



Poverty Reduction and Economic Management
The World Bank

Policy Note

■ **Pragmatic Innovation Agenda for Tanzania:
Global Search for Home-Grown Responses to a Country's
Challenges**

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Pragmatic Innovation Agenda for Tanzania: Global Search for Home-Grown Responses to a Country's Challenges¹

Executive Summary

1. Over the past 15 years, Tanzania has dramatically improved its economic performance as comprehensive economic reforms transformed the country from a controlled economy to an open, market-based one. The country also possesses a significant number of promising innovators, particularly in the rural economy, yet they remain small because of the lack of financing and business support. In government policy, innovation is often equated with R&D and science/engineering innovation. But these types of innovation are of least importance for Tanzania's future. The key issue is diffusion of innovation (defined in this note as a new or improved technology or practice in a given context and not in absolute terms): adopting, adapting and recombining the knowledge and technologies already known to the world. It would require recombination and reform of existing R&D institutes and changes in the support instruments of Tanzania's Commission on Science and Technology (COSTECH).

2. This is a humble agenda because its focus is tangible impact on the ground – productivity improvement and poverty reduction – rather than invention and science. A critical mass of role models – a diverse portfolio of innovative and successful, most likely export-driven, firms, and significant improvement of Tanzania's Ranking in World Economic Forum and Knowledge Economy indices – will be key indications of success along this pragmatic dimension. Even under the best of circumstances and with the best intentions, the transformation of Tanzania's innovation system will be gradual and incremental. The problems of the country's innovation climate are many and they are formidable, so it may be unrealistic to insist on big changes and improvements. Yet modest improvements can coalesce into a virtuous cycle, promising dramatic changes in the longer run.

3. Drawing on the changes already well under way, the *immediate agenda* (years 2010-2011) to sustain such a virtuous cycle could include:

- Taking stock. Taking an inventory of R&D efforts made by sectoral ministries and agencies to arrive at shared understanding of the level and composition of R&D expenditures in the country and performing independent evaluation of R&D institutes and other efforts.

¹ The Note is prepared on the basis of interviews with stakeholders in Tanzania during the week of January 4, 2010 (Annex 3 provides a list of individuals interviewed). Given the very limited time in the field, we rely on prior analysis and our focus is on 'how to' solutions rather than a detailed assessment of problems. Although obviously an important constraint, to maintain focus, human capital issue is not analyzed in any detail. The Note follows the thrust of 2010 Global Forum Action Plan 'Science, Technology and Innovation Capacity Building Partnerships for Sustainable Development', adapting some of its analysis into recommendations specific to Tanzania. Assistance from Mr. Godwill G. Wanga (Daima Associates Ltd) is gratefully acknowledged, as well as detailed comments of peer reviewers: Lev Freinkman, Lead Economist (AFPT3); Peter Nicholas Materu, Lead Education Specialist (AFTED); Kurt Larsen, Senior Education Specialist and Innovation Policy Coordinator (WBIGC); and Thomas Kenyon, Senior Private Sector Development Specialist (LCSPF).

- Developing a portfolio of promising cases of innovation in the country. As innovation initially develops from tinkering and problem-solving in everyday practice within the real sector, such cases are sometimes unknown to the government and much less to the general public. A wholly private R&D effort is the Tea Association of Tanzania and other innovation efforts of rapidly growing exports of organic produce are two such examples from agro-industry, but one would expect such a portfolio of promising efforts to be more diverse. By taking stock and then diffusing the experience of first movers (firms that do new things), they can become role models for others to follow.
- Designing a small portfolio of private-public initiatives which would support first movers. One example is design and establishment of Foundation Tanzania (modeled after Foundation Chile), an autonomous private sector-driven organization with a mission to incubate innovation firms in promising areas of the economy.
- Strengthening and expanding competitive funding schemes to articulate innovation consortia, as recently introduced by COSTECH on a modest pilot basis. In the medium-term, such contests for collaborative innovation efforts should become a main source of funding for national R&D. They should emphasize international participation as a condition and must rely on international peer-reviewing. The main objective of such funding schemes is to give an opportunity for dynamic and entrepreneurial individuals and organizations to develop their own projects in collaboration with each other and with international players.

4. In the *medium-term* (until 2015), the focus should be on a critical mass of changes in the national innovation system. Critical mass is an elusive concept and is difficult to measure. In practical terms, it means two things. First, a portfolio of dynamic export-oriented and innovation-based segments in the real sector such as fishery, organic produce and others. Second, wide diffusion of pro-poor innovation. Recognition that lower-income consumers are a major market opportunity has produced a series of examples of “piggyfrogging”, namely searching and piggybacking on foreign technologies and then leapfrogging by recombining knowledge from diverse domains resulting in new lower-cost, high-performance technical and organizational solutions for low-income and higher-income consumers. More generally, the global search for home-grown responses to a country’s challenges is a guiding principle for the whole Tanzanian innovation agenda (which is summarized in Table 1).

5. The Foundation Tanzania proposed above is one platform for such global search. A second platform, which could be established as a consolidation of some of the existing and underfunded R&D institutes, is Technology (Innovation) Transfer Center focused specifically on the diffusion of pro-poor innovation. It would be responsible for promotion of globally available relevant technological solutions (proved to be useful in countries such as India and South Africa) and working with private sector firms interested in their adoption for Tanzania. Such a Center could initially be set up in cooperation with an established international consultancy firm. The Center would play a dual role on both demand (promotion of available technologies) and supply (helping those who are willing to adopt them) sides and this could be a stepping stone to implementation of institutionally more demanding tasks such as Foundation Tanzania. One of the early tasks for such a Center would be provision of assistance to local firms in building local and global partnerships, including marketing and technological partnerships.

6. The *long-term agenda* (2015-2030) implies a significant improvement of Tanzania’s investment and innovation climate as demonstrated in the World Economic Forum and other

rankings. Contrary to the recent policy claims, the planned increase of R&D expenditures to 1% of GDP should be concomitant with the improvement of the innovation climate and should be a long-run rather than an immediate objective. Over the long-run, an exploration of the ‘game-changing’ innovation is also advisable. The issue is articulation and self-discovery of competitive advantages of Tanzania as an open economy. How will it be able to insert itself into global value chains? As a starting point, three candidates can be considered to attract world-class game-changing companies:

- High value- added agro-processing, particularly based on organic produce. Seeds of an export-driven organic value chain already exist, as demonstrated by diverse successes of Tanzania and East Africa’s Organic Agriculture movement.
- Leveraging the unique geographic position of Tanzania and its closeness to the Middle East, India and China by turning Dar Es Salaam into a logistical hub.
- Although the current IT – readiness of Tanzania is low, exploration of the potential of IT, IT-enabled-services and software development could be advisable.

Table 1: Innovation Agenda for Tanzania

Time Frame and Objectives	Focus	Specific Actions
Short-term (immediate from 2010): Building a foundation – <i>developing role models</i>	Design of a portfolio of private-public innovation programs and pilots	<ul style="list-style-type: none"> • Take an inventory and perform independent evaluation of innovation expenditures and programs • Strengthen existing competitive funding initiatives of COTECH (introduce international peer review, additional effort to articulate projects) • Assemble a portfolio of promising and success stories of innovation with visible impact on the ground • Design a portfolio of private-public innovation programs and pilots, such as matching grant scheme for ‘first mover’ firms
Medium-term (up to 2015): Gaining credibility – <i>scaling up the entry points (critical mass of changes)</i>	Implementation and continuous adjustment of the portfolio of projects	<p>Implement the portfolio of private-public innovation programs with tangible outcomes, which can include:</p> <p>Technology Transfer Center Focused on Bottom of the Pyramid Issues</p> <ul style="list-style-type: none"> • Innovation foresight process as a national shared vision of the long-term future: as a bridge from ‘lower hanging fruits’ to longer term issues • Foundation Tanzania (modeled after Foundation Chile), an autonomous private-public organization with a mission to incubate innovation firms in promising areas of the economy • Focus on bottom-up coordination through competitive schemes to finance consortia developing innovative solutions
Longer run (up to 2030): Structural change – <i>significant improvement of innovation climate</i>	Development of export-driven innovation clusters	<ul style="list-style-type: none"> • Increase R&D expenditures to 1% of R&D • Target 30-40% of innovation expenditures to be financed by business/private sector

1. Introduction

1.1 Tanzania's innovation agenda as it emerges in this note can be cast as a parable of two smallholder tea growers. They share the same history and, until recently, have been almost identical in their endowments of human and fixed capital. Yet one is prospering and exporting, while the other is struggling to survive. The successful tea growing enterprise plants herbal organic tea, which it exports to Europe. It has been able to plug-in into international organic exports networks and relevant donor programs, such as SIDA's organic exports initiatives. Through this collaboration, it takes advantage of technical and marketing capabilities of leading firms in both Tanzania and Europe. More generally, it learns about product differentiation and the importance of just-in-time delivery. Given the rapidly changing tastes of consumers and exigencies of certification, as well as the demanding production and logistics disciplines needed to keep in pace with these changes, the successful firm is becoming part of the new, knowledge-processing economy. Its small size and modest resources are not obstacles to success precisely because technical and marketing skills reside in networks, not individual firms.

1.2 In contrast, the struggling firm, which tea plantation was established a century ago when Tanzania had (briefly) become a German colony, is at risk, precisely because, like so many other firms, it is trying to survive on its own. All the knowledge-induced changes that create opportunities for the first firm are threats to its neighbor. The first firm embarks on a *virtuous circle of learning* (success breeds success: inclusion in knowledge networks brings new expertise and makes subsequent learning more productive), while the second one falls into a *vicious circle of poverty* (failure breeds failure: exclusion from knowledge networks diminishes further chances to catch-up). In a global economy that is increasingly characterized by rapid, non-linear changes from unexpected sources, the success of individuals, firms, regions and national economies is based on their capability to learn by entering virtuous circles while of course avoiding, or rapidly extricating themselves from, vicious ones. Put bluntly, learning to learn is critical when change is. This paradox of diverging trajectories applies far beyond agriculture or manufacturing. Innovation does make a difference, and can increasingly push two neighboring hospitals or two schools to dramatically different and widening performance characteristics.

1.3 This note is written to help Tanzanian policy makers respond to this paradox of diverging trajectories. It consists of four sections and one attachment. Section 1 outlines main issues facing Tanzania's innovation system. Section 2 focuses on entry points and 'lower-hanging fruits' to alleviate most pressing constraints and trigger reform dynamics. Section 3 discusses medium and long-term policy initiatives. Section 4 provides conclusions.

2. Context and main issues

2.1 Tanzania has benefited from a relatively strong economic growth. New sectors such as the fishing industry have grown significantly and yet there has not been much innovation. These improvements have resulted in a wider distribution of commodities and services that significantly impact on the day-to-day life of the population, such as cell phones and small commuting vehicles (dala-dalas) – but do not significantly change the conditions of economic development of the country. The S&T infrastructure is relatively developed with a number of technological institutes and universities that cover most basic sectors and disciplines.

2.2 Weaknesses of Tanzania's innovation performance and innovation climate are well-known and relatively well documented. For instance, at a December 2008 UNESCO workshop in Bagamoyo, Professor Mshinda, Chairman of COSTECH, noted that “Tanzania's innovation system is facing the following challenges: (i) the absence of a strategic vision; (ii) the inability to formulate a national R&D agenda linked to the country's social and economic development priorities; (iii) very low funding levels for R&D (0.18% of GDP, see Mshinda, 2008); (iv) donor funding for R&D is driven by donor priorities which may not correspond to national priorities; (v) brain drain; (vi) an aging cadre of professors and R&D personnel; (vii) decaying Science and Technology infrastructure; (viii) lack of online access to journals and research materials; (ix) a weak culture of collaboration and cross- disciplinary, problem-oriented research; (x) limited interaction between researchers and professors, on the one hand, and the business community, on the other hand; and (xi) a weak, non-supportive enabling regime for STI, including but not limited to IP issues” (Watkins, 2010)

2.3 Similarly, during his opening keynote address at the December 2009 World Bank Global Partnership Forum, Minister for Communications, Science and Technology Peter Msolla argued that the main challenges facing Tanzania's STI system include: (i) human resource capacity development, (ii) financing STI activities; (iii) transforming research findings into products capable of addressing Tanzania's socio-economic problems; (iv) a lack of entrepreneurs and entrepreneurial spirit; (v) weak public support for STI; and (vi) declining student interest in science, technology and innovation (cited in Watkins, 2010).

2.4 One can continue documenting constraints and problems with more precision and detail. Although beyond the purview of this Note, human capital is a significant constraint². However a more thorough understanding of constraints is not likely to shed light on specifics of the how to alleviate them. In order to uncover emerging solutions, attention to the heterogeneity and internal diversity of performance is required (see Attachment 1 for a more conceptual discussion). The following promising innovation in Tanzania will help to clarify key issues.

² As a background, education system reveals the same combination of promising if tentative changes with still low aggregate numbers we see in innovation system, particularly at a micro level. For instance, enrollments have grown substantially at all levels of the Tanzanian education system, with enrollment growth at the secondary and tertiary levels being exceptionally rapid, yet they remain relatively low, in regional perspective (in 2003, Tanzania's Secondary Gross Enrollment Ratio (GER) was only 7%, and the Tertiary GER was only about 1.5% yet by 2006, the Secondary GER had reached 15%, and the Tertiary GER had reached 3%). (World Bank, 2008).

2.5 A technology has recently been designed and was successfully tested to make easily compressed bricks with local materials and compressed without cement. This is a very relevant technology for poor rural communities. It originated in South Africa and has been perfected by several inventors in Tanzania, led by the National Housing and Building Research Agency (NHBRA). The machine to manufacture such bricks costs about USD 450 . This is not a considerable sum, yet the machine is still relatively expensive for a Tanzanian individual or a household with an average annual income of some USD 440 in 2008, and no scheme exists for helping interested individuals or communities either to use or buy the machine. Moreover, there is no mechanism to inform and familiarize potential users with the technology. Therefore, the technology does not get disseminated throughout the country, even though it would have a considerable positive impact on the economy, the society and the environment.

2.6 This example is generic in illustrating four key points.

2.7 First, innovation is a key to address challenge of poverty reduction. As Recent Global Forum on STI capacity convened by the Bank in 2009 (World Bank, 2010) notes: “there can be neither inclusive globalization nor sustainable solutions to any of the critical development challenges -- food security, clean energy, effective health care delivery systems, competitiveness and job creation, etc. -- if developing countries do not build capacity to find and invent appropriate technologies, adapt them to local circumstances, and deploy them to solve local problems”.

2.8 Second, to address everyday needs of the country, there needs to be a shift of focus, from R&D to a more mundane down-to-earth view of innovation. This note defines innovation as diffusion of a new or improved technology or practice in a given context and not in absolute terms. On a micro level, this implies the diffusion of available technologies for use by firms, individuals or households, which can improve their productivity and welfare. On a meso level, it means the development of new industries, based on foreign or local technologies and a source of new jobs, income and exports. Such a view deemphasizes the usual emphasis on R&D. While R&D is important in order to adopt and adapt technologies developed elsewhere, assuring the openness and access to international innovation and knowledge networks is the first order of business for Tanzania’s policymakers.

2.9 Third, the key problem of Tanzanian innovation performance is the lack of effective demand (supported by retained earnings or credit) for innovation. It also underlines the centrality of firms (by which we mean all real sector enterprises, including farms) in the national innovation system. An innovation system consists of the network of organizations, rules, and procedures that affect how a country acquires, creates, disseminates, and uses knowledge. Some key organizations for the creation of knowledge thus include universities, public and private research centers, and policy think tanks. Private firms are at the center of the innovation system. If the productive sector has little demand for knowledge, the innovation system would be fragmented and dysfunctional, as indeed is the case in Tanzania.

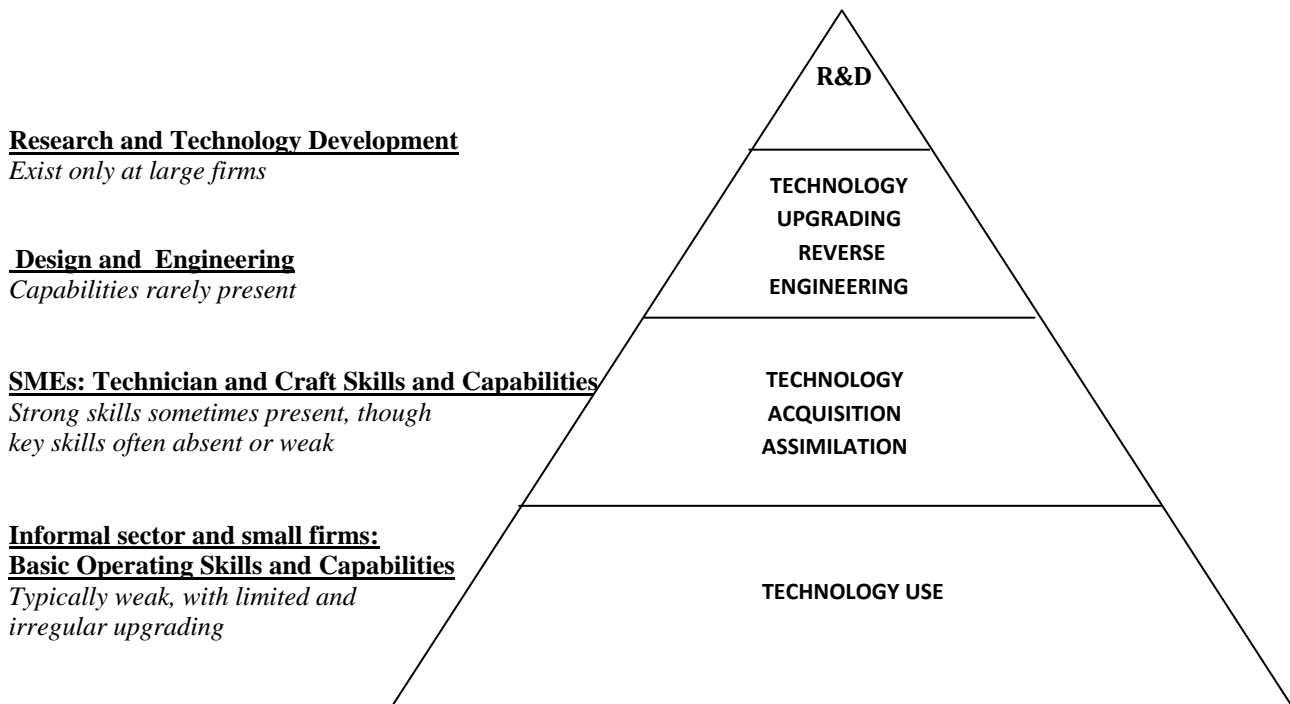
2.10 Fourth, innovations come from innovators. A country’s innovation performance depends foremost on the quantity and quality of its innovators – entrepreneurs who make things happen. For Tanzania as for any developing economy, it is critical to distinguish four distinct types of innovators, and hence four strands of innovation (Rischard et al 2010):

- The first type of innovator is a science or engineer (often a PH.D.) who engages in R&D for new products, new technical processes, and sometimes even new services. He or she is at the heart of the traditional technological variety of innovation, which one could call the S&T-led innovation strand.
- The second type of innovator recombines existing technologies, ideas and knowledge from all over the world into new products or services. These innovators invent things not previously available such new software games that create millions of addicts or new TV series.
- The third type of innovator recombines existing technologies by diffusing new products and services in a given context. This pragmatic innovator is open to the world to adopt and adapt useful technologies developed elsewhere. The key for the pragmatic innovation is not novelty per se but adaptation and diffusion Code words: pragmatic solution, diffusion, ingenuity. The key issue for developing economies is diffusion and scaling up of pragmatic innovators, turning them into role models who everyone would be tempted to follow and strive towards.
- The fourth type of innovator is most often to be found inside frontier, game-changing companies – generally considering the world as their playing field and highly competitive at that – which give him or her elbow room to create value by inventing or reinventing business models, business processes, supply chains; in short, rethinking the way things get done. This innovation is critical to leverage Tanzania's superb geographical position and articulate its position as a logistic hub linking the Middle East, India and China with East Africa.

2.11 The Tanzania policy paradox is the following. Although the country has a number of pragmatic innovators, their experience fails to get diffused and scaled up. As our brick example indicates, because of the lack of financing and business support, they remain small. Instead, in government policy, innovation often tends to be equated with R&D and with science/engineering innovation (for instance, a recently established incubator in the University of Dar Es Salaam has this focus). But these types of innovators is of least importance for Tanzania' future. Two other types of innovators – based on openness to the world and search for relevant solutions – appear to be absent from policy debates.

2.12 One reason is that the innovation system framework, as it has been applied to a variety of case studies in OECD countries, relies excessively on innovation in the sense of development of radical or incrementally new knowledge. Traditional measurements for an innovation system include indicators of expenditure on R&D, activity in high technology sectors (biotechnology, ICT), patenting activity (number, intensity) and researchers per 10,000 population count. These indicators describe the ability to generate new knowledge. However, they are not particularly helpful or relevant in understanding how a traditional, low-tech manufacturing firm or rural enterprise, can learn to upgrade its capabilities to compete in a knowledge-based economy. These are very often just the tip of the iceberg (see Fig. 1) which conceals a layer of firms, mostly SMEs, for which the major issue is acquisition of basic skills in marketing, design, engineering and other operational skills rather than technology upgrading and R&D.

Figure 1: Capabilities of firms (including agricultural sector) in Tanzania



2.13 With this caveat in mind and following the Knowledge Assessment Methodology (which is based on traditional indicators of innovation such as expenditure on R&D, patenting activity etc.), Annex 2 provides a qualitative assessment of Tanzania's innovation performance. Three conclusions are noteworthy. First, indicators that are available signal very low level of innovation. Knowledge Economy Index in 2007 (the latest year available) was 2.17, which is lower than in Kenya (2.77) although higher than some African economies. Second, and even more significantly, in relative terms (i.e. benchmarked vs. other countries in the world) and compare to a reference year of 1995, Tanzania' aggregate innovation performance has declined over time. For instance, in 1995, Tanzania' Knowledge economy index was comparable to that of Vietnam (2.81 and 3.14 respectively) but Vietnam since then has improved while Tanzania' knowledge economy performance has declined significantly in relevant terms. Third, some indicators which are available for other African economies, such as aggregate R&D expenditures, are not available for Tanzania. This is a reflection of decades of neglect of S&T sector and illustration of the fragmentation of innovation system. To conclude, there are many overlapping problems and the issue is how to support promising changes at a firm level and in the government policy which are already emerging.

2.14 Interviews at COSTECH, and other government agencies and firms revealed that although R&D bias is still very strong, many senior officials have an intuitive understanding that innovation needs to yield a tangible impact on life, be it poverty reduction or productivity improvement. COSTECH is broadly on the right track by encouraging consortia between end users in the productive sector and national R&D institutes. Yet there are three specific policy issues with which the policy community of Tanzania continues to grapple (and which this Note purports to clarify and suggest on how to deal with):

2.15 First, perhaps as an echo of the centrally planned economy of the past, innovation is sometimes wrongly seen as beginning with R&D – to be principally developed in public institutes – before being passed over to enterprises. This linear model – from R&D to market – is intuitively appealing, and may seem obvious but it is factually wrong and practically misleading. In Tanzania, it seems to be less of an issue with the coordinating agency (COSTECH), but instead more with line ministries and, curiously, with the consulting industry (which sometimes produces an impression of being well versed in outdated theories). In practice, a linear view puts too much faith in bureaucratic coordination, such as inter-ministerial councils. The latter can be useful in sharing information yet they can deteriorate into cartels of established interests. This particular problem stems from the lack of strong involvement of the real sector in innovation and can only be overcome by tinkering, trying and experimenting with real sector agents, particularly in agro-processing, not by studying and lecturing about how ideal an innovation system should be like.

2.16 Second, a broad and demand-driven view of innovation which emphasizes tangible effects on the ground implies that, in a very real sense, innovation is everywhere. But by the same token, from a bureaucratic point of view, it means that innovation is nowhere – as no single agency can appropriate the whole innovation agenda and the related budget to itself. So in theory, COSTECH is responsible for articulation and coordination of the innovation effort but most of the 40 R&D research institutes in the country are managed by line ministries. This is a conundrum faced by all countries, not just Tanzania. A response to this policy conundrum is emphatically not significant increase in budgetary allocation and management responsibility for an R&D agency like COSTECH, but the development of collaborative consortia-like instruments which shift the ‘driving seat’ of R&D and innovation from the government and its budget to end-users in agriculture, industry and services.

2.17 Third, new pilot approaches are introduced to support innovation, which promises a sea-change in the way public support is managed. From first-come first-served forms of assistance, such as matching grant schemes for firms, a shift to a more proactive articulation of multi-year innovation consortia which put together international players, domestic end-users in productive sector and national R&D efforts is taking place. A recent contest for collaborative R&D efforts announced by COSTECH on a pilot basis is an example of this shift. Yet in this type of innovation support, the devil is decidedly in the details, and these details are so far lacking in Tanzania. For instance, peer review evaluation by international experts (for e.g. by relevant members of the Tanzanian diaspora) needs to be made mandatory. This is to prevent self-dealing, as the innovation system of Tanzania is small and everyone knows one another. The experience of middle-income countries shows that an effort should be made to put together good proposals, as relevant agents tend to have little experience or even interest with competitive funding schemes. If the capabilities of agents are a binding constraint in middle-income economies, this will be even more of a constraint in Tanzania.

2.18 The contest-based scheme introduced on a pilot basis by COSTECH is very important because it allows the identification of dynamic, capable individuals and research institutions with the existing research infrastructure in Tanzania, consisting principally from 40 public R&D institutes and 16 organizations of higher learning. Efforts in some segments of this R&D infrastructure (such as IPI, CAMARTECH, TIRDO and others) are promising and a more systematic study is required to evaluate performance of Tanzania’s R&D and technology organizations. A twin problem of chronic underfunding and weak incentives to collaborate with the

real sector is the reason of the disappointing performance of R&D infrastructure. Most research institutes are funded at a bare subsistence level with just enough funding to pay (very low) salaries and minimal operating expenses such as rent and electricity. As a result, the system is trapped in a low level equilibrium. Yet significantly, there is a small segment which is dynamic, productive, and growing because of the ability to tap into international knowledge networks and firms. These are laboratories and individuals which are efficient, dynamic, and perhaps even approaching world class quality. In these cases, better performing individuals and teams are the ones that would need support and funding, not the R&D institute as such. Contests for specific project allow making this crucial distinction between an often informal and ad-hoc project team and already established organization.

2.19 Even under the best of circumstances and with the best intentions, the transformation of Tanzania's innovation system will be gradual and incremental. The problems of Tanzania's innovation climate are many and they are formidable; it would be unrealistic to insist on big changes and improvements. Instead, we propose strategic incrementalism – modest improvements in the short term which – by coalescing into a virtuous cycle. This promises dramatic changes in the longer run.

3. Immediate Agenda: Entry Points and Lower Hanging Fruits

3.1 Recall the opening parable in the introduction of two tea growers which were once almost identical. Then one began growing rapidly, while the other could barely survive. All of a sudden, this story being set in the southern hemisphere takes a magically realistic turn: a high and benevolent government official comes upon the neighboring farmers. She sees in one glance what the government ought to do: help the struggling firm escape its vicious circles and participate in international knowledge networks. But getting from the general idea of what to do to the specifics of how to do it proves a mighty chore, the government's good intentions notwithstanding. A young official, clear minded and innocent of all the past missteps of economic development policy (realism is still magical, after all), is given the task of figuring out the how. Focusing on just the two firms, she quickly notices subtle but relevant differences: The successful firm had access to capital at a crucial moment through the owner's rich uncle (who emigrated and now lives in UK); the owner of the failing firm was not favored by rich relatives and does not have any diaspora connections. Commercial banks and government lending programs have so much trouble assessing the prospects of turning the firm around that they hesitate to make a loan to the firm. With regard to skills, the story is similar. When it comes to hands-on experience with tea growing, both owners are similar. But the successful one has five more years of formal schooling (the rich uncle again), and so can read manuals on organic certification that the other owner can not. This difference is exacerbated by the fact that the good reader doesn't really need to read all that much because she gets further instruction in all these areas from customers and donors. But in order to overcome her isolation, the functional 'illiterate' who owns the unsuccessful firm may have to rely on the very books closed to her.

3.2 The official is bewildered. This list is the result of cursory inspection. Is it complete enough? How would one know? Can she just ask individual farmers what they need? Probably not, because many of the most isolated farmers, cut off from any experience of new ways of doing things, will be hard pressed to respond with just what it is that they don't know how to do.

3.3 Suppose that because our parable is about the real world, the official, pressed for time, decides that the cursory list is complete enough for starters. But what about the sequence of remedial measures? Plainly put, it is impossible to change everything at once. Change must be stepwise, but some steps may be preconditions for the success of others. So the stepwise changes can't be ordered haphazardly. It makes sense for instance to offer literacy training before providing finance³, so that current reading informs the use of the fresh money. But wouldn't the credit, and the restructuring it enables, create a sense of urgency and opportunity that will motivate attention to remedial reading classes? What about doing both simultaneously? As soon as these questions are formulated, they tangle into a Gordian knot which we will attempt to disentangle.

3.4 Given limited implementation capability, actions should be focused. We suggest a four-prong strategy:

³ This approach is adopted, for by a parastatal entity Small Industries Development Organisation (SIDO).

- Taking stock: taking inventory of R&D efforts by line agencies in order to arrive to an acceptable and shared understanding of the level and composition of R&D expenditures in the country. As already noted, so far even the overall funding of R&D is an enigma (as reflected by widely differing figures), so taking stock is an obvious entry point. In similar vein, COSTECH should evaluate past efforts to learn from mistakes and identify levers of success.
- Developing a portfolio of promising and successful cases of innovation in the country. As innovation develops from tinkering and problem-solving in everyday practice of the real sector, such cases are usually unknown to the government and much less to the general public. A largely private R&D effort in the Tea Research Institute of Tanzania (Box 1) and innovation efforts of rapidly growing exports of organic produce are two such examples from agro-industry, but one would expect such a portfolio of promising efforts to be much more diverse. Precisely because change in innovation system takes time – to build the credibility of the change – it is vital to document and disseminate emerging success stories. By taking stock and then diffusing the experience of first movers (firms that do new things), they can become role models for others to follow.
- Designing a small portfolio of private-public initiatives which would support first movers. Following an evaluation of SIDO' effort in this area, one would redesign a matching grant scheme for SMEs to enable them to acquire technical and marketing knowledge, and perhaps finance limited capital goods (up to USD 5-10K, with overall grant funds to one SME in the magnitude of USD 25-50K).
- Strengthening and expanding competitive funding schemes to articulate innovation consortia, as recently introduced by COSTECH on a modest pilot basis. In the medium-term, such contests for collaborative innovation effort should become a main source of funding for national R&D. They should emphasize international participation as a condition and must rely on international peer-reviewing. The main objective of such funding schemes is giving an opportunity for dynamic and entrepreneurial individuals and organizations to develop their own project – in collaboration with each other and international players. It is an instrument to identify and back emerging winners – dynamic exceptions from the general rule.

3.5 Such competitive funding scheme should rely upon: (i) international peer review, (ii) an emphasis on scientific excellence coupled with a focus on addressing relevant social and economic development issues (water, environment, food processing, health, value addition, food security, adaptation to climate change, clean energy, etc.), (iii) the formation of inter-disciplinary virtual teams of scientists, (iv) linkages with the business community, and (v) the formation of an International Technology and Innovation Advisory Board. Recent Bank projects in Uganda and elsewhere (Latin America and Eastern Europe) suggest that these mechanisms can help improve both the quality and relevance of science and engineering for a country's development.

Box 1: Tanzania Tea Research Institute

3.6 The Tea Research Institute of Tanzania (TRIT) was established in 1996, as an autonomous organization representing the Government of Tanzania and the tea industry. Its duty is to support

the continued development of the tea industry, both large and small-scale producers, with appropriate high quality, cost effective research and technology transfer. It is funded by a statutory cess of 1.5%, levied on all producers of tea, and by grant aid from willing donors. In July 1997 the staff at what was then known as the Ngwazi Tea Research Unit (now Station), a privately funded organization in the Southern Highlands, together with the ongoing research program, were officially incorporated into TRIT. In October 1998 a similar transfer from the Government owned and managed Marikitanda Tea Research Station in the East Usambara Mountains in the northeast of Tanzania to TRIT took place. At the same time an agreement was reached with the Government on the future of Kifyulilo Agricultural Research Institute, the former national centre for tea research, also in the Southern Highlands, whereby selected research on tea farming systems would be commissioned by TRIT on an annual basis.

3.7 TRIT aims to support the development of both small and large scale producers through appropriate, cost effective, high quality research and technology transfer, to ensure the sustainability of the industry. TRIT operates four research programs which represents key priority themes in the Tanzania Tea Industry. The Research programs fall under the Crop improvement, Soil Fertility Management, Crop Water Management and Technology Transfer.

3.8 The objective of the suggested initiatives is pragmatic – to shake up ‘business as usual’ and resistance from vested interests for which it is a way of life can be significant. Hence individual champions pursuing the change agenda in spite of all obstacles and against all odds, and not funding for the initiatives, will be the single most important binding constraint.

3.9 There is, of course, no magical solution to this capability constraint. One solution is to be selective and to focus on a small number of policy initiatives. One has to be creative in locating unexpected allies and supporters. For instance, invariably, every country embarking on a transformation of the innovation system finds support in its diaspora of highly skilled, particularly highly successful professionals – so-called diaspora overachievers. Diaspora overachievers have the reputation, connections and resources to facilitate a desired change at home. They are truly unique and valuable – they know how the system works yet they are not part of its vested interests. Hence one pragmatic approach is to engage successful Tanzanians abroad into 'brain circulation' networks. Thousands of tertiary-educated Tanzanians currently live in OECD economies and many have become successful entrepreneurs, managers and politicians. Many of these overachievers still have a strong Tanzanian identity, which could be used as the basis for an international knowledge networks. As an illustration, see Box 2 on a new University in Ghana established by a diaspora member. As Table 2 indicates, the stock of tertiary educated Tanzanian is not very large, neither in absolute or per capita terms (suggesting that the problem of brain drain has been exaggerated; i.e. in comparison to neighboring countries, Tanzania experiences less significant brain drain), yet it is still considerable. More importantly, the diaspora overachievers' agenda is already being discussed in practical terms by, for instance, Tanzania Investment Center (TIC) which started to identify key Tanzania overachievers abroad. For instance, Tanzania' skills abroad can be drowned upon to compile a portfolio of promising cases of innovation and entrepreneurial role models in Tanzania.

Table 2: Tanzanian Skills in OECD Economies – Benchmarked with Neighboring Countries

	Share of Tertiary Educated in the diaspora	TOTAL number Tertiary Educated
Kenya	44%	58999
Nigeria	62%	106702
Tanzania	49%	22363
Uganda	47%	25561

Source: OECD Migrants Database 2000 – Set A.

Box 2: Diaspora member creates first-mover institution in tertiary education in Ghana

After living in the United States for nearly 20 years, Patrick Awuah moved back to his native Ghana to start a new university to educate Africa's next generation of leaders. Awuah left Ghana in the mid-1980s, when the country was under military rule. He graduated from Swarthmore College with an engineering degree in 1990. Soon after, he joined Microsoft, moved to Seattle and became a millionaire before he was 30. Having achieved economic well-being, a solid reputation and a fulfilling family life, he decided to relocate to Ghana. When asked for his motivation to return to Ghana, he mentioned the birth of his son: "Having a son caused me to reevaluate all my priorities," he says. "This was something that was eating at me. What kind of world is it that my son is going to grow up in? And how is Africa represented in that world?" His goal was to establish a university of Ivy League quality in his home country and train the next generation of African leaders, with a focus on ethical entrepreneurship and integrity. Awuah used his US-American contacts and his professional knowledge to develop and assess his business plan. He found a team of UC-Berkeley MBA students and management consultants to conduct a feasibility study. The Awuahs invested more than half a million dollars in the *Ashesi* project and another US \$4 million more through private, US-based networks, including former colleagues at Microsoft, private corporations and foundations.

Ashesi is a private university in a leafy residential suburb of Ghana's capital city, Accra. Its campus and facilities present a stark contrast to Ghana's five public universities, where enrollment has soared to 65,000 since 1990, and overcrowded lecture halls, substandard student residences, rising tuition fees and poor staff salaries have led to angry protests and frequent strikes. However, tuition at public universities is also much cheaper than the US \$4,500 in fees that Ashesi charges.

Ashesi has small classes, well-trained and well-paid staff and international partnerships with top-tier universities such as New York University and with the Council on International Educational Exchange (CIEE). About 80 percent of the university's students are from Ghana. The rest are from other nations in Africa. About half of the students receive financial aid. In 2005, four years after enrolling its first crop of freshmen, Ashesi issued its first diplomas to a graduating class of 20 students. Ashesi offers two four-year degrees, in computer science and business administration, both of which also emphasize a broad foundation in liberal arts. Students describe the experiences as "You're like raw gold. The school is like a furnace. The heat from all the courses, from the professors, from the projects that you undertake -- you come out as a refined substance, you come out glittering. You dream beyond your world."

Source: World Bank staff.

4. Longer-term agenda: Institutionalizing Promising Changes

4.1 This section is focused on identification and subsequent support of clusters of innovation activities in the Tanzanian economy. This process is called “self discovery”—the search process by which an enterprise or entrepreneur determines what markets and public needs it can serve (Hausmann and Rodrik, 2002). More generally, it is the global search for home-grown responses to a country’s challenges.

4.2 Depending on the type of the entrepreneur or enterprise, self-discovery has three distinct segments which can be visualized as pyramid similar to Fig. 1. At the foundation of this pyramid is a so-called bottom-of-the-pyramid innovation by the poor and for the poor. Its middle layer is technological adoption and adaptation – the search for global knowledge to be adapted to local needs. High value added agriculture, particularly export-driven, is an example. The tip of the pyramid is self-discovery of new clusters that the country can excel in. Ricardo Hausmann and Dani Rodrik (2002, 2007) have pointed out a number of cases of unlikely and remarkable growth —cut flowers in Columbia, soccer balls in Pakistan, hats in Bangladesh, and software in Bangalore, India—where once an entrepreneur showed that if certain goods could be produced in the country, then others could relatively easily emulate and reap the lion's share of the benefits.

4.3 This section will provide one detailed example per each of these three segments. Many more programs and initiatives can be suggested. Yet, given implementation constraints, the preference leans towards a few focused initiatives implemented well.

4.4 From the point view of implementation, bottom-of-the pyramid innovation is the most straightforward, as significant experience has shown from the case of India (to which a study tour to the innovation agency – CSIR – is advisable) and East African economies such as Uganda.

4.5 Recognition that lower-income consumers are a major market opportunity has produced a series of examples of “piggyfrogging”, namely searching and piggybacking on foreign technologies and then leapfrogging by recombining knowledge from diverse domains result in new lower-cost, high-performance technical and organizational solutions for low-income and higher-income consumers. Examples (from India) include \$24 water filter targeted at rural households with no electricity or running water, with adaptations such as using one of the country’s most common waste products, rice husks from milling, to filter out bacteria; as well as affordable access to technology services (mobile phones, computers, Internet), financial services (mobile banking, micro finance), farmer services and food security (real-time information on crop prices, fertilizer and pesticide advances, weather forecasts, crop and livestock insurance, supply chain integration), and education and health services (distance learning and diagnostics/treatment, virtual libraries, real-time collaboration with global institutions). To facilitate design and diffusion of this type of innovations, we suggest an Innovation/ Technology Transfer Center *Focused on Bottom of the Pyramid Issues*.

4.6 Possibly established on the basis of consolidation of some of the existing (and grossly underfunded) R&D institutes, the Center would be responsible for promotion of globally available relevant technological solutions (proved to be useful in places such as India and South Africa) and work with private sector firms interested in their adoption for Tanzania. Such a center could initially be set up in cooperation with an established international consultancy firm. The services of

the center provided to private clients should be subsidized through a matching grant scheme as suggested earlier. The idea of the center is somewhat similar to the traditional extension service centers in agriculture, with the primary difference being that its clients would be not farmers but urban SMEs in manufacturing and services. The center would play a dual role on both demand (promotion of available technologies) and supply (helping those who are willing to adopt them) sides and this could be a stepping stone to implementation of institutionally more demanding tasks such as Fundación Tanzania introduced below. One of the early tasks for such a center would be providing assistance to local firms in building local and global partnerships, including marketing and technological partnerships.

4.7 Two segments of the self-discovery process – the bottom of the pyramid and high value-added agriculture -- require substantial experimentation and piloting and here is why producers in Tanzania and other less developed economies face distinct challenges when seeking to enter international knowledge networks and alliances, and increasingly require bundles of inputs or services—standards, certification, de facto property rights, and specific regulations—that only public authorities can provide. This means that self discovery also typically entails collaborative search with government that will facilitate certain kinds of transactions for institutional solutions. Thus understood, self discovery shades into open-ended industrial and innovation policy: a process by which firms and governments collaborate in the identification and pursuit of promising opportunities for development. The problem, however, is that service providers and other partners which can potentially help firms succeed are often diffused and uncoordinated. So the challenge of a credible orchestration and coordination is a central one. In this section, we provide examples of a powerful institution which performs orchestration of an effort of many diverse actors by performing the following functions:

- Articulating a niche in the international market by adapting existing but diffuse technologies
- Articulating and coordination efforts of diverse service-providers, at the sub-national, national and global levels
- Motivating agents of change among firms: orchestrating a demonstration effect on a firm level and articulating first movers: creating firms and investing in them as an early stage venture capital firm.

4.8 Let us discuss the example of Fundación Chile. The Fundación was created as a non-profit corporation by the Chilean government in 1976 with a USD50 million payment by the conglomerate ITT as part of an agreement indemnifying the company for expropriation of its national telephone subsidiary. Under the agreement, ITT was to manage the new facility for ten years, and its initial efforts in that direction were not auspicious: the first director general, a semi-retired food ITT research scientist, thought the new institution should provide social services such as school lunches and nutrition for infants. A year later, he was replaced by the head of ITT's Spanish telecommunications laboratories, who helped the Fundación learn project-management skills, but who would have dedicated the Fundación to telecommunications projects, for which there was no market, and foodstuffs, for which the markets were incipient. Discussion of the shortcomings of his suggestions, however, drew attention to prospects in renewable resources—principally forestry, aquaculture, horticulture—which became the Fundación's enduring focus.

4.9 Only in the aftermath of the economic shock of 1982 did Fundación Chile develop the activities that came to define it. A combination of sharp devaluation, low domestic interest rates and high uncertainty produced a situation favorable to domestic investment but with nationals willing to invest. Seeing an opportunity in salmon farming, the Fundación decided to launch firms itself, hoping the success would lead to imitation and complementary activities. Thus it acquired the necessary technology, for free, from specialist public agencies in the US Pacific Northwest, and founded one firm to produce smelts, another to develop hatching and ranching technology for Chilean waters, and a third for smoking fish. From these firms grew the Chilean salmon industry, which now produces USD600 million in exports annually.

4.10 In the next two decades, the Fundación's model of supporting development was refined in three crucial ways.⁴ First, it shifted from creating start-ups itself to co-venturing with outside partners. Whereas between 1985 and 1993, 87 percent of the Fundación's start-ups were wholly owned by the Fundación itself (and only one of the joint ventures involved a foreign partner), from 1994 to 2004 only 75 percent of the startups were joint ventures, and 6 of these were with foreign firms. Thus the foundation went from spinning out projects developed internally to networking with outsiders to create projects. Second, the technological complexity of projects increased, with biotechnology in particular becoming more and more important. Since projects in this area—new vaccines, development of pest-resistant fruit varieties—often required integration of scattered intellectual property and diverse technical tools for genetic manipulation, many of the external partners had to construct networks of their own to serve the specific needs of the emergent companies. Therefore the Fundación in effect builds networks of search networks linking global knowledge with local capabilities.

4.11 Third, the Fundación's own project-selection and review mechanism became more explicitly comparative or competitive: staff members, hired on the basis of demonstrated technical knowledge and familiarity with the markets and business practices in a particular sector, apply for internal grants to develop a case for launching a new venture in some general area. The best of these preliminary plans can be used to apply for a second, longer term grant to develop a business plan for a new venture, typically in partnership with outsiders; and so on until the proto-venture becomes a candidate for seed capital and enters the familiar sequence of venture capital financing. So far, at least, the transparency inherent in the broad and continual benchmarking of projects at every stage has also functioned as an effective governance mechanism, assuring that public funds are indeed directed towards public purposes, as best as these can be defined at any moment.

4.12 Drawing on the functions of project-based coordination established in the beginning of this section, we propose to establish *Foundation Tanzania* as a hub and springboard for private-public international search networks. Foundation Tanzania could be conceived as a private-public entity with a sizeable (for Tanzania) endowment which would be autonomous from the government, and which would develop and provide – in collaboration with the private sector – seed financing to generate a demonstration effect of how new technologies address mundane but pressing issues of Tanzania's everyday life (examples include but are not limited to: value-added agriculture, appropriate transportation solutions, etc.).

⁴ This account follows Fundación Chile, "Una oportunidad para Promover la Creación de Negocios Innovadores en Clusters Claves," Santiago, nd.

4.13 To summarize, in order to be successful, Foundation Tanzania needs to perform two tasks simultaneously:

- Project development: scan the world in search of appropriate technologies, adopt them to the country's needs, and based on that develop commercially viable projects.
- Seed capital financing: provide seed capital to some of the projects as a demonstration and trigger to the venture capital industry and other sources of finance.

4.14 Above all, this possible new organization must have autonomy from day-to-day operations of the government and have entrepreneurial management attentive to the needs of the productive. If these two conditions are not met, failure is likely. But as the example of Tanzania Tea Research Institute (Box 1) illustrates, it is indeed possible to meet these two conditions. A realistic strategy is to scale up existing dynamic organizations, such as TRIT rather than establish a new organization from scratch.

4.15 Finally, a third aspect or task that could be considered is the exploration of the 'game-changing' innovation. The issue is articulation and self-discovery of competitive advantages of Tanzania as an open economy. How will it be able to insert itself into global value chains? The economic history does not show a single country which has been able to sustain high growth rates without acquiring manufacturing experience, usually export led. But in Tanzania, much like in the rest of Sub-Saharan Africa, manufacturing is in decline and its resurgence – given the presence of China and India – cannot be taken for granted. What kind of value creation can supplant the traditionally defined manufacturing experience? As a starting point, three candidates can be considered to attract world-class game-changing companies:

- High-value added agro-processing, particularly based on organic produce. Seeds of an export-driven organic value chain already exist, as demonstrated by diverse successes of Tanzania and East Africa's Organic Agriculture movement.
- Leveraging the unique geographic position of Tanzania and its closeness to the Middle East, India and China by turning Dar Es Salaam into a logistical hub.
- Exploration of the potential of IT, IT-enabled-services and software development as potential competitive advantages. The recent report of the Commonwealth Business Council (Outsourcing, 2010) shows that Tanzania has very lower IT readiness compared to other African countries. Nonetheless, the focus on IT-enabled services as a strategic opportunity is important to coordinate efforts to enhance and upgrade the human capital which is unquestionably the key binding constraint in this area.

4.16 Note that these are just examples of promising economic domains rather than a suggestion to 'pick winners'. Picking winners in a modern, fast-changing global economy (in which no single agent can have a panoramic view) is futile. Rather, the important issue is "self-discovery"—organizing a search process by which an enterprise or entrepreneur determines what markets it can serve. The innovation foresight process, which usually takes about 9-12 months, has proved effective in facilitating such self-discovery. The key idea is to examine, with the help of international experts, possibilities of game-changing innovation that can alter Tanzania's future and

link the out-of-box thinking about the future with positive trends and first movers already present in the country.

One can consider a *Tanzania Innovation Foresight Process* with the following characteristics:

- Participative – with the processes receiving as much emphasis as the outcomes to develop a shared vision across the independent agencies. Diaspora members should also be included into the Foresight process.
- Medium to longer term – with perspectives of medium term (5-8 years) to as long as 25 years in terms of direction and tendencies, although resource plans and implementation elements are usually much shorter, typically with three to eight year horizons.
- Focused on needs rather than technologies – emphasising the key trends in society's changing needs for products and services, and the contribution that knowledge and research in science and technology in particular are likely to make in achieving increased well being.
- Early efforts using the Foresight approach, of the nature described below, were carried out in the UK in the 1990's but they have now been adopted widely throughout both the EU and wider afield. They have proved particularly useful in defining longer term needs and helping to develop the creative linkages from which innovations emerge. Their methodology, in summary, entails:
 - A steering group – comprising of leaders of the three main constituent communities: the government, academia and businesses
 - A secretariat - that identifies the main participants (usually through some variant of a co-nomination exercise), begins and shapes the discussions (initial position papers, arranging and orchestrating working groups), and draws together, along with working groups, their individual contributions into an integrated summary
 - An organised programme of semi-autonomous working groups – organised on topic lines (which reflect a mix of key needs and strategic technologies) that undertake analysis, receive evidence and reach conclusions within the designed time frame and produce a report summarising their evidence, findings and prognosis
 - An integrative effort – usually conducted by chairs of working groups and the secretariat to integrate the works of the groups into a whole and develop from that a strategic conclusion from the entire effort, which usually suggests lines of action and priorities for resource use over a shorter time frame.

4.17 An important output, in parallel with the written papers, is the cohesion that emerges from the collaborative process and a broad ownership, although not necessarily universal, of the strategic lines and priorities for action in the future. It provides the government, academia and businesses with a template against which to reference their efforts in the future. In several cases, this exercise has been taken to a lower level of aggregation – taking national Foresight exercises to the regional level, for example. Exercises have been repeated and analyses and conclusions have been updated using the same processes, although sometimes reduced in scale and scope, on three to five year cycles to ensure they remain relevant and take into account both intervening scientific progress and changes in society's needs. Promotion and dissemination efforts are then made to ensure

widespread knowledge about the findings and conclusions of the Foresight reports. These again add to the shared visioning goals and reduce information asymmetries across the target audience. This also enables them to be incorporated into public policy and budgetary cycles, and into strategic decision making in the enterprise sector. Academic bodies have also used the reports to shape their allocations and priorities for selective efforts in research and teaching. With the Foresight reports as a guide, the steering groups use their connections and influence with the concerned independent executive agencies to direct resources and fund programmes of activity that are informed by the findings of the reports.

5. Conclusions

5.1 To summarize, the proposed pragmatic innovation agenda for Tanzania – global search for home-grown solutions -- implies focusing on bottom-up entry points (the immediate policy agenda – building the foundation), and then scaling them up to ensure coordination and concerted action (the medium-term policy agenda – gaining credibility), and on that basis, moving onto or sustaining major changes (the longer-run policy agenda). The art and craft of policy making lies in the sequencing of the various horizons of a policy agenda to achieve a virtuous circle of innovation and growth. Concrete, manageable bottom-up approaches serve as demonstration projects to advance the more ambitious policy agenda (Figure 2).

Figure 2: From Entry Points to Attractive Innovation Climate

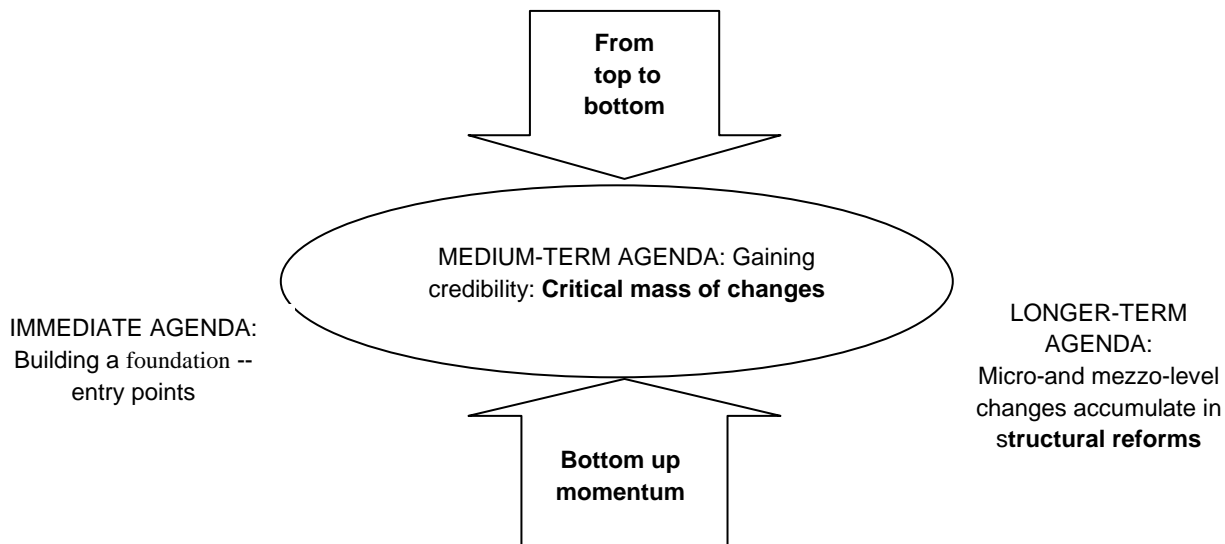


Table 3 brings together immediate, medium- and long-term planning horizons.

Table 3: Innovation Agenda for Tanzania

Time Frame and Objectives	Focus	Specific Actions
Short-term (immediate from 2010): Building a foundation – <i>developing role models</i>	Designing a portfolio of private-public innovation programs and pilots	<ul style="list-style-type: none"> • Take an inventory and perform independent evaluation of innovation expenditures and programs • Strengthen existing competitive funding initiatives of COTECH (introduce international peer review, additional effort to articulate projects) • Assemble a portfolio of promising and success stories of innovation with visible impact on the ground • Design a portfolio of private-public innovation programs and pilots, such as matching grant scheme for ‘first mover’ firms
Medium-term (up to 2015): Gaining credibility – <i>scaling up the entry points (critical mass of changes)</i>	Implementation and continuous adjustment of the portfolio of projects	Implement the portfolio of private-public innovation programs with tangible outcomes, which can include: Technology Transfer Center Focused on Bottom of the Pyramid Issues <ul style="list-style-type: none"> • Innovation foresight process as a national shared vision of the long-term future: as a bridge from ‘lower hanging fruits’ to longer term issues • Foundation Tanzania (modeled after Foundation Chile), an autonomous private-public organization with a mission to incubate innovation firms in promising areas of the economy • Focus on bottom-up coordination through competitive schemes to finance consortia developing innovative solutions
Longer run (up to 2030): Structural change – <i>significant improvement of innovation climate</i>	Developing export-driven innovation clusters	<ul style="list-style-type: none"> • Increase R&D expenditures to 1% of R&D • Target 30-40% of innovation expenditures to be financed by business/private sector

Annexes

Annex 1: Creating institutions of growth and innovation by growing and innovating: Lessons for Tanzania from China, India, Kenya and other economies

1. Creating Institutions of Growth by Growing

Development economics conventionally focuses on endowments: Economies with an appropriate endowment (good institutions, good investment climate, cultural dispositions, property and trade laws, as well as institutions for assuring the rule of law) grow. Those lacking such endowments do not. But the surprising frequency of spontaneous growth episodes in “poorly” endowed economies; the sharp disparities in regional developments within national economies subject to the same general rules; and the periodic successes of economies that change their institutional endowments by growing (China) rather than growing by first fixing endowments all strongly suggest fundamental flaws in this all-or-nothing endowment view. There is compelling evidence that, with the few exceptions, less developed economies – Tanzania included -- are on many dimensions internally differentiated and rapidly changing—too heterogeneous and mutable to be any one thing. There is strong evidence, furthermore, that the institutions of developing economies are highly differentiated as well. Far from forming indissoluble wholes, they exist as connected but often detachable pieces, some performing well or easily reformable, others dysfunctional.

Because at least some parts of a developing economy are likely to be (on the verge of) doing well much of the time, and some of its surrounding institutions are likely to be improvable, the problem of development is not starting growth, but using the functioning institutions to relax obstacles to the growth likely to be under way. In the most dramatic cases—of which China is the best current example—the outcome of this piecemeal reform is a thoroughgoing transformation of the economy and the institutions of development.

The cascade of institutional changes begins with in the 1970s with an agricultural reform recognizing the peasants’ control over the plots they are currently working, and permitting them to sell, at market prices and for their own account, surplus above target levels. The result is a sustained increase in agricultural productivity and a rise in rural incomes. In the 1980s another wave of reform allows for the investment of the proceeds of agricultural improvement in Town and Village Enterprises (TVEs): manufacturing firms owned by municipalities or co-owned by them and private parties, and producing for both domestic and export markets. Again proceeds in excess of tax obligations to higher authorities are retained by the enterprise and available to its stakeholders. The TVE’s continue to expand through the mid 1990s, competing with state-owned firms and adding to the modest pressure for their reform exerted by the central state. The changes are accompanied and accelerated by partial reforms of the financial system and the opening of export-processing enclaves to foreign firms and joint ventures. The upshot is a profusion of new institutions that create incentives for investment and efficiency-enhancing behavior in domain after domain without ever creating what, on the consensus, view, seem to be the essentials of a capitalist economy: China is very haltingly privatizing state firms, only recently recognized private corporate property as a distinct legal category, and makes little pretense of an independent judiciary.

An incomparably smaller, but still arguably revealing instance of institutional change in the small concerns reform of the institutions responsible for assuring hygiene and food safety of the Nile perch fishery on Kenya’s portion of Lake Victoria. Exports of the fish, predominantly to the European Union, increased from under barely \$100,000 in 1985 to just under \$44 million in 1996 (perch 35). Starting in that year, however, the EU and various member states began to restrict perch imports from Kenya because of concerns about pathogens and pesticide residues, and, more generally, concerns that Kenyan producers could not assure food safety and hygiene by meeting EU regulations based on Hazard Analysis of Critical Control Points (HACCPs). Under this form of regulation producers identify the production steps where pathogens are most likely to be introduced; devise remedial measures; test to verify that these measures produce outcomes within parameters fixed by the regulator for the relevant class of product; correct remaining

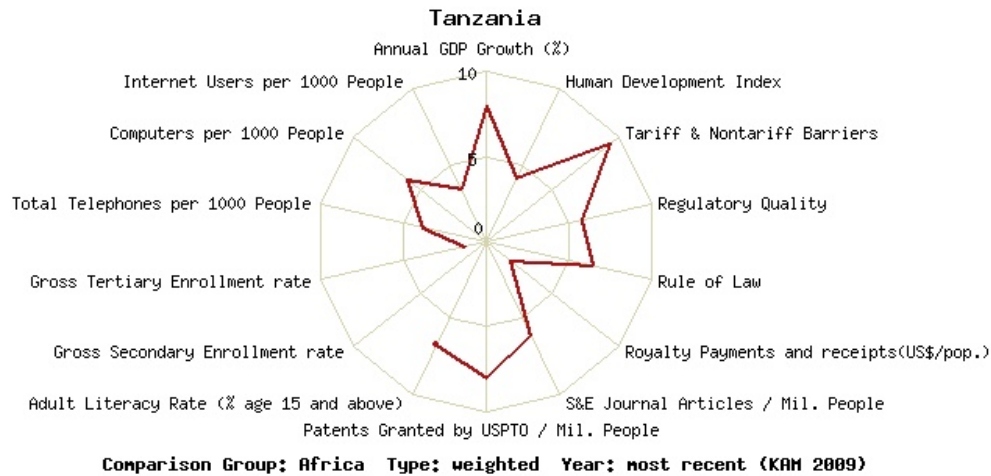
shortfalls; and regularly verify, by routine tests, the effectiveness of the eventual methods. A competent public authority in turn periodically verifies the reliability of this self-monitoring.

An EU technical assistance mission inspected the fishery with Kenyan counterparts and documented problems ranging from unhygienic storage of fish on the fishing vessels to spotty record keeping, especially of “own checks” and inadequate vermin control at processing facilities, to insufficient training of fisheries inspectors. (perch 42) to a wide variety of deficiencies in testing laboratory organization, maintenance, and equipment. In response, the Kenyan government concentrated oversight authority for the fisheries industry from three entities to one, and the fisheries producers formed themselves into a single association to treat with the government. The World Bank study on which this account draws noted substantial improvements not just in compliance with HACCP regulation, but also in the organization of many links in the supply chain and the public sector infrastructure (though the landings often fell short). During the period of these reforms Kenya ranked around 80 of 117 countries on the World Economic Forum’s competitiveness index: a poor enough showing in the league tables of institutional adequacy to cast doubt on its ability to accomplish any reform, let alone to effect, in a short period, a coordinated series of demanding changes within the public sector and between it and private firms. Again, aggregate assessments obscure the internal differentiation which is both a product of and creates the possibility for reform.

Despite its marginal economic significance—in good years Nile perch accounts for only 2.5 percent of Kenyan exports—the regulatory reform of the fishery reflects broad trends in development. The HACCP-based reform is of piece with the shift to just-in-time production noted above: In effect, the regulatory authorities are requiring firms to demonstrate the same general capacities to detect and correct problems upon which the firms’ customers insist as a condition of doing business. Because they accord local actors great autonomy in determining how to meet general goals, rather than setting out universal and detailed rules for compliance, such regulatory systems are well suited to ensure product safety in a period where product life-cycles are short, precise production arrangements are likely to vary greatly from place to place, and the judgments regarding the acceptability of particular risks are frequently revised. Partial reform, domain by domain, or, as in this case, reform one cluster at a time, also appears to be commonplace: the accounts of cluster development referred to above almost invariably interweave discussion of restructuring of firms, and the relation among them, with re-organization, in that particular cluster, of the public infrastructure for verifying compliance with standards set both by public authorities and private buyers of the cluster’s products. Likewise the EU’s technical mission to Kenya to investigate problems and propose changes is part of broader pattern. Because developing country institutions are changed domain by domain and leading professionals in each domain are likely to participate in international communities of interest, it is often opportune to create teams of local and foreign experts to address problems in context, and propose correspondingly specific solutions. Thus the EU routinely insists that candidate members create committees to review key governance domains with qualified EU counterpart teams of their own choosing; and close observers of such collaboration, among them the World Bank, judge it to be one of the most reliably effective means of securing governance reform. From this vantage point the EU and Kenya were applying to the reorganization of the Nile perch fishery a tested method of piecemeal or place-by-place reform of the new, just-in-time type.

On this process view of development, the fundamental conceptual problem is not specifying with more and more precision the foundations of growth, for the process creates its own “foundations,” but rather clarifying in what sense, and by what general means developing economies can influence this process to their advantage.

**Annex 2: Assessing TANZANIA on the basis of Knowledge Assessment Methodology (KAM)
Tanzania 2007: Basic Knowledge Assessment Methodology Scorecard**



Variable	Tanzania (Group: Africa)	
	actual	normalized
Annual GDP Growth (%), 2003-2007	6.80	8.06
Human Development Index, 2005	0.47	4.19
Tariff & Nontariff Barriers, 2009	75.60	9.33
Regulatory Quality, 2007	-0.37	5.81
Rule of Law, 2007	-0.45	6.45
Royalty Payments and receipts(US\$/pop.) 2007	0.02	1.85
S&E Journal Articles / Mil. People, 2005	2.78	6.13
Patents Granted by USPTO / Mil. People, avg 2003-2007	0.01	8.06
Adult Literacy Rate (% age 15 and above), 2007	72.31	6.77
Gross Secondary Enrollment rate, 2007	n/a	n/a
Gross Tertiary Enrollment rate, 2007	1.48	1.38
Total Telephones per 1000 People, 2007	210.00	3.87
Computers per 1000 People, 2007	10.00	6.00
Internet Users per 1000 People, 2007	10.00	3.55

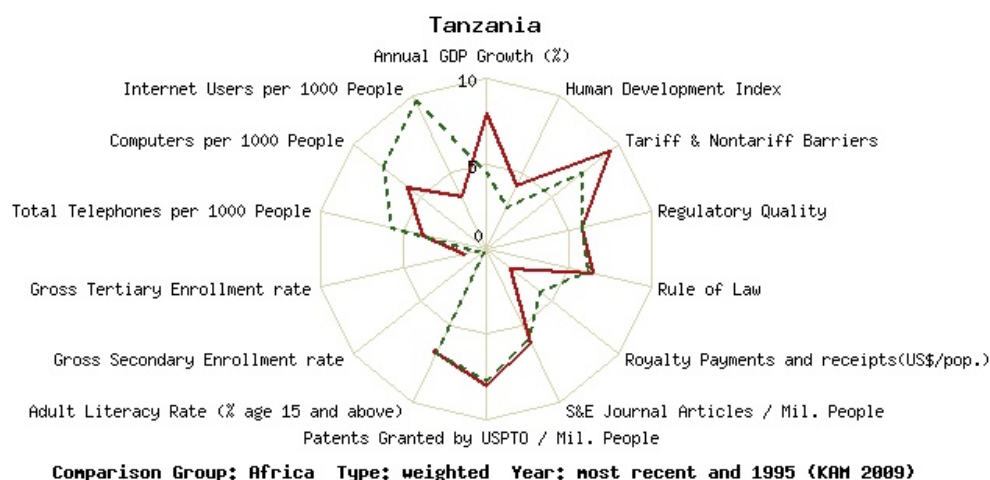
Comparison Tanzania – Rest of the World 1995 – 2007: regression, not advance

✖= Incomplete Data

Export to Excel

Country	Knowledge Economy Index		
	most recent	1995	Change
Angola	2.00	1.97	+0.03
Argentina	5.57	6.72	-1.15
Vietnam	✖ 3.51	✖ 3.14	+0.37
Bangladesh	1.48	2.39	-0.91
China	4.47	3.93	+0.54
Denmark	✖ 9.52	✖ 9.54	-0.02
Ecuador	3.90	4.87	-0.97
Ethiopia	1.30	1.91	-0.61
France	8.40	8.94	-0.54
Greece	7.39	7.86	-0.47
Hong Kong, China	✖ 8.32	✖ 8.28	+0.04
Iceland	8.95	8.63	+0.32
Indonesia	3.29	✖ 3.88	-0.59
Italy	7.79	8.23	-0.44
Jordan	✖ 5.54	✖ 5.57	-0.03
Kenya	2.77	3.19	-0.42
Lithuania	7.77	6.55	+1.22
Moldova	5.07	5.11	-0.04
Slovak Republic	7.47	7.08	+0.39
Tanzania	✖ 2.17	2.81	-0.64
Ukraine	6.00	✖ 5.97	+0.03
United Kingdom	9.10	9.41	-0.31
Venezuela, RB	4.18	5.20	-1.02
Aruba	✖ 7.38	✖ n/a	n/a

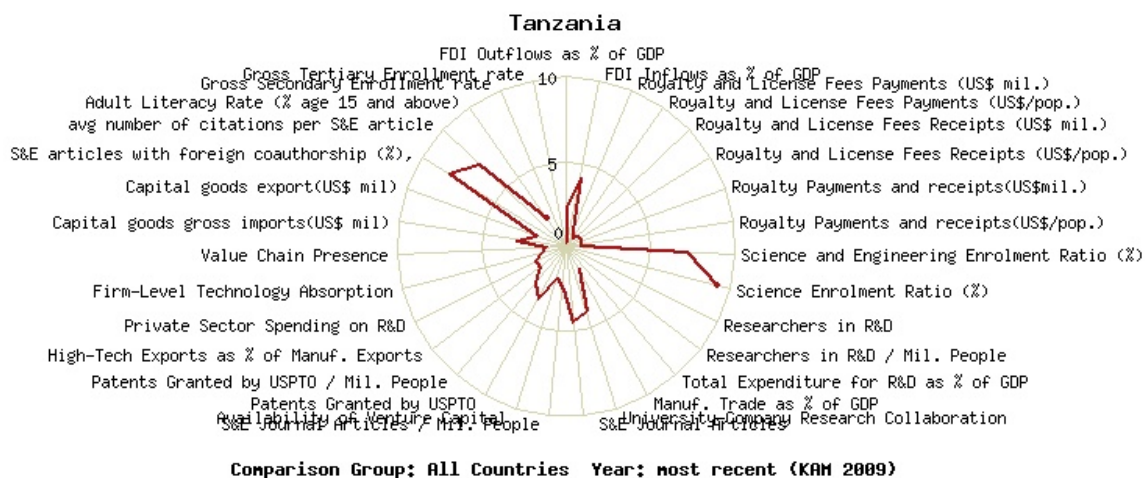
Comparison Tanzania – 1995 and 2007. In the graph below the red line corresponds to 1995 while the green line to 2007



Export to Excel

Variable	Tanzania (most recent) (Group: Africa)		Tanzania (1995) (Group: Africa)	
	actual	normalized	actual	normalized
Annual GDP Growth (%), 2003-2007	6.80	8.06	3.20	4.52
Human Development Index, 2005	0.47	4.19	0.42	2.76
Tariff & Nontariff Barriers, 2009	75.60	9.33	53.80	7.24
Regulatory Quality, 2007	-0.37	5.81	-0.06	5.81
Rule of Law, 2007	-0.45	6.45	-0.42	6.13
Royalty Payments and receipts(US\$/pop.) 2007	0.02	1.85	0.01	4.07
S&E Journal Articles / Mil. People, 2005	2.78	6.13	3.24	5.81
Patents Granted by USPTO / Mil. People, avg 2003-2007	0.01	8.06	0.00	7.74
Adult Literacy Rate (% age 15 and above), 2007	72.31	6.77	70.00	6.77
Gross Secondary Enrollment rate, 2007	n/a	n/a	5.44	0.32
Gross Tertiary Enrollment rate, 2007	1.48	1.38	0.46	0.67
Total Telephones per 1000 People, 2007	210.00	3.87	0.00	5.81
Computers per 1000 People, 2007	10.00	6.00	0.00	7.86
Internet Users per 1000 People, 2007	10.00	3.55	0.00	9.68

KAM Scorecard Tanzania Innovation



Variable	Tanzania (Group: All Countries)	
	actual	normalized
FDI Outflows as % of GDP, 2003-07	0.03	2.33
FDI Inflows as % of GDP, 2003-07	2.88	4.18
Royalty and License Fees Payments (US\$ mil.), 2007	0.68	1.03
Royalty and License Fees Payments (US\$/pop.), 2007	0.02	0.78
Royalty and License Fees Receipts (US\$ mil.), 2007	0.00	1.00
Royalty and License Fees Receipts (US\$/pop.), 2007	0.00	1.00
Royalty Payments and receipts(US\$mil.), 2007	0.68	0.92
Royalty Payments and receipts(US\$/pop.) 2007	0.02	0.84
Science and Engineering Enrolment Ratio (%), 2007	24.22	7.10
Science Enrolment Ratio (%), 2007	15.24	9.20
Researchers in R&D, 2006	n/a	n/a
Researchers in R&D / Mil. People, 2006	n/a	n/a
Total Expenditure for R&D as % of GDP, 2006	n/a	n/a
Manuf. Trade as % of GDP, 2007	20.27	1.53
University-Company Research Collaboration (1-7), 2008	3.00	4.00
S&E Journal Articles, 2005	106.96	4.44
S&E Journal Articles / Mil. People, 2005	2.78	2.57
Availability of Venture Capital (1-7), 2008	2.40	2.00
Patents Granted by USPTO, avg 2003-2007	0.40	3.49
Patents Granted by USPTO / Mil. People, avg 2003-2007	0.01	2.88
High-Tech Exports as % of Manuf. Exports, 2007	1.00	2.06
Private Sector Spending on R&D (1-7), 2008	2.60	2.08
Firm-Level Technology Absorption (1-7), 2008	4.00	1.60
Value Chain Presence (1-7), 2008	2.70	1.28
Capital goods gross imports(US\$ mil), 2003-07	1.167.66	3.02
Capital goods gross exports (US\$ mil), 2003-07	47.77	1.94
S&E articles with foreign coauthorship (%), 2005	88.61	8.18
avg number of citations per S&E article, 2005	1.67	7.13
Adult Literacy Rate (% age 15 and above), 2007	72.31	2.05
Gross Secondary Enrollment rate, 2007	n/a	n/a
Gross Tertiary Enrollment rate, 2007	1.48	0.29

Methodological Note: Knowledge Assessment Methodology (KAM)

The KAM is a user-friendly tool designed by the World Bank Institute to help client countries assess their ability to compete in the global knowledge economy. It estimates a country's preparedness to compete in the knowledge economy through a series of relevant and widely available measures. A set of 76 structural and qualitative variables (available for 121 countries) benchmarks how an economy compares with other countries. The KAM helps to identify the problems and opportunities that a country faces, and where it may need to focus policy attention or future investments. The 76 variables serve as proxies for the four areas (pillars) that are critical to the development of a knowledge-based economy: economic and institutional regime, education, innovation, and information and communications technologies (ICTs). Also included within the 76 variables are several measures that track the overall performance of the economy.

Normalization Procedure for the KAM

1. The raw data (u) is collected from World Bank datasets and international literature for 76 variables and 121 countries.
2. Ranks are allocated to countries based on the absolute values (raw data) that describe each and every one of the 76 variables (rank u). Countries with the same performance are allocated the same rank. Therefore, the rank equals 1 for a country that performs the best among the 121 countries in our sample on a particular variable (that is, it has the highest score), the rank equals to 2 for a country that performs second best, and so on.
3. The number of countries with worse rank (N_w) is calculated for each country.
4. The following formula is used in order to normalize the scores for every country on every variable according to their ranking and in relation to the total number of countries in the sample (N_c) with available data: Normalized (u) = $10 \cdot (N_w / N_c)$.
5. The above formula allocates a normalized score from 0 to 10 for each of the 121 countries with available data on the 76 variables. 10 is the top score for the top performers and 0 the worst score for the lagging economies. The top 10 percent of performers receive a normalized score between 9 and 10, the second best 10 percent receive allocated normalized scores between 8 and 9, and so on. As mentioned earlier, more than one country can be allocated either the best or worst normalized scores. The 0-10 scale describes the performance of each country on each variable relative to the performance of the rest of the country sample.

More information on the KAM, its functionalities, technical notes, data sources, and a user guide are available on its website: www.worldbank.org/kam.

Annex 3: List of People and Organizations interviewed

1. Government Ministries, Departments and Agencies

- 1.1 Mr. A. J. Chilumanga, Head of Policy Section, Ministry of Industry, Trade and Marketing (MITM)
- 1.2 Mr. Mapolu,
- 1.3 Mr. A. S. M. Mwaimu, Director of Policy and Planning, MITM
- 1.4 Dr. John Solomon Kasonta, Chief Research officer, Division of Science, Technology and Innovation, Ministry of Communication, Science and Technology (MCST)
- 1.5 Ms R. Makuburi, Director of Postal Affairs, Tanzania Communication Regulatory Authority (TCRA)
- 1.6 Mr Lawi Odiero, Spectrum Management Engineer, TCRA
- 1.7 Mr. Katabwa J., Chief Quality Assurance Officer, Tanzania Bureau of Standards (TBS)
- 1.8 Mr. Emmanuel D. Ole Naiko, Executive Director of Tanzania Investment Centre (TIC)
- 1.9 Mr. Mike Laizer, Director General, Small Industries Development Organisation (SIDO) HQ
- 1.10 Mr. Pius Wenga, Director of Training & Extension Services, SIDO HQ
- 1.11 Mr. Emmanuel T. Saiguran, Director of Technology Development and Planning, SIDO HQ
- 1.12 Mr. T. Kyaruzi, Technology Development Officer, SIDO HQ
- 1.13 Mr. Damian J.M. Chang'a, Regional Manager, SIDO Mwanza Region
- 1.14 Ms. Frida Mnguru, Regional Manager, SIDO Mara Region

2. Research and Academic Institutions

- 2.1 Prof. Jamidu H.Y. Katima, Principal of the College of Engineering and Technology (COET), University of Dar es Salaam
- 2.2 Dr. Ludovick C. Manege, Director of Industrial Research, Tanzania Industrial Research and Development Organisation (TIRDO)
- 2.3 Dr. Matheo L. Raphael, Director of Center for the Development and Transfer of Technology, COSTECH.
- 2.4 Dr. G. M. Kawiche, Chief Executive of the National Housing and Building Research Agency (NHBRA)

3. Private Sector Organizations and Prominent Individuals:

- 3.1 Prof. Samuel Wangwe, Chairman, Daima Associates Limited.
- 3.2 Ms. Bitrina Diyamet, Executive Director, African Technology Policy Network – Tanzania
- 3.3 Mr. Ramesh Patel, Chairman and Managing Director of Comafic Ltd/ Automec
- 3.4 Ms. Janet Bitegeko, Executive Director, Agricultural Council of Tanzania (ACT)
- 3.5 Mr. Cleophas C. Rwechungura, Communication Officer, Agricultural Council of Tanzania (ACT)
- 3.6 Mr. Said S. Said, Networking Officer, Agricultural Council of Tanzania (ACT)
- 3.7 Mr. Jones M. Sikira, Executive Director, Tea Association of Tanzania (TAT)
- 3.8 Prof. Bruno J. Ndunguru, Executive Director of Tea Research Institute of Tanzania (TRIT)
- 3.9 Mr. Jordan Gama, Executive Director, Tanzania Organic Agriculture Movement (TOAM)
- 3.10 Mr. Noel Kwai, Marketing Officer, TOAM.

Bibliography

- Agro Eco BV & Grolink AB. *Organic Exports – A Way to a Better Life? Export Promotion of Organic Products from Africa*. 2008.
- Aubert, Jean-Eric & Wanga, Godwill. “Innovation in Tanzania: Insights, Issues and Policies.” World Bank Institute, 2005.
- Kingamkono, Rose R. & Mshinda, Hassan. “STI For Economic Development In Tanzania (Vision 2025; Mkukuta; Mkuza & Tanzania’s Current STI System)”. Bagamoyo, Tanzania: Consultative Workshop on the Review Process for NIS in Tanzania, December 15-16, 2008.
- Outsourcing to Africa - Tanzania Country Report (2010) Commonwealth Business Council . Available at http://www.cbcglobal.org/CBC_Pages/LibraryDetails.aspx?Id=413
- Richard, J. F et al. (2010) Candid Review of Jordan’s Innovation Policy. Draft Prepared for World Bank
- Tanzania Organic Agriculture Movement. Directory of the Organic Agriculture Operators 2009.
- Tea Association of Tanzania.
- The World Bank, Poverty Reduction and Economic Management. “Tanzania: Towards a Trade and Competitiveness Strategy to Propel Growth.” Policy Note. Washington: The World Bank, November 19, 2007. The World Bank (2008)
- The World Bank (2008) “Implications of Secondary Education Expansion in Tanzania: The Quest for Greater Enrollment with Quality”. Policy Note. Washington, October 29, 2008.
- United Nations Industrial Development Organization, *Industrial Development Report 2009 Breaking In and Moving Up: New Industrial Challenges for the Bottom Billion and the Middle-Income Countries*. Vienna, Austria: UNIDO, 2009.
- Watkins AI (2010) Back to Office Report, Tanzania Innovation Get Assignment , World Bank, March 29
- World Bank (2010) Global Forum Action Plan: Science, Technology and Innovation Capacity Building Partnerships for Sustainable Development. May 28, 2010.