



**STRENGTHENING GENDER AND INCLUSIVITY IN THE NATIONAL SYSTEM OF
SCIENCE, TECHNOLOGY, AND INNOVATION (STI)**

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LITERATURE REVIEW

COUNTRY: ETHIOPIA



Introduction

Ethiopia being a Sub-Saharan African country had exceptional, perhaps, interesting history in Africa from the perspective of women roles in its society. The country had more women queens and empresses throughout its history practically than any other African country (Pankhurst, 2020), has the oldest known women queens in Africa (Koltuv, 2013), and purports to be committed to gender equality and inclusiveness, but ended up undermining its own objectives of achieving gender parity in its contemporary society. Given this narrative, puzzling for social and political scientists that gender inclusiveness is yet to be achieved by Ethiopia. The post-socialist Ethiopia since 1991 formulated a policy framework which is neither centrally planned, nor the Laissez-faire as articulated in the mainstream orthodox policy argument, as implied in the constitution of the federal democratic republic of Ethiopia (Dejene, 2019).

Despite the constitutional provision for the rights of women, the government failed to live up to its rhetoric due to structural and institutional constraints (Burgess, 2013). Women play an essential role in every household chore including collection of firewood for lighting, cooking, heating as well as care for children (Burgess, 2013; McDowell, 2019). Because women and girls are primarily responsible for the massive of unpaid household work, engendering policies to change the social roles of women is a very essential initial step but insufficient to bring gender parity to the socio-economic system. Achievement of gender parity requires transformational gender policy and not the simple integrationist policy approach which focuses on dealing with ‘gender concerns within existing development policy paradigms’ (Beveridge & Nott, 2020).

Due to the legal and policy-based actions, the position of women in Ethiopia has been improving over the last two decades (AfHDR, 2016; Kumar and Quisumbing, 2015). However, negations and gaps in protecting certain basic rights of women continue to exist due to the century-long engraved social structure attributing low status to women. The Government has actively, both through law and policy, sought to improve the status of women. Initially driven by the reformist movement in the post socialist Ethiopia, women’s issues and concerns were taken forward by the nationalist movements and subsequently sustained by the global women’s movement context with the commitment of the political elites in Ethiopia. Women in Ethiopia continued to struggle for basic

rights and property rights, despite several protective legislations (Burgess, 2013). Women's access to resources, such as land, credit, skill training, and education, is relatively poor, while they still carry the burden of a 'double shift' at home cooking, cleaning, caring for the young and the old, adversely impacting their abilities to contribute to and compete effectively in the labor market (Emebet, 2010).

The 1987 constitution (Article 36) of the military government stated that "women and men have equal rights," and that "the state shall provide women with special support, particularly in education (PDRE, 1987)." However, despite these patronizing words, little practical and affirmative action was taken on behalf of women. The first major development regarding women's issues evolved pursuant to the change of government in 1991. The new government took major steps by establishing Women's Affairs section in the Prime Minister's Office. The 1994 federal constitution (Article 35) of Ethiopia states that "women are entitled to remedial and affirmative measures" (FDRE, 1994b). Given the weight of patriarchal tradition in the society, however, it has been a long time before the idiom of the constitutional protection of women's rights is in fact translated into practice. In a similar fashion to many developing post-conflict societies around the world, most women in Ethiopia had a subordinate status because of the patriarchal society that keeps women in a lower position (Haregewoin & Emebet, 2013; Hirut, 2014). They have been denied equal access to education, training, and gainful employment opportunities. Their involvement in policy formulation, access to and control over productive economic resources, and decision-making processes has been very minimal.

In Ethiopia, a woman's identity is linked to her family and the ascribed gender role as a mother and homemaker (Burgess, 2013). That is, women's' socially ascribed roles are limited to homebased chores (fetching water, firewood collection, taking care of children, etc.) and community activities which are usually less profitable and regarded as doing nothing. As for Staeheli et al. (2014), inequality in gendered power resulting from ascribed roles and embedded power relations is maintained through everyday practice. However, as succinctly put by Connell (2015), such patriarchal gender relations are often challenged and transformed by counter hegemonic social and political movement.

Women have been the majority constituting 50.2% of the population and contribute the lion's share in agricultural production and other household activities (Dejene, 2019). However, they have not reaped the benefits of their labor equally with their male counterparts. In Ethiopia, women's ownership and inheritance of productive assets, such as land, were prohibited until the reform in family law in 2000, and the introduction of land policy with related responsibility devolved to state governments (Kumar & Quisumbing, 2015). The participation of women in qualified jobs and related fields are at its lowest level. For instance, in Ethiopia, the National Labor Force Survey in 2012 indicates that women account for only 23.9% in technical and professional fields (CSA, 2013). Most women perform tiresome, low paid, and even unpaid jobs. The 2007 census on employment also shows that Ethiopia's women represented only 27.3% of the total government employees and 93.2% of them were engaged in low-grade clerical jobs (CSA, 2018).

While the political inclusion of women is low, their representation has been increasing in recent years. Women held 21% of the seats in the federal parliament as of 2005 and hold 38.8% of the seats in 2016 (Inter-Parliamentary Union, 2016). Seven percent of the cabinet ministers were women in the executive body in 2005 and the figure reached 13% by 2015. A 'lack of finance for electioneering, household/family responsibilities, and gender-based discrimination' were some of the factors identified in a recent study to explain the imbalance. Despite government efforts to reach out to women in rural areas, it is often difficult to create awareness or provide them with relevant information because of the lack of communications, infrastructure, and transport. This poses a challenge for different associations and groups seeking to participate in events where gender inequality and its remedies are discussed. Nonetheless, this situation changed after the demise of the socialist political regime when gender inclusiveness became a political issue at the highest levels of political echelon in the society. Several steps were taken to expand women's rights and increase the participation of women in politics.

Gender Inclusiveness: The Case of Ethiopia

Ethiopia's constitution and national policies are consistent with international legal instruments on gender inclusiveness, such as the Convention on the Elimination of All Forms of Discrimination against Women (CEDAW), the Beijing Platform of Action, the African Charter on Human and

People's Rights, and the Convention on the Rights of the Child. The Ethiopian constitution guarantees the rights of women as equal to those of men in all spheres including equality in marriage, the right to equal employment, and rights to maternity leave with pay, the right to acquire, administer, control, use and transfer property, with emphasis on land and inheritance issues and the right to access family planning and education. The labor proclamation 377/2003 clearly labels discrimination against women as unlawful (FDRE, 2004b). The Civil Service Proclamation No.262/2002 also provides equal employment opportunity for both sexes. A Federal Family Code, based on the principle of gender equality, came into effect in July 2002. It rose the minimum age of marriage from 15 to 18 years and established the rights of women to share any assets the household had accumulated if only a couple had been living together for at least three years in an irregular union.

Ethiopia's Achievements in Gender Inclusiveness: The Transformative Perspective

In the area of Gender Equality and Women's Empowerment, Ethiopia has registered remarkable achievements over the last two and half decades. The integration of gender issues into national policies is a basic principle within the Constitution of Ethiopia (FDRE, 1997). Since the setting up of the new federal government structure after the 1995 elections, the participation of women in the political process has been increasing. In the 2015 government structure, women hold about 38.8% of the seats in federal parliament, 32% in The House of Federation/upper house (i.e., entrusted with legal interpretation), and 15% in the executive government cabinet (Inter-Parliamentary Union, 2016).

Gender Inclusiveness in Ethiopia's Educational System

Ethiopia has made a promising progress in terms of social development thereby improving access to social services such as education. Free of charge delivery of basic education is under implementation and has been facilitating full access to education (Humtsoe and Arackal, 2017). In relation to gender, the education policy recognizes the centrality of women's contribution to national development and has, therefore, articulated the need to integrate gender with all education interventions and gear education towards reorienting society's attitude and value pertaining to the role and contribution of women in development. A woman's level of education, her employment status, particularly employment for cash, and media exposure are expected to be positively related

to empowerment (AfHDR, 2016). Current statistics shows that the enrolment of girls at primary schools like in most Sub-Saharan African economies has significantly improved although their participation at secondary and higher education institutions signifies that more effort should be exerted to bring gender parity in education and training (Habtu, 2013).

Gender Inclusiveness in Ethiopia's Health system

Like the education sector development, the health sector progress has substantial implication for women in Ethiopia. This is because women bear the vast majority of the costs of healthcare service problem as a result of their socially ascribed role as house makers. Women would be compelled to remain economically inactive not only when they themselves encounter health problem but also when a family member faces illness due to the care service expected from them. Improving health service is, therefore, one of the key tools to empower women. Health and health services have improved significantly in Ethiopia since 2000, despite Ethiopia remaining a low-income country (Kodabux, 2017). Health in Ethiopia has improved markedly in the last decade, with government leadership playing a key role in mobilizing resources and ensuring that they are used effectively. According to Evans, Hsu, and Boerma (2013), a central feature of the sector is the priority given to the Health Extension Programme, which delivers cost-effective basic services that enhance equity and provide care to millions of women, men, and children all over the country.

Gender Inclusiveness in Agriculture

Ethiopia is an agricultural-based economy, with more than 85% of its population largely depending on the agricultural sector for its livelihood. The sector currently accounts for 52% of GDP and 90% of the total foreign exchange earnings (Human Development Report, 2019). The agricultural sector is dominated by small scale resource poor farmers who produce 90–95% of all cereals and oil seeds and grow 98% of the coffee produced in Ethiopia. Fifteen percent of the farming population are women.

The agricultural economy is characterized by food insecurity largely due to low productivity compounded by storage and processing losses, high rate of population growth, and workload on women. Food insecurity is getting worse all the time, and the low status of women which has led to misdirected development programmes, that do not consider women's vital role in agriculture.

Traditionally men gain access to land, except female heads of households. Ploughing is designated to men, and women owning land, hire men for ploughing to get only a portion of the output. Except for female heads of households, women have minimal role in decisions related to land distribution and agricultural production. It is estimated that the average Ethiopian woman has a working day of 12–14 hours, much of it spent in hard physical labour. Women's role as producers in its present form, is generally detrimental to their well-being and that of their children. In the peak agricultural season, women spent up to 10 hours per day in the field. The heaviest workload on a woman during the pre-harvest and harvest generally coincides with the period of lowest household food availability increasing the strain on her, the situation being aggravated if she is pregnant or lactating.

Women's participation in food production is vital, with an estimated 60 and 80 per cent of the total labour expended on farming activities in Africa contributed by them (Ahmad et al, 2019). But, as modernization reorganizes agricultural production and marketing, women are increasingly marginalized. They continue to work in production, their labour may increase but they lose access to the new resources that increase productivity. As agriculture becomes devoted to cash crops, women are left to provide for family food consumption on the least productive land, while men specialized in production of these new crops for cash sales.

The process of introducing modern technologies, in agriculture inputs, planning and harvesting or storage and marketing has not been gender sensitive. Agricultural services worked with male farmers, credit could only be extended to individuals with land titles and other collateral. Activities like marketing, traditionally female dominated at village level, are taken over by men once they became sophisticated with motorization and transport, and linkages of villages to cities and ports were established. This is because the new technology demanded greater financial resources and wider geographical linkages than women could acquire.

Gender Inclusiveness and the Ethiopian Industry

Women in the rural areas play vital roles in food production, preservation, and storage. They are totally responsible for processing foods for consumption and marketing the surplus locally to generate income. They are involved in making invariably all food stores and containers except for

granaries. Although women's participation in the traditional food processing is high, their participation at food processing industries is insignificant. The food products and beverages industrial group ranks first in terms of the number of establishments in the large and medium scale category. According to the statistical survey of May 1999, compared to other industrial groups, the manufacture of the food products also ranks first in terms and number of persons engaged. Of the total number of employees engaged in the manufacture of food products and beverages (medium and large-scale industries) in the public and private, only 19% are female (Maceira, 2017).

Women's low status in education, income, and time constraint for self-advancement, have hindered them from participating in employment in industries. They are either unaware about them, or are not given the required training, priority being given to men because in most instances, men would have the necessary basic education to participate in the training. The number of Ethiopian women participating in industry and commerce is insignificant, due to lack of access to productive resources, such as land and credit, advisory services, training and information, and thus unable to benefit from industrial and commercial activities. The limited financial capacity of women would also hinder them from using available technology.

Gender Inclusiveness in Employment

Employment in this context is defined as work done to earn money and includes both formal and informal employment. For formal employment, women are underrepresented in the formal sector (Hirut, 2014). Data from Pankhurst (2020) shows that in the year 1999/00, among all government employees, women constituted only 30.75%. While this is the national picture, we see a wide regional variation. Addis Ababa has an almost equal number of (50.13) male and female government employees while some emerging regions have low figure for female government employees, 19.94% in Somali and 27.19% in Afar. The 30.75% referred to could be misleading as scrutiny of the statistics show that women are highly concentrated in the routine type and low paying jobs. For example, looking at the Federal picture we find only 13.01% of the employees in professional and scientific fields, and only 14.0% in administrative position. Women are highly concentrated in jobs such as clerical and fiscal (63.35%) and custodial and manual (48.07%). This might be related to the problems girls face in accessing and succeeding in their education.

With regards the informal sector, many of the women are engaged in it (McDowell, 2019). They are in small businesses that require small capital, not demanding sophisticated management and bookkeeping skills. According to a survey undertaken on 300 women in Addis Ababa, selling of vegetables and fruits, bakes like enjera and bread, charcoal and firewood, traditional drinks, second-hand clothes and shoes, handicrafts, and goods such as sugar and salt were the major trades women were engaged in. However, a little more than half of them were engaged in selling fruits and vegetables with the rationale that this trade requires a very small capital (Hayat, 2020). According to the same study women engaged in the informal sector encounter a variety of problems. These are lack of working capital and business skills, unavailability of convenient working place, low demand, and harassment by the police for doing business in the streets. However, lack of working capital was identified to be the most serious problem by more than 80% of the respondents.

In reaction to these problems, the Ethiopian government has taken initiatives to support micro finance institutions by establishing such funds as Ethiopian Women Development Fund (EWDF) and the Federal Micro and Small Enterprises Development Agency (FEMSEDA). EWDF supports poor women both financially and in capacity building while FEMSEDA assists Regional Micro and Small Enterprises Development Agencies in their effort to support operators. The government has also lifted the requirement of licensing for enterprises with an initial capital of less than Birr 1000.00 (Zenebework et al, 2020).

Gender Inclusiveness in Ethiopia's Political Participation

When evidence from the entire federal structure including state governments was accounted, parliamentary seats occupied by women grew from 26.6% in 2005 up to 34.3% in the 2010 elections (UNDP, 2014). In a country where 50.2% of its population is composed of female (CSA, 2014a), this evidence could demonstrate the limit to the promotion of women to higher political positions. However, for a society in which issues of gender inclusiveness was ignored for centuries from the policy process, this is a tremendous accomplishment which cannot be undermined if not praised, even though Ethiopia had more women queens and empresses throughout its history than practically any other African country had not, and it also has the oldest known women queens in Africa. The problematic issue observed in this regard is the profile of the women represented in

the government. Most of the women in the parliament and the house of federation are having very low profile both in terms of conventional education and political experience.

Most of them are holding academic qualifications lower or equal to a university bachelor's degree from local universities. As a result, because dialogue and debate inherently favour the dominant group which properly articulates the interests of its constituents, their influence in the policy process could be limited (Verloo, 2015). The implication from here is that the country has not sufficiently invested in women's capability building (Nussbaum, 2011; Sen, 1999) and furtherance into the area of capacity building for Ethiopian women remains imperative if the gender relations are to be transformed. The Government of Ethiopia has made a strong commitment to integrate gender into policy and strategic planning instruments. However, to succeed in bringing gender parity to the social system requires transformational gender policy as opposed to a simple integration of gender issues within existing development policy perspectives (Beveridge & Nott, 2020).

In the Ethiopian context, it is difficult for women to hold a key position in politics, economics, and administration. As a patriarchal society, the attitude of the majority towards women holding a high position, the way society and workplaces are structured, and the gender division of labour all pose a serious challenge. Women have a marginal position in accessing and succeeding in their education. Most women in the civil service are in clerical and manual jobs. Therefore, it is not surprising that we do not see many women in key positions both in politics and administration.

Female candidates have mentioned problems women face in political participation including lack of experience in the election process; lack of the consideration of gender issues in the election process; shortage of finance; as well as ignorance and lack of information on the part of women voters. However, despite the difficulties a small number of women have managed to get seats in parliament. For example, Pankhurst (2020) discovered that currently, out of the 547 seats 42 (7.68%) are held by women. Though this is very small, we see a slight improvement from the previous election. In the previous election only 2.38% of the seats were held by women. What these figures suggest is that women's participation is negligible and unless serious efforts are made, to increase women's political participation at all levels, good governance will be beyond reach.

Science, Technology, and Innovation Gender Objectives List

In sub-Saharan African countries like Ethiopia, technology and innovation has played a significant role in improving the livelihood of their citizens. Science, technology, and innovation has improved the health, working, and living condition of people, and it also contributes to increase their income and amount of leisure time (Amha and Mekuriaw, 2008). Above all, in a country where food insecurity prevails and impacted by climate change, the need for science, technology and innovation is enormous.

The first half of the 20th century is considered as the beginning of application of modern science and technology in Ethiopia, along with the establishment of higher education institutions (Amha and Mekuriaw, 2008). Ethiopia established Ministry of Science and Technology for the first time in 1975 as a commission and currently it is renamed as Ministry of Innovation and Technology (MoIT). The Ministry was established with the aim of providing study-based recommendations to the government of Ethiopia for adopting and revising policies, strategies, laws, and directives for the development of STI that support the realization of the country's development objectives (Tesfa, 2015). Ethiopia applies STI as an instrument to achieve the long-term vision to be among the middle-income countries (MoE, 2015).

One of the cross-cutting issues in STI ecosystem is gender. In a country where gender inequality prevails, ensuring gender equality in all spheres of life is important for sustainable development. Ensuring gender equality in STI plays a crucial role in meeting the needs of the country through the contribution made by women. Despite this fact, gender imbalance exists in such fields particularly in higher education institutions in Ethiopia. Though various measures have been taken to redress the gender inequality by enhancing the participation of female students and instructors in higher education institutions in science, technology, engineering, and mathematics (STEM), the result obtained has not been satisfactory as only few women are shown up in such fields of study.

Assessment of The Feasibility of STI and G&I Environment in Ethiopia

Ethiopia has adopted a national economic policy that mainly focuses on implementing the Agricultural Development Led Industrialization (ADLI). The objectives of ADLI include promotion of economic

efficiency and growth, development of domestic technological capacities and capabilities for the promotion and development of small, intermediate, and capital goods industries. The real Gross Domestic product (GDP) of the country grew for the seventh time in a row in two-digit rates from 2003/04 through to 2009/10. The registered growth was achieved mainly due to the improved performance of the agricultural sector. This growth has been achieved through broad-based and diversified activities in which structural transformation was evidenced. Export earnings are steadily increasing owing to the increase in the value and volume of export commodities.

As a result of the economic growth, the total imported commodities of the country have also increased. However, it has become clear that the growth of the Ethiopian economy cannot be sustained without building its technological capability. In fact, a closer look into the development phases of the newly industrialized South East Asian countries shows that their success is mostly explained by the countries' outward looking market economies and technological capability accumulation. This policy is, therefore, aimed at providing the basic framework to initiate, guide, coordinate and support the efforts of the country to acquire, use and master technologies. The document contains the overall policy framework and directions along with major strategies of implementation. The background and elaboration of this policy are contained in the National Science, Technology, and Innovation (STI) Policy Green Paper prepared through a series of consultations with stakeholders. The vision of Science, Technology and Innovation is formulated based on the national vision stated as: "to see Ethiopia become a country where democratic rule, good governance and social justice reign upon the involvement and freewill of its peoples, and once extricating itself from poverty becomes a middle-income economy." Achievement of the vision requires, among other things, conscious application of science and technology as the major instrument to create wealth.

Current STI policy has a strong focus on technology transfer. Adopted in 2012, this STI policy is a revised version of the 2006 STI policy (Ethiopian Science and Technology Agency, 2006), but with a strong emphasis on transfer of technology rather than local technological learning and innovation capability-building (MOST, 2012). The decision to revise the STI policy in 2012 was carefully coordinated with changes in the Government's national development strategy as articulated in the First Growth and Transformation plan (GTO 1), which became operational a year earlier, in 2011. In addition to continuing with major programmes that started in previous five-year plans, GTO 1 gave a renewed impetus to export-led industrialization, anchored in the manufacturing sector. It was largely in support of the export-oriented policy that the plan gave special emphasis to "transfer of technology" and access to essential inputs required by exporters,

GTP 1 stated that “The main objectives of science and technology during the plan period are to establish organizations and agencies that contribute to improvements in productivity and quality of local produce. Means to facilitate technological transfer will be established. Quality and standards information will be used for the technological transfer to help exports of services and products compete in the global market” (MOFED, 2010: 118).

The focus of the transfer of technology aimed at satisfying the needs and demand of export-oriented enterprises for easier access to foreign technologies so that they would be able to produce quality products that they could sell competitively in the international market. During GTP 1 and including during the current development plan (GTP 2), it became relatively easier to import technologies – either embodied in goods such as machines and equipment, or licensing – for businesses engaged in export-oriented activities or selected sectors earmarked for import substitution. Enterprises operating in priority areas or for export could import technologies in the form of capital goods and knowledge transfer without paying duties.

Given the Government’s desire to promote innovation and technological learning, including in new technologies, the overwhelming focus towards technology transfer should be rectified in the new STI policy that technology ministry is currently preparing. The Government needs to find an equilibrium between enabling local enterprises to acquire technology from abroad through various channels of technology transfer and the need to ensure that the transferred technology contributes to technological learning and innovation capability building through linkages and assimilation of technologies locally.

No country has accumulated knowledge and achieved economic development without acquiring technologies and know-how from more developed countries – thus, transfer of technology is essential; but neither has any country succeeded in accumulating technological capabilities and fostering a robust NIS without concerted and State-led efforts in technological learning and innovation. How to create harmony between these essential processes is one of the challenges of formulating effective STI and technology transfer policies.

STI promotion institutions in Ethiopia and their relationship to G&I

In line with the envisaged role of Science, Technology and innovation in the national development, a functional organizational structure for the coordination, promotion, and development of STI

activities is required. To this end, the organizational structure of the national STI system in Ethiopia shall 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

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

NSTIC is the highest decision-making body for STI policy and plan of action. Based on the National STI Policy, it establishes and directs the general framework and strategy for STI development and determines 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 (Member)
- ❖ Minister of Agriculture & Rural Development (Member)
- ❖ Minister of Health (Member)
- ❖ Minister of Water Resources (Member)
- ❖ Minister of Trade and Industry (Member)
- ❖ Minister of Mines and Energy (Member)
- ❖ Minister of Education (Member)
- ❖ Minister of Federal Affairs (Member)
- ❖ S&T Advisor to the Prime Minister (Member)
- ❖ President of the Ethiopian Chamber of Commerce (Member)
- ❖ Three Prominent Scientists and Technologists (Members)
- ❖ 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. The Council

meets once every three months and evaluates the performance of STI activities based on which it issues guidance, directives, and decisions. Additional meetings can be held as and when necessary.

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

The Committee is 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 is 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. The Councils prepare detailed policies and guidelines, set priorities of R&D plans, determine the financial assistance for research and innovative programmes and projects submitted to the Agency and follow-up their implementation. They will also study ways of application of research and development results generated from various sectors and present these to the National Science, Technology, and Innovation Council through the Director General.

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

There shall be research institutes, technology centres, design enterprises, and various S&T support services in various sectors and higher educational establishments which would be responsible for the actual performance of S&T activities. The Agency shall 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. The establishments shall either merge with other relevant organizations or function as autonomous bodies when they reach the stage of maturity.

Factors blocking the advancement of G&I in STI

Most of the issues are common to and shared by most developing countries as described by Padilla and Gaudin (2014). There is a common saying that ‘a policy is as good as its implementation’. One of the most important challenges is found to be failure to effectively translate the policy into practice. This is mainly because of the following reasons: Most policies that come from the top down to the bottom have implementation issues. The ‘Top-Down’ approach to policy formulation coupled with limited public awareness of the significances of STI has curtailed efforts in effectively implementing the policy. Similarly, the absence of programs that translate STI policy objectives into action contributes to the inefficiencies in the implementation processes.

The other important challenge is the shortage of qualified personnel in the national system of innovation in general and the various STI actors. The lack of knowledge, skills, and attitude of personnel at all levels of the system has constrained people from discharging their responsibilities in science and technology effectively. The STI policy shows the direction and the commitment to facilitate linkages between the various players but in practice there is a manifestation of disconnect. There is immature coordination and collaboration of the STI stakeholders which was meant to bring about synergy. Specifically, the feeble link in the Triple Helix though improving overtime remains a big challenge in this regard.

The limited understanding of the benefits of STI by the infant manufacturing sector and the MSEs which lacks significant growth have hindered their active involvement in the system. The lack of financial resources is the most significant barrier for STI development in developing countries,

and Ethiopia is not an exception. The over reliance on state funding and the poor engagement of the private sector have also greatly challenged STI activities. In fact, the absence of different nationally developed guidelines and research evaluation models for the allocation of the scant fund is a barrier that adds up to inefficiencies and resource wastages. The lack of data warehouses, and poorly designed websites with little or no information about the stakeholders makes it hard to grasp developments in the sector. STI infrastructure is crucial for searching for, selecting, learning, adapting, and disseminating technology. However, outdated laboratory facilities, insufficient equipment and above all the poor telecommunication networks in Ethiopia contribute to the poor performance.

The poor institutional culture to monitor and evaluate programs and policies implementations also has its implications in the overall effectiveness of the accomplishment of the mission of the STI policy.

Key ingredients for success and best practical examples in advancing G&I in STI in Ethiopia

Examining the Ethiopian STI policy involves a proper understanding of the various sub-systems that made up the national system of innovation. Although there is no universally agreed definition of system of innovation, Freeman's (1987) defined a system of innovation as "the network of institutions in the public and private sectors whose activities and interactions initiate, import, and diffuse new technologies". The approach that was pursued by Freeman (1988), Lundvall (1988, 1992) was used to address the framework of national system of innovation to serve the purpose of this paper. Accordingly, the national system of innovation encompasses the often interrelated and interdependent components including firms, industries, higher education institutions (HEIs), research institutes, Technical and Vocational Educational Training Colleges (TVET), and other government entities that are essentially engaged in science and technology. As such, the Ethiopian STI policy (2012) acknowledges the above-mentioned actors in the national system of innovation. Moreover, the document established linkages of the R&D activities by the actors in a way that enhance long-term competitiveness and growth of the country.

The vision of the STI policy is put as follows:

"To see Ethiopia, entrench the capabilities which enable rapid learning, adaptation and utilization of effective foreign technologies by the year 2022/23."

The mission of the policy:

“To create a technology transfer framework that enables the building of national capabilities in technological learning, adaptation and utilization through searching, selecting and importing effective foreign technologies in manufacturing and service providing enterprises.”

The vision envisages the establishment of national innovation systems that will search for, select, learn, adapt, and utilize appropriate and effective foreign technologies. It is imperative to comprehend that the main thrust of the mission and vision statements is to ensure effective and efficient achievement of the national development agenda of the country. Objectives of the New National STI Policy The major objectives of the Ethiopian STI policy (2012) are to:

1. Establish and implement a coordinated and integrated general governance framework for building STI capacity.
2. Establish and implement an appropriate national Technology Capability Accumulation and Transfer (TeCAT) system.
3. Promote research that is geared towards technology learning and adaptation.
4. Develop, promote, and commercialize useful indigenous knowledge and technologies.
5. Define the national science and technology landscape and strengthen linkages among the different actors in the national innovation system.
6. Ensure implementation of STI activities in coordination with other economic and social development programs and plans.
7. Create conducive environment to strengthen the role of the private sector in technology transfer activities sustainably.

The objectives are well articulated and comprehensive. It addresses the most important aspects of science and technology. Following this is the policy directions which has been identified based on the analysis of the major STI problems of the country and the review of experiences of the benchmarked countries. The policy directions and strategies are indicated under twelve critical policy issues in which the government intends to intervene to create efficient and dynamic national innovation system for the realization of the country’s development vision. The critical policy

issues are: National and Regional Innovation Systems; Technology Transfer; Human Resource Development; Business Enterprises; Research; Financing and Incentives; National Quality Infrastructure; University - GRI - Industry Linkage; Intellectual Property Rights; Science and Technology Information; Environmental Technologies; and International Cooperation. Policy statements are followed by the strategies under each critical area.

SN	Policy Issue	Description	Strategy
1.	The National and Regional Innovation Systems	<p>Constructive interaction of the stakeholders in the innovation systems through the process of adoption, adaptation, application and generation of technologies and scientific knowledge is a prerequisite to national technological capability building.</p> <p>However, such systems are not clearly defined and organized in Ethiopia. Consequently, technological, and scientific activities in the country are not prioritized and coordinated both at national and regional levels. This is because most of the elements are lacking and the interaction among the existing elements is very weak.</p> <p>Thus, National and Regional Innovation Systems shall be established and implemented to foster rapid and sustainable development of the country.</p>	<ol style="list-style-type: none"> 1. Constitute the NIS of Ethiopia under top government leadership. 2. Encourage and support establishment and/or strengthening of balanced regional innovation systems. 3. Establish regional centers of excellence to undertake research focused on technology adaptation. 4. Ensure strong linkage between the Federal and Regional STI activities
2	Technology Transfer	<p>Technological learning and change in Ethiopia shall take place primarily by improving foreign technologies that are required by the economy. Currently, however, there is lack of systematic transfer of foreign technologies based on the demands of the various social and economic sectors. There is also</p>	<ol style="list-style-type: none"> 1. Expand the flow of technology through foreign direct investment. 2. Promote the development of domestic technological capabilities for the effective absorption of foreign technologies.

		<p>weak technological capability for the effective absorption of foreign technology. The country shall, therefore, devote resources to assimilation, adaptation, and improvement of foreign technologies with prior attention given to development of domestic technological capabilities</p>	<ol style="list-style-type: none"> 3. Accelerate inter-firm dissemination of technological information and know-how 4. Set national priority programs for the transfer of major technologies. 5. Use intellectual property and standards information as sources of foreign technology.
3	Human Resource Development	<p>The acquisition, diffusion and upgrading of technologies which exist in the more technologically advanced countries require locally available and competent scientists, engineers, and technicians. However, the different sectors of the Ethiopian economy face serious shortage of trained manpower who can be actively involved in the imitation of foreign technologies and subsequent innovative activities. Hence, the educational system of the country shall align itself with the national development objectives and prior attention shall be given to the creation of competent and innovative manpower, predominantly in the fields of engineering, technology and natural sciences.</p>	<ol style="list-style-type: none"> 1. Establish specialized science and technology institutions that focus on producing finest scientists and engineers for the economy. 2. Sustain the 70:30 university intake ratios in favor of science & Technology for the coming 10 years. 3. Develop positive attitude towards TVET programme within the society. 4. Create a separate quality assurance center for TVET teachers, SME workers and owners to improve their skill. 5. Introduce high quality, dynamic, practical, interactive, and attractive science and mathematics curricula at teachers training institutes as well as primary and secondary schools.

4	Business Enterprises	<p>The role of business enterprises ranges from performance and support of various STI activities including research, technology transfer and diffusion to the creation of policy framework. Small enterprises are mainly users of innovation while medium and large enterprises play significant role in technology imitation and adaptation. The major problems that need to be addressed urgently to promote and support small, medium, and large business enterprises as important elements of the national innovation system include lack of processed technological information, inadequate training capabilities at TVET centers, lack of access to financial and other resources and absence of consultancy support. Hence, conducive, and supportive environment should be created for nurturing and developing of innovative business enterprises as important agents of technology transfer and productivity improvement.</p>	<ol style="list-style-type: none"> 1. Strengthen linkages among SMEs and Large Enterprises along the value chain in the various sectors. 2. Create SMEs' national council. 3. Create the mechanism by which government procurement process is used to strengthen innovative efforts of SMEs. 4. Establish an award scheme to recognize and encourage innovative SMEs. 5. Create SMEs bank to solve long term financial problems of SMEs including shortage for startups, marketing, expansion, etc.
5	Research	<p>The acquisition, diffusion and improvement of foreign technologies require a considerable local effort which focuses on adaptive research. Research in Ethiopia should address the major challenges of the country and</p>	<ol style="list-style-type: none"> 1. Reform of the existing Government Research Institutes in a technological capability building perspective.

		<p>contribute to the achievement of national development objectives. However, there is a disconnection between the focus of the research undertaken by GRIs and academic institutions and the needs of the major social and economic sectors of the country. Thus, the national research system shall concentrate mainly on adaptation of appropriate foreign technologies to meet domestic needs, with some basic research activities.</p>	<p>2. Promote demand driven and systematic research activities in the agriculture and health sectors. 3. Focus on adaptive research and reverse engineering based on the needs of industry.</p> <p>4. Create and strengthen linkages between GRIs and Industry.</p> <p>5. Create more GRIs to fulfill the necessary research landscape</p>
6.	Financing and Incentives	<p>There are significant financial costs associated with the activities involved in the adaptation and assimilation of appropriate foreign technologies. The current total research expenditure in Ethiopia is one of the lowest in the world. The existing financial system of the country is not also designed to address the needs of innovative activities in the enterprises sector. Therefore, appropriate financing and incentive mechanisms should be created to promote scientific, technological and innovative activities.</p>	<p>1. Create national technology and innovation funds.</p> <p>2. Introduce fiscal incentives such as tax exemption and duty-free privileges for scientific, technological, and innovative activities of Ethiopian SMEs.</p> <p>3. Create a system of special privileges and awards for outstanding innovations/achievements</p> <p>4. Develop and implement pro-innovative government procurement policy.</p>

			5. Increase budget allocation for adaptive & applied research at tertiary education institutions and TVET centres
7	National Quality Infrastructure (NQI)	Inefficient use of valuable resources and poor adherence to quality standards are the major drawbacks within the engineering sector of Ethiopia. As a result, standards failed to provide an essential platform on which new products and processes can be built on. In order to tackle the problems related to productivity and quality; and to create competitive manufacturing industry, the national standardization, metrology and conformity assessment services should be reoriented and operated in a concerted manner towards sustainable technological capability accumulation.	<ol style="list-style-type: none"> 1. Promote world best practices in productivity, quality, and safety management system arenas throughout the industry. 2. Introduce NQI elements at Universities and TVET schools. 3. Replace traditional measuring technologies by modern measurement technologies. 4. Use Standards as a means for technology transfer. 5. Establish a reliable conformity assessment system to ensure safety and quality of products before they hit the market. 6. Establish an integrated national accreditation system for industry, education, and health sectors 7. Make use of more mandatory standards as basis for technical regulatory activities. 8. Establish strong regulatory and enforcement environment for the NQI.

8	University - GRI - Industry Linkage	Universities, GRIs and Industries are the major actors in the national innovation system. The strength and productivity of their linkages depend on the orientation and capacity of the actors to be innovative. The current situation in Ethiopia is that the universities are lagging the industry sector in-terms of understanding and using technology. This necessitates the linkage to be strengthened with a two-way technological flow between the universities and the industries. Their joint efforts shall be focused on identifying technologies and their sources, understanding the technologies through learning-by-doing and adaptation of these technologies. Creating a synergy of Universities, GRIs and Industries in imitating, adapting, and generating appropriate technologies through the establishment of strong linkage shall be an urgent task	<ol style="list-style-type: none"> 1. Allocate an agreed free time for known industrial research professors. 2. Establish special funds to encourage joint technology transfer and research undertakings by universities, GRIs and industries in national priority areas. 3. Establish mechanisms to regularly exchange personnel among universities, GRIs and industries. 4. Encourage and support consultancy business support services of universities to SME startup and expansion activities. 5. Change the university curricula to practical, problem-solving type that values a good working culture.
9	Intellectual Property Rights (IPRs)	IPRs can be considered as beneficial when they foster the development of domestic technological capabilities through diffusion of knowledge, technology transfer, foreign direct investments and licensing, among others. However, the intellectual	<ol style="list-style-type: none"> 1. Use patent information for technological catch-up. 2. Adapt the national patent system to the needs of local industries and traditional knowledge holders.

		<p>property regime of Ethiopia has played a minimal role in facilitating the transfer of foreign technology and the development of local innovative activities. The national IPR regime shall, therefore, create a conducive environment for imitative learning and the protection of new knowledge; and foster the development of indigenous knowledge.</p>	<ol style="list-style-type: none"> 3. Strengthen the national intellectual property system for the regulation of access to genetic resources. 4. Build the capacity to manage IP both at the national and institutional levels. 5. Use copyright protection to promote the growth of the creative industries. 6. Use trademark protection to create and enhance a competitive environment among enterprises.
10	<p>Science and Technology (S&T) Information</p>	<p>In Ethiopia, S&T information is handled in a very fragmented way. There is not systematically collected, organized and processed scientific, technological, and industrial information that can be easily accessed by SMEs, scientists/researchers, entrepreneurs and other stakeholders. National and regional S&T information in the form of statistics, databases, indicators, and bibliographies is not also produced on a regular basis and in a systematic way. Accomplishment of this task requires creation of a national information system with the right institutional set up and critical mass of professionals. Hence, the capability to identify,</p>	<ol style="list-style-type: none"> 1. Create a national science and technology information center. 2. Support generation and dissemination of value added STI information, scientific knowledge and technologies. 3. Put in place an instrument required to ensure the harmonious management and operation of information resources, services, and systems. 4. Design an up to date STI information capturing mechanisms and create information networks at national, regional, and international centers.

		collect, process, organize, disseminate, and properly use S&T information shall be developed to support and facilitate technology transfer and diffusion	5. Support research activities related to scientific and technological information collection, processing, management and dissemination strategies and methodologies.
11	Environmental Technologies	The major environmental issues in Ethiopia include the growing problem of desertification, forest clearing and land degradation. Absence of integrated solid and liquid waste management system is also the other environmental problem especially in urban areas. The solution for the major environmental problems of Ethiopia is adoption, adaptation and generation of green technologies in agriculture, energy and water resources use and management.	<ol style="list-style-type: none"> 1. Introduction and expansion of fast-growing trees with multipurpose uses including biomass energy, soil conservation and timber and pulp production. 2. Locally produce windmills and solar cells to make solar and wind energies affordable. 3. Adopt sanitary landfill solid waste disposal and wastewater removal and treatment technologies in conjunction with generation of energy from solid waste.
12	International Cooperation	Cooperation in the areas of science and technology is essential for accessing technological information, manpower training, expert assistance, scientific visits, collaborative research, joint ventures in technology transfer, and funding of scientific and technological activities. The current international cooperative undertakings of Ethiopia with various countries is not consciously oriented towards facilitating national	<ol style="list-style-type: none"> 1. Create strong bilateral and multilateral cooperation with countries of the world on concrete programs of cooperation. 2. Ensure incorporation of STI capacity building elements in bilateral and multilateral agreements.

		<p>technological capability building through systematic exchange of S&T information, ideas, scientists and engineers. International S&T cooperation with developed and developing countries as well as multilateral organization shall, therefore, be strengthened with the prior objective of building the national technological capability</p>	<p>3. Encourage exchange of students, professors, and researchers through South-South and North-South cooperation.</p> <p>4. Redirect most research to take place within the country in collaboration with international institutions</p>
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