower prices of goods and services resulting from increased productivity are likely to increase international competitiveness and boost foreign exchange earnings.

1.4.4 Human Capital Development in Science and Technology:

Economies that are driven by scientific and technological innovation rely on existence of a critical mass of scientists and engineers. Capacity building in STI fields is therefore essential for building this human resource base for STI-led growth.

1.4.5 Environmental Conservation:

S&T contributes to a good environment and a rich natural resource base, which are all critical for poverty eradication and economic growth. It is estimated that this sector contributed 54.4% of total GDP in 1998 (TEPB, 2004).

1.4.6 Science Tourism:

Science tourism focuses on flora, fauna, visits to scientific parks etc. Tomonia's tourism is largely

confined to the nature tourism segment with some small contributions from cultural tourism; rural tourism and business travel. Tourism represented a quarter of the total value of exports of goods and services that the country generated in 2004. The total revenue from exports of services was US\$700 million of which about 45% was from tourism (TEPB, 2004).

1.4.7 STI and Rural Livelihoods:

Science, technology and innovation play a significant part in shaping the livelihoods of the rural folks who include peasant farmers, artisans, traders and casual workers. The amount of technology available to the rural communities determines the health, productivity, level of development and social economic well-being of the rural population which currently stands at over 70% (UBOS, 2005). A significant proportion of the 31% of Tomonia's population that is below the poverty line, are resident in rural areas. This is largely due to low levels of STI development in rural Tomonia.

1.5 STI Sector Coordination

1.5.1 Institutional Responsibilities

The responsibility for managing the STI activities and several technology-intensive programmes is currently entrusted in various government institutions such as departments, Authorities, Commissions, Councils and some private sector institutions with very little coordination or sharing of lessons and experiences. This policy emphasizes the need for a clear coordination framework among the various SETIs.

1.5.2 Demarcation of Roles

The policy also seeks to demarcate institutional roles and responsibilities in policy implementation in line with their mandates.

1.5.3 Coordination

Sector coordination has been mainly effected through a multi-sectoral Council, several sector and inter-disciplinary committees on agriculture, health, ICT, industry, physical sciences, natural sciences, social sciences and humanities coordinated by the TNCST. This framework emphasizes individuals rather than institutional representation and therefore requires strengthening in terms of composition, numbers and modality of work as well as inter-sectoral and inter-institutional linkages and collaboration.

1.5.4 Definition of Stakeholder Roles

The Role of Central Government: The Central government will formulate policies, enact regulations and provide adequate financing for implementation of STI policies and regulations. It will also provide an appropriate institutional framework for policy implementation and performance monitoring and evaluation.

The Role of SETIs:

The science, engineering and technology institutions will implement the Technology Policy through appropriate programmes and projects as provided for by their institutional mandates.

The Role of the Local Government:

As provided for under the Local government Act (1997) for devolution of powers from the central government to the district and other lower councils, the Local governments will ensure participation of the local communities and districts in the formulation, implementation and monitoring of STI activities.

The Role of the Private Sector:

The private sector will conceive and finance programmes and projects for implementation of the Technology Policy in partnership with the government, NGO, academia and civil society.

The Role of NGOs and CBOs:

The NGOs and CBOs will develop and finance programmes and strategies for STI implementation in line with their missions and development priorities. They will also advocate for the participation of the special interest groups and disadvantaged groups.

The Role of the Local STI Communities:

The local communities will participate in the conception and implementation of community level STI programmes and also provide feedback on appropriateness and effectiveness of the programmes in addressing societal problems.

The Role of Development partners and international community:

The development partners are expected to contribute to financing of the implementation of the policy in line with their funding priorities. The international community is also expected to support best practices in management of the science and technology system in Tomonia.

2.0

OTHER COUNTRIES

(To be filled later)

3.0

PEOPLE WHO SHOULD BE APPOINTED TO LEAD THIS INITIATIVE

3.1 People

The committee that came up with this policy should continue working by being appointed into key positions in future.

3.2 Names

The names of these people will be sent to the minister.

4.0

POLICY STATEMENTS AND STRATEGIC ACTIONS

Strategic actions for the implementation of the Technology Policy will be guided by the principles outlined in Section 2. Strategic actions for addressing specific policy areas will be undertaken as outlined below:

4.1 Create an Enabling Policy Environment to Foster STI and Augment their Contribution to National Development

4.1.1 Technology Forecasting, Assessment and Transfer

POLICY STATEMENT 1 :

Assess, forecast and advise on issues regarding STI, taking into account current and future trends in development, transfer and diffusion of both local and foreign STI outputs.

Strategies for implementation of the above statement will include the following actions:

- i. Conduct technology audits and forecasts and advise on Technology Policy and programs.
- ii. Conduct policy studies on topical issues to facilitate evidence-based advice and decision making in all matters pertaining to STI.
- iii. Evaluate and promote technology choices for public and private sector investment.
- iv. Create a system to facilitate the transfer, promotion and development of technologies.
- v. Strengthen collaboration with Research and Development Institutions (RDIs), professional bodies, private sector, NGOs and civil society in facilitating technology transfer and utilization.

4.1.2 Industrial Development

POLICY STATEMENT 2 :

Provide a conducive environment for industrial development in Tomonia.

4.1.3 Intellectual Property Management

POLICY STATEMENT 3:

Facilitate and encourage S&T innovation through protection and use of Intellectual Property Rights.

Strategies for implementation of the above statement will include the following actions:

- i. Enact appropriate legislation to ensure sustainable use of natural resources, equitable benefit sharing, protection of creativeness and innovation.
- ii. Establish a fully-fledged national IPR office to undertake searches, formal and substantive examinations, grant and register patents, trademarks, copyrights and other IPRs.
- iii. Encourage membership to regional and global organizations dealing with IPR in order to enhance efficiency and cost effectiveness of the national system.
- iv. Facilitate the setting up of institutional support systems for production, protection and commercialisation of innovations and artistic works.
- v. Incorporate aspects of IPR in the school curricula at the various levels of education in order improve awareness.
- vi. Facilitate protection and beneficial exploitation of indigenous technologies.
- vii. Support fora aimed at sensitising the public in matters related to IPR.

4.1.4 Traditional, Conventional and Emerging Technologies

POLICY STATEMENT 4:

Guide the judicious use and application of traditional, conventional and emerging technologies for sustainable development.

4.1.5 Gender Equity

POLICY STATEMENT 5 :

Mainstream and actively involve the special needs groups, men, women, and children in all STI activities in order to ensure that the resultant impacts are evenly spread across all sections of society.

4.2 Build STI Sector Capacity for Generation and Transfer of Technology.

4.2.1 Sector Financing and Investment

POLICY STATEMENT 6 :

Provide financial support for STI activities to build capacity and put in place the necessary infrastructure.

Strategies for implementation of the above statement will include the following actions:

- i. Increase STI sector allocations from 3% to at least 5% of total Government expenditure per annum.
- ii. Increase funding of R&D from 0.28% to 1% of GDP as recommended by the African Union.
- iii. Identify and access complimentary funds from bilateral and multilateral sources for the support of STI development.
- iv. Encourage the private sector through various incentives to make effective financial contribution to STI development.
- v. Create a national STI Fund to support strategic S&T innovations, acquisition of IP rights for local innovators, and recognition of scientific excellence
- vi. Encourage STI institutions to generate funds by commercialising their services and products and utilize these funds for the promotion and expansion of STI activities.

4.2.2 Human Capital Development and Retention

POLICY STATEMENT 7 :

Build an educational and training system that produces human resources with capacity to generate and effectively apply STI based on contemporary and future needs of society.

4.2.3 STI Infrastructure

POLICY STATEMENT 8:

Provide adequate and state-of-the art STI infrastructure to facilitate cutting-edge research and scientific innovations.

Strategies for implementation of the above statement will include the following actions:

- i. Establish, operate and maintain major national facilities for research and innovation.
- ii. Establish and adequately equip science laboratories in public research and training institutions.
- iii. Establish a national and regional science parks to act as nuclei for cutting-edge research and product development activities in all fields of science and technology
- iv. Encourage increased private sector participation in the development of STI infrastructure.
- v. Establish, operate and maintain technical services (e.g. metrology, standardisation, and calibration).
- vi. Establish electronic networking for STI information dissemination and knowledge sharing among Tomonian universities and centres of excellence.

4.2.4 Research

POLICY STATEMENT 9:

Support basic, applied and development research for enriching the STI knowledge base and product development for enhancing indigenous knowledge and adaptation of imported technology.

4.2.5 Technology Incubation

POLICY STATEMENT 10:

Support development and growth of small and medium enterprises through provision of essential services and infrastructure.

Strategies for implementation of the above statement will include the following actions:

- i. Establish and maintain science and technology parks with state-of-the-art infrastructure.
- ii. Support researchers to develop prototypes from results of their research.
- iii. Facilitate establishment of central research infrastructure facilities to incubate commercially viable innovations
- iv. Promote the creation of innovative technology-based companies by assisting them to access funding facilities and viable partnerships.
- v. Provide entrepreneurial and business skills through training and consultancy.

4.3 Establish and Strengthen Legal and Regulatory Framework to Ensure Ethics and Safety in STI Development and Application.

4.3.1 STI Safety Regulations

POLICY STATEMENT 11 :

Apply appropriate safety and health measures in the generation, development and application of STI in all its aspects.

Strategies for implementation of the above statement will include the following actions:

- i. Develop policies, guidelines and regulations on conceivable unintended or detrimental effects of scientific and technological development.
- ii. Strengthen the research and clearance function of the Government.
- iii. Improve facilities for and ensure adoption of best practices in generation and application of STI.
- iv. Encourage regional and international co-operation in safety on STI.

- v. Develop national capacity for risk assessment and management in scientific and technological development.
- vi. Promote adoption of cleaner production technologies and practices.
- vii. Raise public awareness on safe use, application and disposal of STI products

4.3.2 Ethics in STI

POLICY STATEMENT 12:

Establish mechanisms to ensure development and application of STI in accordance with acceptable morals and national societal norms.

Strategies for implementation of the above statement will include the following actions:

- i. Establish acceptable ethical codes of conduct for undertaking STI applications.
- ii. Strengthen the ethical review system through establishment of Institutional Review Boards in all SETIs.
- iii. Streamline the procedures for research registration and clearance.
- iv. Enhance monitoring and field support for R&D programmes and activities.
- v. Establish a National Research Register.

4.3.3 Standards and Quality Assurance in STI

POLICY STATEMENT 13:

Promote the standardization of Tomonian products and services in line with required international standards.

Strategies for implementation of the above statement will include the following actions:

- i. Strengthen institutional framework for enforcement of quality standards in the development and application of STI.
- ii. Establish testing systems to enable laboratories to test both raw materials and manufactured goods for domestic and foreign markets.
- iii. Introduce certification systems for products and companies.
- iv. Introduce accreditation systems for both laboratories and company certification bodies.
- v. Ensure national standards are developed for all products to assist in establishing programmes for orderly evaluation, selection, acquisition and adaptation of appropriate traditional and contemporary technologies.
- vi. Establish an information system on standards and quality.
- vii. Establish an import quality control mechanism to enforce the minimum quality standards for Tomonia.

- viii. Train personnel from industry, research and development institutions and government departments in all matters related to standards and total quality management.
- ix. Ensure that all goods produced and sold in Tomonia conform to the national standards.
- x. Encourage the use of sustainable technologies, which are environmentally sound and safe to the consumers.
- xi. Sensitize the public on process and product quality and standards.

4.4 Strengthen the STI Coordination Framework to Enhance Sector Performance.

4.4.1 Public Awareness and Appreciation of STI

POLICY STATEMENT 14:

Promote STI awareness and ensure public commitment and support for STI activities and programs.

4.4.2 Information Management System

POLICY STATEMENT 15 :

Develop an STI information management system to facilitate the production, storage and dissemination of accurate, timely and up-to- date information on STI activities.

4.4.3 Sector Coordination and Partnerships

POLICY STATEMENT 16 :

Strengthen the central co-ordinating institution – (TNCST) – to effectively provide a sector-wide framework for policy, planning and coordination; and establish support linkages with local, regional and international development partners.

5.0

SUPPORT FOR TECHNOLOGY POLICY IMPLEMENTATION

The key areas for support for implementation of the Technology Policy include: sector policy and planning; sector financing and investment; sector regulation; institutional framework; sector coordination; and monitoring and evaluation.

5.1 Sector Policy and Planning

A National Science and Technology Plan (NSTP) will be developed using a sector-wide and participatory approach in line with the principles, objectives and strategies spelt out in this policy. The NSTP will elaborate the policy actions, provide short-term, medium-term and long-term priorities and targets for the sector consistent with the National Development Plan (NDP). It will provide a broad framework for development of STI and will be regularly reviewed to take into account new developments in the sector.

5.2 Sector Financing and Investment

Implementation of the Technology Policy will build on current - commitments for the STI sector although more funding commitments in the short-, medium-, and long-term perspective are envisaged. While the bulk of the resources can be obtained from the current sector allocations, new funding sources for long-term development of the sector are required to build on the already available US\$ 33.35 million under the Millennium Science Initiative (MSI) Project. The science, technology and engineering institutions (SETIs) which are responsible for implementing this policy will budget for and directly access funds through their sectoral budgeting processes. The initial five year cost forecast for coordinating the Technology Policy implementation by the TNCST is estimated at 830 billion. A contribution of 56.5 b has already been availed thus reducing the funding requirement to 773.5 billion.

In addition to current financial commitments to research and development through support to SETIs, Government will endeavour to fully operationalise an STI Fund with up to 1 percent of GDP over the medium term, to finance scientific research and innovations of strategic national importance; acquisition of intellectual property rights by local innovators; and recognition of scientific excellence among local scientists. To this end, Government has already allocated 8 billion Banana Industrial Development and Malaria research efforts by distinguished local researchers.

Furthermore, Government will continue to explore mechanisms for increasing both foreign and local investment in STI by fostering private-private and public-private sector partnerships for financing the sector.

5.3 STI Sector Regulation

Government will within the provisions of this policy, enact enabling regulatory measures to guide and promote the STI sector development. However, implementation of this Policy will

initially rely on the existing legal framework within the STI sector followed by a review of some obsolete provisions of the national STI legislations and laws, the TNCST Statute and the associated laws therein, especially in regard to research and development regulations, IP-related regulations, biosafety regulations among others.

5.4 Institutional Framework

Implementation of the Technology Policy is a joint responsibility of several SETIs within the entire national STI sector, with the TNCST as the overall sector coordination agency. The other implementing agencies will include R&D institutions, academic institutions, regulatory institutions, policy institutions, central government ministries and departments, local governments, private sector, civil society, and NGOs. The institutional framework for the STI sector will be strengthened to implement the Technology Policy. The roles and function of each of the above stakeholders in the STI sector will be as provided for within their institutional mandates and as elaborated in this Draft Technology Policy.

5.5 Sector Coordination

The STI sector coordination framework will be strengthened to provide a mechanism for effective sector-wide planning and coordination. The framework provides for participation of Government Ministries involved in the STI sector, local government, higher education sector, private sector, and civil society. This will ensure a balanced approach to STI sector development and coordination of stakeholder involvement. An STI consultative forum will be established to allow the public, development partners and other stakeholders to contribute to regular dialogues on the STI sector, to improve sector coordination and facilitate national STI priority setting.

5.6 Monitoring and Evaluation

The Government will, within the provisions of this Policy, continuously monitor and assess STI sector performance on the basis of measurement parameters as provided for under the relevant Technology Policy statements and the National Integrated Monitoring and Evaluation System (NIMES) framework.

The government will establish a well-defined information management system, with reliable STI indicators and statistics that facilitate performance monitoring and impact evaluation over the short-, medium-, and long-terms. The results of this sector monitoring and evaluation will be published regularly in reports on the status of the STI sector that will serve as the basis and tool for STI sector policy development.

END

