A Word from the Ministry of Education and Higher Education

Science, Engineering, Technology, and Innovations (SETI) are becoming the code words for economic development, prosperity and good standards of living in the 21st century. Sufficient evidence suggests that investments in SETI build stronger economies, creates jobs with higher incomes, and serves as the foundation for social development and cultural enrichment required for success in the global arena.

The Ministry of Education and Higher Education (MOEHE) guided by its mandate for scientific research, and its obligations and responsibility to educating our youngsters into the careers required by the 21st century has committed itself to a process aimed at establishing a strong foundation for SETI development in Palestine.

Realizing the enormity of the tasks that lay ahead, and recognizing the need to involve all the players of SETI development in the process, the MOEHE has embarked on this first step in the development of the SETI in Palestine; namely, the development of a national policy document on the development of SETI.

In developing this policy document, the MOEHE, in an open and participatory process with all stakeholders, defined a framework for SETI development, including the roles of the different players.

Ensuring that any plan of action developed reflects the needs of the Palestinian private sector, which is the engine of economic growth in Palestine, The Ministry took to heart their involvement, through their organizations. Institutions and mechanisms were developed to ensure that the results of scientific research and technology transfer are adapted by the end users, including the private sector.

Further, and recognizing the important roles universities, research centers, NGOs, and professional associations play in SETI development, The Ministry worked closely with their representatives in formulating this policy document.

Finally, this first generation policy document is a first step in the development of SETI in Palestine. This first step shall be followed, in an open and participatory process, by the development of a full fledged action plan, which defines our strategic directions for SETI development, develops programs, and proposes projects aimed at carving a place for the emerging state of Palestine in the global economy and substantially enhancing the standards of living of its citizenry.

Chapter 1
Introduction

1. BACKGROUND

The current state of Palestinian SETI development is one of poorly-funded, unorganized and lacking in direction. While education and scientific achievements are core values in the Palestinian society, the development of SETI in Palestine has been hampered by a multitude of factors including the Israeli occupation, the young state of the Palestinian National Authority (PNA), and the less than optimal allocation of donor funding.

This chapter includes a discussion of the SET development in the Occupied Palestinian Territory (OPT). In addition, this chapter defines the goals and objectives of this policy document, and the method used for its development.

1.1 An overview of SETI development in Palestine

The beginnings of SETI activities in Palestine started in the 1970s when Palestinian universities were established, despite of the Israeli occupation. Prior to the Israeli occupation in 1967, the Palestinian higher education system consisted of nine teachers' training colleges offering two years post secondary education. After 1967, Palestinians focused on their struggle to end the occupation while obliged to address the needs of a growing population. For this reason, and despite of the constraints of the Israeli occupation, the Palestinians embarked on developing local Palestinian universities marking the beginning of the development of the higher education sector. Since then, universities and higher education institutions grew and expanded both in number and programs.

The following discussion highlights the development of scientific research in the OPT during the past four decades. It mainly focuses on scientific research within higher education institutions and other research centers.

1.1.1 Higher Education

Major universities in the OPT started with schools of Arts and Sciences, followed by schools of engineering and later agriculture, pharmacy, and medicine. The horizontal expansion, of new programs, came about after extensive discussions on whether the conditions under the Israeli occupation justify such an expansion. The belief that there is a great need to set the foundation of a Palestinian State, despite the occupation, was at the core of the decisions to expand the programs offered by Palestinian Universities.

The late seventies and early eighties witnessed a growing number of universities, students, and teachers. This was encouraged by the increased interest and support from the Palestinian Liberation Organization (PLO) in developmental issues in the OPT. The PLO was instrumental in providing the financial support to keep the higher education institutions running since their establishment.

In 1977, the Council for Higher Education (CHE) was established to promote cooperation and coordination among higher education institutions. It was mandated by the PLO to overseeing policies of the higher education sector. In 1988 the responsibilities of the CHE were expanded to the entire education sector, including General, Vocational/Technical and Higher Education.

The emphasis of Palestinian universities, though, was placed on teaching while academic and scientific research suffered drastically from both lack of funding and the absence of a positive environment within which to flourish. In addition, conditions for faculty development and joint research were extremely rare and quite sporadic, thus adding further handicaps to the existing underdeveloped system.

Subsequent to the Oslo Accords, the PNA started setting up new institutions in the OPT. The Ministry of Education and Higher Education was established in 1994 amongst the first PNA institutions. This newly established ministry took over the management of community colleges from the CHE. In 1996, the PNA established the Ministry of Higher Education (MOHE), which was mandated with the responsibility for higher education including universities, community colleges, and research, ending the rest of the mandate of the CHE. In 2000, the MOHE was renamed the Ministry of Higher Education and Scientific Research (MOHER). Finally, in 2003, both the Ministry of Education and MOHER were consolidated into the Ministry of Education and Higher Education (MOEHE). At present, both higher education and scientific research in Palestine continues to follow the higher education sector in the MOEHE.

1.1.2.1 Current Situation of Higher Education

At present, there are eleven Palestinian universities; seven in the West Bank, three in the Gaza Strip, along with Al-Quds Open University with branches throughout the OPT. Eight of these Universities are non-for-profit institutions, two governmental and one private. The non-for-profit status of most Palestinian Universities reflects uniqueness in the region and in much of the world where universities are governmental institutions. There are also over twenty community colleges and nine University Colleges in the West Bank and the Gaza Strip.

There are over 5,400 teaching professionals at Palestinian institutions of higher education, of which over 3,750 hold masters or doctorate degrees, working at these institutions catering to about 120 thousand students, as per the school year 2003/2004. This number corresponds to 3.2 percent of the total population, and to about 19 percent gross enrollment rate, which is higher than the number in the Arab World, yet only about a third of the gross enrollment rate in more developed countries.

The number of students increased four folds since 1994. The student to instructor ratio stands at 22:1, which is over a third higher than the 14:1 ratio in most countries. The high student to instructor ratio is in part due to the competition that higher education institutions face with the PNA and NGOs, which, in many cases offer better financial

incentives attracting qualified professionals. The financial constraint of the "unified salary scale" at higher education institution, which was adopted by the "Rector Conference" is at the core of this problem.

Another factor contributing to the high student to instructor ratio is the funding of higher education, which comes primarily from student fees and tuition, in addition to revenues from technical centers, and some donor funding. The dependence on student fees resulted in admitting more students without the ability to hire more staff. Further, the limited options of funding drove tuition and fees up, without having a safety net to help those in the lower income brackets. Available data indicates that only 10 percent of Palestinians in the lowest income quintile received a college degree, compared to 35 percent of those at the highest income quintile.

With regard to fields of study, students majoring in an SET related field stands at 23 percent compared to the world average of 38 percent, and 44 percent in more developed countries. Students in graduate programs related to SET stands at under 4 percent of the total student population in higher education. Female students constitute 45 percent of the student population. While female students outnumber male students in the colleges of art, education, medicine and pharmacy, their percentage in engineering and agriculture drops to 30 percent. The statistics provided here covers graduates from Palestinian institutions, and does not cover Palestinian students who study abroad, which comprise fifty percent of the total number of graduates.

Out of those who study abroad, only one third returns to work in Palestine, while two thirds of graduates from Palestinian institutions stay in Palestine. Further, job market statistics indicate that thirty percent of college graduates from local institutions are not employed. In addition, anecdotal evidence suggests that graduates from medicine, pharmacy, engineering, nursing, and IT have better chances of employment than graduates from other fields. Anecdotal evidence also suggests that the market needs more graduates with technical skills, and knowledge in advanced technologies.

Finally, the educational support facilities, laboratories and libraries, at higher education institutions are limited by the availability of funding. There is no data on the quantity or the quality of equipment and facilities used for laboratory purposes. There is, however, evidence suggesting that, while laboratories at certain institutions may be sufficient for teaching purposes, the usefulness for research is questionable at best.

With regards to libraries, there are over 680 thousand volumes available at all libraries at institutions of higher education. In addition, internet access is available at all institutions and most students, and instructions have access to free online journals and publications, in addition, to a multitude of online libraries.

1.1.2 Scientific research

Scientific research, prior to 1967, in the OPT was limited to agriculture. There were eleven experimental stations in the West Bank, within the Jordanian Ministry of

Agriculture, involved in agricultural technology transfer. Following 1967, the Israeli authorities took over these stations in line with their policy to obstruct any developmental process in the OPT. As a result, all research activities in these experimental stations came to a halt by the early 1980s.

Research at Palestinian universities and colleges was and continues to be modest, both in quantity and quality with only 0.75 publications per university researcher per year, which is similar to productivity in the Arab World, and far less than that in developing countries. In addition, forty percent of published research in Palestine is thesis-driven.

A primary force behind much of the research done at Palestinian universities had to do with promotion and, therefore, was not oriented towards societal needs. This is mainly due to the scarcity of research resources and funds. Further, coordination and cooperation between research institutions and the private sector is very weak: the industrial sector does not solicit, hence fund, universities or research centers to conduct applied research, nor, by and in large, do universities manifest to the industrial sector what they can provide. This is clearly reflected in the fact that less than 5 percent of research output is applied in Palestine. Also worth noting is that, while Palestine has not registered a single patent, several have been documented abroad as research results in Palestine.

The low productivity of research publications is due to several factors, including:

- Heavy teaching load, as claimed by university Professors.
- Insufficient funding.
- Lack of coordination and cooperation amongst local institutions.
- Insufficient number of specialists, and lack of interaction with institutions at the regional and international levels.
- Poor satisfaction with the existing research infrastructure standing at a low of 30 percent.
- Lack of financial incentives for researchers, which is further manifested with the absence of Intellectual Property Rights Laws.

In 1996, the Ministry of Planning and International Cooperation (MOPIC) established the Science and Technology Planning Unit (STPU) to act as a focal point for development, planning, and policy formulation in S&T in the government sector. The unit conducted an assessment of the infrastructure and performance of scientific research at higher education institutes and research centers. The findings of the study were published in two reports in 1999, and they can be summarized as follows:

- A large proportion of the work done by the surveyed centers cannot be qualified as scientific research,
- No indication that the centers' work involves any innovative developments of either products or solutions,
- Cost-benefit analysis of the projects does not seem to be an issue of concern in the work of the centers,

- Several centers work on the same general area of research, compete within the international donor environment for the same funding, and have minimal collaborative links with each other.

It was postulated in the study that these outcomes are a result of the absence of a national R&D policy, lack of monitoring procedures of the centers activities, and deficiency of coordination between the centers.

While this was the first assessment to be performed, for this sector, in an attempt to diagnose its strengths and weaknesses and identify the needs for development, the study had several limitations related to funding, diffusion of technology, and linkages to users. Since, the STPU ceased to exist, while its functions are conducted at the MOEHE.

The period from 1995 to 2000 witnessed a surge in scientific research in the OPT, which may be attributed to the following:

- The end of isolation imposed on Palestinian scientists by the Israeli occupation,
- A growing interest of donors in promoting development in Palestine,
- The availability of funding opportunities aimed at promoting regional cooperation.

Most funding for scientific research, during this period, came from bilateral or multilateral donors. Research activities lacked direction, and were not coordinated either at the sectoral or the MOEHE levels, nor were they coordinated with the needs of the private sector.

After, the start of the second intifada in September 2000, aimed at ending the Israeli occupation, the economic and humanitarian situation in the OPT deteriorated due to the Israeli aggressions. This has driven the PNA and the donors towards humanitarian funding aimed at meeting the very basic needs of the Palestinian population. The results were less funding available for development and regional cooperation, and any scientific research to that end.

Additionally, in the Diaspora, the PLO had institutionalized a Scientific Committee, which operated prior to the establishment of the PNA on an international level, mainly outside the OPT to develop close scientific ties with scientific and research institutions in different Arab countries.

1.2 SETI Developmental Constraints

The development of SETI in the OPT was hampered by three primary factors, as discussed earlier. These included the Israeli occupation, an inexperienced PNA, and a less than optimal allocation of donor funding. The following is a discussion of these constraints:

1.2.1 The Israeli Occupation

By far the current under-developed state of the Palestinian SET is due to the continued Israeli occupation since 1967. As an occupier, the Israeli army adopted and implemented policies that effectively created conditions unsuitable for SET development on all levels.

On the educational level, the Israeli army continues to-date to disrupt the Palestinian educational process at all stages. This policy is manifested through the curfews, closures, and blocking access to educational facilities, and through policies of destruction of physical infrastructure. In addition, the development of curriculum essential to improve the educational system was not a task encouraged by the Israeli occupying power. Further, and throughout the many years of occupation, access to education outside of Palestine was hampered by the Israeli army denying many Palestinians to gain the expertise needed to lead the development of SET in Palestine. Finally, and given the Israeli policy of economic destruction in the OPT, many of the educated Palestinians, either leave the territory, or simply remain to work outside.

On the scientific research and technology transfer levels, the Israeli occupation constrained the Palestinian ability to conduct scientific research using several means including, (1) controlling access of Palestinians to technology, (2) controlling access to materials needed for research, (3) ensuring that Palestinian institutions were lacking in physical and technical infrastructure, and (4) ensuring depressed economic conditions for the Palestinian people, which necessarily translated into lack of funding for such activities.

1.2.2 The Young PNA

Building the educational system in the OPT has been, and continues to be, the PNA's top priority. The overall development of SET has been hampered by a multitude of factors, in addition to the Israeli occupation. These include the following:

1. The process of setting up institutions, and the transfer from a revolutionary to a state building objective is a complex process. The difficulty of this process was further complicated by the young age of the new authority, and the lack of experience in the development of such institutions. The results were the creation of many institutions, often with competing mandates, and in many cases inexperienced personal.

2. Another complex issue had to do with the different legal systems in the West Bank and Gaza, and the different curriculum that the young authority had to reconcile with.

3. With an overburdened educational infrastructure, at all levels, a primary focus of the PNA was placed on development of new schools to meet the existing needs of an over-crowded classrooms, in addition to absorbing the ever increasing demand due to natural population growth.

4. Coordination and cooperation between the different Palestinian stakeholders in the SET development is a difficult task under normal conditions. The complexity of the task to the young authority is much greater under the occupation.

Despite, these constraints, and the Israeli occupation, the PNA through the MOEHE, managed to develop a new curriculum, construct thousands of classrooms, and support, through donor funding many research projects. In addition, and through bilateral and multilateral agreements with different donor organizations, the PNA managed to enrich and build the human capacity, which will have an impact on SET development in Palestine.

Further, the PNA embarked on a serious process of reform and institution building and development, which culminated in defining the mandates and structures of the different ministries and authorities. The reform process is continuing to institutionalize a process of cooperation and coordination between the different ministries and authorities, and between them and the Palestinian public and organizations.

1.2.3 Allocation of Donor Funding

Donor funding to the Palestinian people has been instrumental in laying a foundation for the developmental process in the OPT. In addition, the funding was essential in meeting the humanitarian and emergency needs of the Palestinian people under the continued Israeli aggressions.

Today, with some prospects of shifting some of the donor funding towards development, it is essential that problems associated with the allocation of funding be identified and addressed, which is especially relevant given the fact that most SET related projects are donor funded. The following is a summary of these problems:

1. Lack of coordination and cooperation amongst SET stakeholders: The submission of proposals to different donors resulted in duplication of work, in many cases not the best methodologies or experienced professionals conducted the research, and more seriously, projects funded may not be of high priority.
2. The lack of a national policy and programs for SET development and direction was a reason, for many donors to fund as they saw best, which may not necessarily reflect the national priorities.
3. Some donors are more interested in their priorities, and the politics of the issues, rather than meeting the Palestinian priorities.

The development of this national policy framework is a first step in the direction of setting the national priorities for SET development. This policy combined with the use of the single treasury account at the Ministry of Finance (MOF), by the donors, promises to improve the process of SET funding.

2. Mission

To direct the Palestinian Human Capital potential by strengthening, coordinating, and upgrading scientific, engineering, and technology research and innovation towards optimizing the allocation of resources to support the Palestinian development process aimed at substantially raising the standards of living of the Palestinian people.

3. Strategic Goals

The following strategic goals have been identified by the Ministry of Education and Higher Education:

(1) Improve the standards of living of the Palestinian people through economic development brought about by the optimal allocation of Palestinian resources using and developing new state-of-the-practice science, engineering, technology innovations.

(2) Create a foundation for social equity through equitable allocation of resources brought about by increased opportunities through involvement of women and other marginalized groups in science, engineering, and technology.

(3) Seek out a place for Palestine in the regional and global market through using science, engineering, and technology to create a "niche" for the emerging state.

4. Strategic Objectives

The Ministry of Education and Higher Education (MOEHE) identified the following strategic objectives for science, engineering, and technology development in Palestine:

(1) Directing public investments (including donor funding) towards science, engineering and technology development.

(2) Provide incentives for private sector investment in SET development.

(3) Coordinate at the national level SET development in Palestine.

(4) Work with regional and global partners to map a place for Palestine in SETI development, and to coordinate SETI innovation efforts.

(5) Work with research practitioners and the private sector and coordinate the efforts with regional and international partners to develop mechanisms for technology transfer and application in Palestine.

(6) Help local research and innovation stakeholders in generating regional and global funding to support the development of the sector in Palestine.

(7) Develop both the physical and human infrastructure required for the development of SET in Palestine.

(8) Define and institutionalize a process aimed at improving the cooperation and coordination amongst the different SETI stakeholders in Palestine.

(9) Create a process aimed at harnessing the SETI expertise of Palestinian in the Diaspora, and encourage their investments in the sector in Palestine.

(10)   Positively affect the access of women and other marginalized groups to SET, and increase their participation in SETI related jobs, and as such improve their standards of living.

5. Operational framework: National System of Innovation (NSI)

The MOEHE believes that an effective national policy is one, which is formulated with the active participation of all stakeholders in SETI. To this end, a great emphasis and efforts were placed on stakeholder input in the development of this document.

In defining the operational framework for the national policy on SETI development, the Ministry looked at comparative experiences in relatively small countries, which embarked on effective industrialization program. It was found that countries such as Singapore, Malaysia, and Finland used the concept of NSI as the policy framework leading to their rapid development. Further, the democratic Government of South Africa has chosen this route.

The concept of the National System of Innovations is defined, by the OCED, as "A network of institutions in the public and the private sector whose activities and actions initiates, import, modify, and diffuse new technologies."

Appreciating both the urgency for presenting a clear organizational map as to how challenges in SETI development will be addressed, and the need to secure the co-operation of all stakeholders in the development of the system, the MOEHE conducted the following activities:

- A consultative study that involved several ministries of the PNA, autonomous government authorities and committees, universities, technical colleges, independent research centers, and private sector organizations.
- A "brainstorming" workshop held in Jericho with expertise drawn in from Government, the Higher Education Sector, State Corporations, and Research Institutions.
- A Working session held in Pretoria, South Africa involving Palestinian expertise from the higher education sector and university representatives, government (MOPIC and the Palestinian Water Authority), and research institutions. This session was held in cooperation with the South African Department of Arts, Culture, Science, and Technology.

These consultations, and looking at comparative experiences, shaped a firm decision that the "Plan" for the development of SETI will be formulated within the policy approach of a "National System of Innovation". Further, and in line with the stated policy of the MOEHE of full stakeholder participation, components of the system, its organization and governing institutions, and processes were formulated after the input from the different stakeholders.

The conceptual approach to managing SETI activities within the context of NSI immediately signals acceptance of the importance of all those institutions in the "knowledge industry". This includes public and private sector research institutions, higher education institutions, non-governmental organizations engaged in science and technology activities, and other organizations not engaged in research but in some recognized field of science and technology. It profiles them anew as strategic national assets whose performance must be optimized for achieving higher levels of sustainable economic growth and social development.

This calls on Palestine to consolidate and build on the institutional science, engineering and technology capacity for greater economic benefit in a multi-disciplinary approach.

To this end, and in formulating this national policy document, the MOEHE drew upon leading national expertise in the fields of SET to draft a working paper, which it titled "Green Paper". This paper included components of the national system of SET, its current state, and future potential. Specifically, the document included the following sections:

- Organization and Governance,
- SET infrastructure and performance,
- New SET opportunities and economic imperatives,
- Human Resource Development (HRD) and research capacity building,
- Research, Technology, and Quality of life,
- Science and Society,
- Women in Science,
- SET "terms of engagement" with partners within the region and in the regional and global context.

This document was distributed for stakeholder participation, to 70 national organizations, institutions and centers, both inside and outside universities, and 65 national experts, in some capacity, in the area of SET development, application, and impact. Input provided was incorporated into the "Green Paper".

Finally, and as a last step in the process of the development of this policy document, the MOEHE held a workshop, which included the relevant PNA agencies to review the document and provide final comments on it. The result of this process is this, the first generation national SET development policy framework document.

Chapter 2
Organization and Governance of the Science and Technology Base

SETI development is key to socio-economic development worldwide. This led many to assert that the world is now divided according to technology rather than geography or ideology. Anecdotal evidence from developing countries indicates that the physical transfer of technology is not sufficient for adequate socio-economic development, and that the adaptation, appropriate application, and further development are essential.

The Palestinian development strategy, as outlined in the first Palestinian Development Plan (PDP), aims at facilitating and enhancing the ability of the Palestinian economy to promote, acquire, adapt, apply, and finally be able to produce appropriate technologies to create a competitive advantage for the economy. The strategy also aims at laying the ground for good governance based on democracy, accountability, transparency, and human rights.

To this end, the PDP assigns paramount importance to the human factor and to human resource development[1] (HRD). This was further stressed in the socio-economic stabilization program of 2004, which placed high import on HRD, within the context of the institution building and reform programs at the different PNA and private sector organizations. Additionally, the medium term development program 2005 to 2007, further illustrates the high priority of the PNA in HRD to meet the needs of the Palestinian people.

Therefore, it is clear that designing policies to efficiently and productively utilize the fast growing Palestinian labor force, reduce dependence on outside markets for employment, and making sectoral choices that maximize the benefits of Palestinian high-tech services, lies at the heart of the Palestinian development strategy, as formulated by the PNA with the participation of the private sector and the Palestinian civil society.

Despite the difficult conditions under which the Palestinian people live, due to the oppressive measures of the Israeli occupation, Palestinians believe that the development of SET is central to addressing their current and future needs as they approach the translation of their national goals and aspirations for statehood. This chapter addresses the central issues that shape the governance of SETI development. As such, issues of organizations, structures, and processes are tackled.

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[1] Palestinian Development Plan, 1999-2003, Palestinian National Authority (1998).

2.1 SETI stakeholders in Palestine

While SETI policy development and implementation is mandated to MOEHE, the Ministry believes that the involvement of all stakeholders in the process is essential for its success. To this end, the following stakeholders in SETI were identified.

- Governmental Institutions
- Higher Education Institutions
- Research Institutions
- Civil Society institutions
- Private Sector
- Professional Unions

2.2 Role of government in SETI

The Palestinian people, as reflected in the many policies of the PNA, believe in a free market economy where the government is involved: (1) to rectify socio-economic imbalances due to the free market system, and (2) to maximize economic externalities arising from certain actions. The role of the government in SETI development in Palestine is within this framework of the free market.

To this end, and within the framework of the free market economy, the government is responsible for the development of national and sectoral SETI policies, plans, and programs, and in setting strategic directions for SETI development in cooperation and coordination with the different stakeholders in the system. Further, the government is responsible for the allocation of public funds, or securing donor funding, for implementation of SETI plans and programs.

The powers of the government in SETI development are exercised through its exclusive prerogative, by developing policy tools, within the following frameworks:

2.2.1 Legislative framework

This is a responsibility of the Palestinian Legislative Council to enact legislations guiding the development, direction, and programs of actions for the development of SET in Palestine. In addition these legislations may define or impact the roles and responsibilities of, and the relationship between, the different stakeholders in SET development.

These acts of legislations may be "positive legislations" aimed at maximizing the benefits of the socio-economic externalities arising from SET development, or they may be "retarding legislations", aimed at the prohibition of certain SET activities, which may either compromise SET development or may create negative environmental and social conditions.

2.2.1.1 Positive Legislations

Economic externalities arising from SET development are immense, and to maximize these externalities, the government through its legislature may adopt such legislations to include:

1. Provide direct funding (including donor funding) to support the development of physical infrastructure required for the development of SET. This includes specifying a line item in the budget for research and development.
2. Provide direct funding (including donor funding) to support research activities in SET aimed at the implementation of the national policy objectives.
3. Provide subsidies or tax incentives to encourage the involvement of the private sector in the development of SET infrastructure.
4. Provide subsidies or tax incentives to encourage the involvement of the private sector in research activities in SET.
5. Provide direct funding (including donor funding) to support the education and training required for HRD, and research capacity building essential for SET development in Palestine.
6. Provide subsidies or tax incentives to encourage the involvement of the private sector in the capacity building required for HRD in SET.
7. Provide the incentives, through direct funding or through private sector subsidies or tax incentives, to support a program and a process of cooperation and coordination amongst the different universities and research institutions in conducting research, especially in multidisciplinary areas.
8. Provide the incentives, through direct funding or through private sector subsidies or tax incentives, to support programs and processes of technology transfer and adaptation by the different stakeholders in SET development in Palestine.
9. Provide the incentives, through direct funding or through private sector subsidies or tax incentives, to support programs and processes aimed at the protection of the environment and the public health of the Palestinian people.
10. Provide the incentives, through direct funding or through private sector subsidies or tax incentives, to support programs and processes aimed at providing access and opportunities for women, and other marginalized groups in the Palestinian society to ensure equitable allocation of the benefits arising from SET development.
11. Provide the incentives, through direct funding or through private sector subsidies or tax incentives, to support programs and processes aimed at encouraging participation of Palestinians in the Diaspora in SET related activities and investments.

2.2.1.2 Retarding Legislations

In addition to legislations intended to encourage certain behaviors and activities, the legislature may enact legislations to protect SET development, protect human dignity and the environment. Such legislations include the following:

1. Intellectual property rights, which are laws aimed at protecting intangible properties, namely; patents, copyright, trademarks, and trade secrets. The aim of these laws is to foster SET development and to encourage investments and innovation in the sector.
2. Laws geared towards the protection of human dignity including those relevant to human cloning, genomics, etc. In addition to laws on the use of humans in scientific experimentations.
3. Laws geared towards the protection of the fragile Palestinian environment and ecosystem from certain SET activities.
4. Laws also may be drafted on the use of animals in scientific experimentation.
5. Laws geared towards the protection of laborers, including using child labor in SET development and activities.
6. Laws may be enacted to prohibit discrimination in all SET activities on the basis of gender, religion, age, etc.
7. Laws may be enacted to protect the safety of those working in the SET fields, and the safety of the general public.

2.2.2 Regulatory Framework

Legislations enacted by the legislature are implemented through the executive branch of the government. The implementation is generally carried out through the development of regulations. These regulations could include:

1. Development of criteria and standards to measure the development and performance in SET for individual projects, programs, institutions, etc. This is essential for the monitoring and evaluation of the impact of SET policy.
2. Development of criteria and standards for the development, submittal, and evaluation of SET proposals ensuring transparency and equal opportunity to all.
3. Development of standards, specifications, and methodologies for conducting research in SET ensuring safety and ethical standards, and appropriateness of results.
4. Development of standards and specifications guiding the import, production, and distribution of SET related products to the public.

2.2.3 Judicial Framework

The development of legislations and regulations, in of itself, is not adequate in addressing the needs of SET development. To encourage investments in SET in Palestine, it is essential to have a strong judicial system able to address the complex issues, which may arise. This includes the need to have adequately trained legal professionals in the field of intellectual property laws, and the disputes, which may arise in international trade, as they relate to SET.

The previous discussion focused on the role of government, and the development of policy tools to guide SET development in Palestine, in the general sense. The chapters that follow deal with specific issues in SETI development from infrastructure to HRD,

and from the issues of women to international and regional context. In these chapters, specific policies will be developed to address each of the issues, in addition to defining the role of the government, and that of other stakeholders in each of the issues.

The rest of this chapter though, will be focused on the institutional framework of SETI, its structure and processes, in addition to a discussion of financing options, "good governance", and a note on Palestinian in the Diaspora and SETI.

2.3 Role of the Other Stakeholders

The role of the other stakeholders in SETI includes the following:

1. To implement SETI programs and projects including research, development, technology transfer and adaptation, and capacity building, training, and education.
2. To participate in the formulation of SETI policies and programs.
3. Participate in the formulation of ethical standards and provisions as it relates to the different fields of SETI.
4. Formulate, within the framework of any legislation regarding ethical standards, professional standards of ethics to govern the conduct of their members, or employees, holding them accountable to such standards.
5. Advocate and promote SETI amongst the general public.
6. Develop, participate in, and promote networks of Palestinian SETI professionals in the different fields.
7. Develop, participate in, and promote the publication of Palestinian journals and other publications in the different fields of SETI.

In addition to these general roles, professional unions, and private sector organizations may certify their members as a prerequisite to their professional practice, as may be provided for in the laws.

2.4 Mandate of SET in international and regional experiences

While looking at experiences in other countries may help the development of a Palestinian SETI system, it is important that any system developed reflect the Palestinian needs and conditions. Without indulging into details, the mandate for SETI development in other countries follow one of four major modalities:

SETI falls under the auspices of a relevant Ministry: These may include the Ministry of Higher Education, Ministry of Industry, etc. In the majority of Arab countries SETI is linked to the Ministry of Higher Education, which is responsible for policy, planning and coordination of both education, and scientific research and technology transfer at the national level.

SETI falls under the auspices of relevant ministries: SETI functions are shared between all ministries of relevance to its development. In this model, a national body is usually established for coordination.

A Ministry for Science and Technology which is mandated with all policy, planning, coordination, monitoring and funding of SETI activities.

An Independent Commission for Science and Technology which is mandated with all policy, planning, coordination, monitoring and funding of SETI activities.

In Palestine, the SETI development has been mandated to the MOEHE in accordance with the Law of Higher education of 1998. The following is the SETI governance structure.
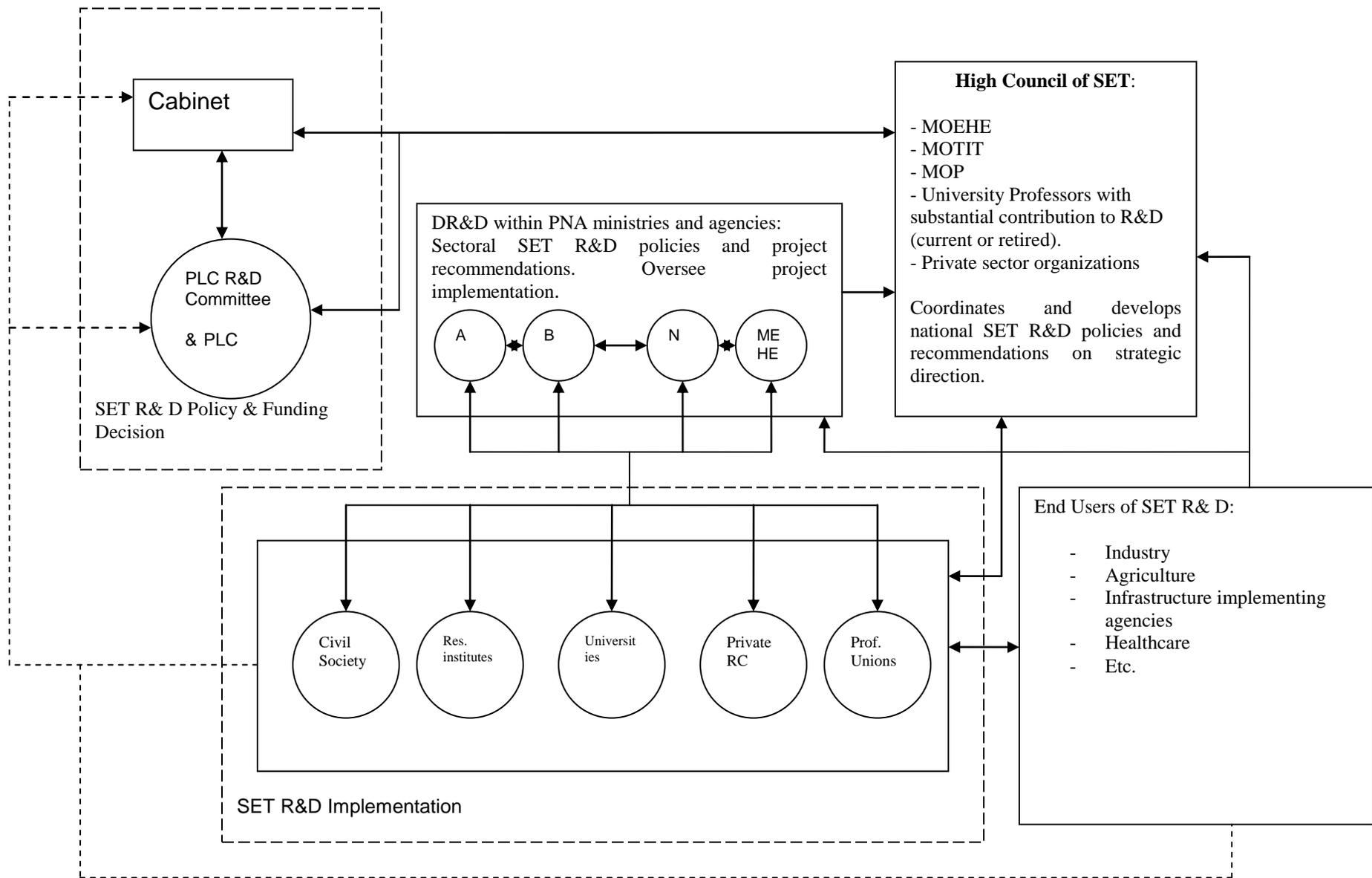
2.5 Governance Structure of Palestinian SETI

The development of the structure of the Palestinian SETI involved a process of assessing the current state of SETI and the future needs and objectives. The roles of each of the units in structure were also defined to assure attainment of the set goals. Finally, the relationship, whether formal or informal, amongst the different units were assessed. Accordingly, the structure was developed based on the following:

1. The structure contains adequate mechanism to develop and implement national policies in SETI taking into account the needs and priorities of the private sector, the needs and abilities of research institutions and universities, and the priorities, needs and abilities of the Palestinian people through the PNA.
2. The structure contains adequate mechanism separating SETI policy development, priorities, funding, implementation, monitoring and evaluation.
3. The structure contains adequate mechanism to ensure research results are delivered to, and synthesized in the private sector.
4. The structure ensures appropriate coordination amongst the different PNA entities involved in SETI.
5. The structure ensures adequate coordination and coordination in funding SETI activities between the government and the private sector.
6. The structure should, in as much as applicable, use and build upon existing institutions and legislations.

The following schematic illustrates the structure of the Palestinian SETI governance.

As can be seen from the schematic, the structure is rather complex reflecting the complexity of the task, and the role of the different stakeholders in the system. The system was developed based on tasks and functions to meet the needs of SETI development. The following is a summary of the structure and processes:

High Council of SET:

- MOEHE
- MOTIT
- MOP
- University Professors with substantial contribution to R&D (current or retired).
- Private sector organizations

Coordinates and develops national SET R&D policies and recommendations on strategic direction.

Cabinet

PLC R&D Committee

& PLC

SET R& D Policy & Funding Decision

DR&D within PNA ministries and agencies: Sectoral SET R&D policies and project recommendations. Oversee project project implementation.

A   B   N   ME HE

Civil Society   Res. institutes   Universit ies   Private RC   Prof. Unions

SET R&D Implementation

End Users of SET R& D:

- Industry
- Agriculture
- Infrastructure implementing agencies
- Healthcare
- Etc.

2.5.1 Components and Institutions of the SETI Structure

The components and institutions of the SETI structure include the following:

2.5.1.1 Cabinet, PLC and PLC R&D Committee

These institutions are self explanatory and their roles in SETI are their generic role in plan and policy approval and funding. The PLC R&D Committee is the committee within the PLC responsible to ensuring adequate funding and policy development.

2.5.1.2 High Council of Science and Technology (HCST)

This Council is an independent entity, both financially and administratively, reporting directly to the Minister of Education and Higher Education, who shall maintain financial and professional oversight. It is composed off the following members:

A representative of the Ministry of Education as Chair.
A representative of the Ministry of Telecom and IT.
A representative of the Ministry of Planning.
University Professors (current and retired) (7 members)
Private Sector Organizations (PSO) (2 members).

The role of HCST includes the following:

1. The Council is charged with coordinating the proposals of sectoral SET policies, and strategies into proposed national policies and strategies.
2. The Council is mandated with the task of promoting SETI development in Palestine.
3. The Council shall be mandated with the responsibility of establishing and coordinating the necessary programs aimed at harnessing the wealth of knowledge and experience in SETI in the Palestinian communities in the Diaspora.
4. The Council in addition to a representative from the Ministry of Planning (MOP), and a representative from the Ministry of National Economy (MONE), and given the current state of program funding, is to act as formal or informal sectoral or sub-sectoral working group on SETI, and as such, is mandated with the task of fund raising for plan implementation with the donor community.
5. The Council may form any specialized committee(s) required for the efficient functioning of the council. These committees may include members of the different PNA institutions, the private sectors, civil society, and experts. The mandate and Terms of Reference of these committees shall be decided upon by the Council.

The Council shall report to the Minister of Education and Higher Education. University professors and representatives from the PSO shall be nominated by the Minister of Education and Higher Education for cabinet approval.

Finally, and upon approval of this council, it shall include the mandate of the Council of scientific research, in addition to the new additional mandates relevant to technology development.

2.5.1.3 Directorates of SETI R&D at different PNA Ministries and Authorities

These are SETI relevant directorate at relevant ministries and authorities, which are represented by the letters "A" through "N" in the schematic. The following is a summary of their roles:

1. Development of sectoral SETI policies, plans, programs and projects.
2. Development of regulations to implement SETI legislations, which includes specifications, standards, methodologies, and criteria to govern SETI activities, each in their domain.
3. Evaluation and assessment of proposals submitted for funding under SETI plan of action.
4. Awarding contracts for implementing SETI activities.
5. Monitoring the implementing agencies ensuring compliance with the signed contracts.
6. Evaluating individual projects and programs, and assessing their impact on SETI development and directions.

2.5.1.4 SETI Implementing Agencies

These include private sector for profit and non-profit research companies and centers, civil society organizations, professional unions, and higher education centers. The following is a summary of their role:

1. Implement SETI related projects and activities including research, development, training and capacity building, and technology transfer.
2. Participate in policy, plan, program, and project development.

2.5.1.5 End Users

These are the beneficiaries of SETI development in Palestine, which include amongst others, industry, agriculture, infrastructure implementing companies and agencies, etc. Their role in the process includes the following:

1. Participate in plan and policy development.
2. Participate in plan and policy evaluation.
3. Apply the results of SETI development.

2.5.2 Mechanisms and Processes

The process of development of SETI policies and strategic directions should be conducted for the medium term (3 to 5 years) with annual review to determine the need to

altering any of the policies or strategies. While the process of programming and project implementation should be developed and reviewed annually, in accordance with the fiscal budgetary process of the PNA. The following is a summary of the mechanism and process for SETI policy, strategic directions, programs, and project development, implementation, monitoring and evaluation.

2.5.2.1 Policy Formulation

SETI policy proposals are formulated along sectoral and national levels. Along the sectoral level, the different directorates responsible for research and development within the different Palestinian ministries, relevant to SETI, formulate policy proposals in cooperation with the end users of SETI and the different stakeholders. These policies are then sent to the High Council on Science and Technology (HCST), who then formulates proposals for the national policy and strategic direction of SETI.

Once the proposal for national policy and strategic direction of SETI are formulated, they will be delivered to the cabinet and the PLC R&D committee, where final decisions on policy recommendations will be made. Once approved by the cabinet, it moves on to the PLC for enacting the legislation upon the recommendations of the PLC R&D committee, and on to the President to endorse it, creating the national policies and strategic directions for SETI in Palestine.

One final note on the process, the schematic illustrates dashed lines connecting the end users and the different SET R&D implementing agencies with the PLC, Cabinet, and the PLC R&T committee, this is to illustrate the lobbying, which influences the process in a free and democratic society.

2.5.2.2 Program and Project Formulation and Prioritization

Once the national policy and strategic directions have been enacted into legislations, the process of program and project formulation and prioritization commences. In some cases certain ministries may have programs ready based on their sectoral plans, however, after the national policy is passed into law, it becomes clear which programs will be implemented, and therefore helps avoid spending precious time on developing programs, which will not be considered national priority.

Generally, programs required for the development of SETI are divided along a certain sector or multi-sectors.

In case of a single sector program, the line ministry mandated with the sector is responsible for the development of the program. Examples of single sector programs include research programs to reduce water losses. This program may entail several research projects, which may involve the evaluation, development and use of certain technologies. Such a program is sectoral in nature, and falls under the mandate of the Palestinian Water Authority (PWA). As such PWA will be responsible for program development.

With regards to multi-sector programs, different combination of ministries may be involved, depending on the scope. For example a program to support technology transfer into the Palestinian industrial sector using subsidies, and tax exemptions requires the involvement of the Ministry of National Economy (MONE) and the Ministry of Finance (MOF) in its development. Also certain programs in the agriculture sector may require the involvement of the Ministry of Agriculture (MOA) and PWA. In such cases, where intervention is called for along multi-sectoral levels, a combination of line ministries and PNA authorities may be mandated with the process of developing the programs and projects, with one ministry or authority clearly defined as the leading agency.

Once program development authority has been identified, and the roles of the different ministries and authorities have been formulated, program design and project or proposal collection, evaluation, and prioritization commences. In this process, stakeholders from the end user community and from implementing agencies provide input to the line ministry, or ministries charged with program development. This process, whether a single or multi-sector, will culminate in several programs, which include projects and a proposed implementation plan in accordance with the priorities within each of the programs.

These programs are then sent to the HCST for reconciliation into a proposal for a national action plan. Once the proposed national plan is developed, it moves into the cabinet and the PLC R&D committee, where it is once again reconciled with the sectoral programs, and finalized into an action plan for SETI development. From there and upon recommendations of the PLC R&D committee, the PLC passes the legislation, and the President endorses it, to become the National SETI development action plan.

Again, note the dashed lines in the schematic, which illustrates the lobbying throughout this process.

2.5.2.3 Project Implementation

Once the SETI action plan is approved, it is sent to the different Ministries and directorates within the PNA for its implementation.

The implementation of the SETI plan is then subcontracted to the different institutions based on a competitive process, which evaluates bids and proposals submitted based on a multitude of criteria including, methodology, competency, experience, and transparency of the institutions, and which in certain cases may include expert peer review.

It must be stressed here, that transparency, efficiency, and optimizations of the limited resources in SETI requires that functions of implementation of projects, and the monitoring and evaluation be separated. Further, the Free Competition of Ideas amongst competing institutions will undoubtedly generate best methodologies, and necessarily, optimal results for the SETI development in Palestine.

To this end, PNA agencies shall not implement research, development, technology transfer and capacity building projects relevant to SETI. Such a role, as defined in the structure is left to private sector, professional unions, research centers, and civil society, while the monitoring and evaluation will be tasked to the PNA agencies.

2.5.2.4 Transfer of Knowledge to End Users

Given the importance of applying the results of SETI development to improve the overall living standards of the Palestinian people, it is essential that these results be transferred and adapted by the end users.

As such, it is essential that any program developed under the SETI development action plan includes adequate provisions for transfer and adaptation of results to the end users. Such actions may include training components, or may include supplying new technology or methods, or upgrading existing ones at the end user level.

2.5.2.5 Monitoring and Evaluation

The final step in the cycle of SETI policy and action development plan, which marks the start of a next phase, is that of monitoring and evaluation.

This task is a core function of the relevant directorates within the PNA agencies. The task calls for monitoring of individual projects outsourced to ensure compliance with signed agreements, and to make adjustments, which may be called for to optimize the benefits of individual projects and programs. Further, the evaluation process of projects and programs, which is done using clear criteria and milestones, will provide the necessary assessment of the current status, at the time, of SETI development and the extent to which the policy objectives are being met. This will provide the foundation for policy recommendations and directions to optimize the benefits of the next generation plans.

While, monitoring and evaluation are mandated to the different PNA agencies, the involvement of the end users and the different implementing agencies in process will be an important component to the success of the process.

2.6 Innovative Financing of SETI

A list of programs and projects without financing does not constitute a plan. To become a plan, the list requires funding over a set timeframe. To this end, a discussion of financing options of SETI development in Palestine is essential.

Given the current situation of the PNA, which is in the process of reforming its institutions and structures, and the impact of the Israeli occupation on economic development, and public revenues, the discussion, for purposes of this first generation SETI policy will be based on the existing conditions. In addition, a discussion of the different innovative funding mechanisms will be included to highlight the potentials for considerations into next generation plans.

2.6.1 Existing Financing Mechanisms

Financing of SETI development in the OPT comes from a variety of sources. These include the PNA, which allocates 2 percent of the universities' budget to research, roughly four hundred thousand US dollars. Further, small endowments were established to support certain SETI activities. In addition, the majority of funding comes from a variety of donors in the Arab world and the international community, through bilateral or multilateral agreements, or through specialized funds for such purposes.

Absent a national policy, and action plan, which prioritizes SETI development in the OPT, and the lack of coordination amongst the different stakeholders in the system, created the conditions for less than optimal allocation of resources. This condition is obvious through the following observations:

1. Project duplications: different donors support the same project by different implementing agencies.
2. Low national priority: Projects financed by the donor community do not necessarily reflect national importance.
3. Improper implementing agency: In many cases donors funded research projects to agencies, which should not be implementing projects; namely PNA agencies. In most of these cases, the projects failed and the donors seized funding. It is important to stress again that donor funding, under the current conditions, is aimed at overcoming the lack of available public funding, and as such should be treated as public funding. Therefore, there should be a separation between the implementing and the monitoring agency. A situation where the donor monitors and evaluates the implementation of PNA agency goes against the national policy of free market economy, and does not contribute to proper capacity building in the PNA, or for that matter research implementing organizations.
4. Lack of competition: So long as SETI implementing agencies, as described in the SETI structure, do not compete for funding of projects, there is no guarantee that new ideas and methodologies will be developed, or when they are developed, they may not necessarily be the best. As such, when donors fund SETI related activities without adequate competition, which is the norm, the resources are not optimized.
5. Lack of incentives for coordination and cooperation: majority of donor funding for SETI related activities do not require the joint cooperation of the implementing agencies. This does not help in building a network of professional able to come together generating new ideas and innovations, which is essential for SETI development.

While the problems associated with the existing structure related to donor funding, which constitutes the majority of funding for SETI, has been discussed, shortcomings of the PNA has been a major reason behind these problems.

To deal with these shortcomings, the PNA has developed this first generation SETI policy in Palestine, which defines the national policy objectives in the sector. Subsequent to this policy document, the PNA shall develop a national SETI action plan, which shall further highlight the strategic directions for SETI development, the programs of actions, and the priority projects. Such a plan will necessarily include an analysis of the existing SETI infrastructure to assess its strength and weaknesses, and to determine the opportunities and how to optimize them, and the threats that need to be dealt with.

To reconcile this effort with donors' funding, the HCST, in addition to representatives from MOP and MONE, shall act as a formal or an informal sector or sub-sector working group on SETI leading the fund raising efforts for the plan with the donor community.

2.6.2 SETI Innovative Financing Options: Towards a New State

While donor funding for Palestinian development is expected to continue over the medium term, even after the establishment of an independent Palestinian State, it is important to look at the SETI development financing options absent donor funding. The following discussion is intended to highlight innovative financing options, which eventually will be needed to sustain funding for SETI development.

Further, given the fact that developed nations have realized that SETI funding was essential for their economic development and raising the standards of living of their respective citizenries, Palestine shall strive to progressively increase its SETI spending levels as a percent of its GNP to reach the levels of more developed countries. Therefore, developing innovative financing options for SETI becomes essential.

2.6.2.1 Public Finance

Public finance of SETI activities is expected to continue to be the main source of funding for SETI development. In addition to the obvious option of funding through allocating general funds from the general budget to support SETI activities and programs, the following options should be considered:

Using revenues from special taxes and fees: This option involves the use of tax revenues or certain fees, in part or in full, for purposes of specific or general SETI activities. Examples of such options include, amongst others, the following:

1. Use a portion of the Gasoline tax to support R&D and technology transfer in roadway or environmental research.
2. Use a portion of fees collected from water and waste water use to support R&D and technology transfer in the water/waste water, environmental or agricultural sector.
3. Use portion of the taxes and fees collected from telephone and wireless services to support SETI activities in development of, and in support of public access to ICT.

4. Use a portion of the revenues from excise taxes on cigarettes to support SETI research, development, and technology transfer in the healthcare sector.
5. etc.

Public Bonds: In layman term, bonds are "I owe you" notes issued by the government to the public. In short, the government borrows money from the public, which it repays, with interest, over a period of time.

The use of public bonds has been instrumental in the development of many nations. A recent example of the use of public funds to support SETI activity, which gained international coverage, was the adoption of the State of California in November of 2004, a public bond measure in the amount of 3 billion US dollars to support the development of stem cell research.

The use of public bonds requires stable political conditions, in addition to development of appropriate legislations and implementing mechanisms, which needs to be considered in an independent Palestinian State.

Finally, public Bonds in Palestine maybe instrumental in generating the funding necessary to support the development of major SETI infrastructure, such technology parks, or to support R&D programs requiring large investments.

2.6.2.2 Public-Private Partnership

An alternative method to finance public structures or infrastructure related to SETI development, when public funds are lacking, is through the use of public-private partnership schemes. This involves allowing the private partner to generate revenues form the infrastructure for a period of time, in exchange for constructing the infrastructure or structure.

An example of such partnership would be to have the private sector build the communications networks required for SETI related institutions (private and public), and allowing it to charge a user fee for a period of time.

An import issue, which should be noted, is that the fees charged by the private sector, and the timeframe over which it can collect fees, should be clearly defined minimizing the costs to the beneficiaries.

2.6.2.3 Private Sector Financing

The use of private funds to support SETI activities is an essential component in the overall financing of SETI. To encourage such activities, it is essential to have strong Intellectual Property Right Laws, and in some cases provide incentives for investments in certain SETI related activities.

2.6.2.4 Non-Profit Funding

The creation of research and technology development endowments can help support the development of SETI in Palestine. Further, charitable giving to support research in certain fields or adaptation of certain technologies can help fill some of the gap in financing the SETI plan.

To this end, the government shall facilitate such activities, through recognition in certain instances, and by providing incentives in others.

2.7 Good governance

The success of any system requires "good governance". At one level, good governance necessarily means transparency, and avoidance of conflict of interest at all levels in the system and for all stakeholders. At a different level, "good governance" means a process of cooperation and coordination meant to advance the public over the individual interest.

To this end, and in line with the process of reform the PNA is undergoing, the structure of governance adequately separates the roles of policy and project selection from program implementation, and both from monitoring and evaluation. This will minimize the conflict of interest.

In addition, reporting requirement on the use of public funds by the stakeholders in the system, combined with an empowered legislature with its mandate of oversight, shall provide the proper foundation for "good governance".

Further, and to foster a process of cooperation amongst the different implementing agencies, the PNA shall strive to finance, and support donor funding of SETI programs, which include, as prerequisite for funding, the partnership of different institutions.

Finally, and to foster the relationship between the civil society, professional unions, the private sector with the government, the PNA shall strive to include all the SETI stakeholders in policy and plan formulation, development, and evaluation.

Palestinians in the Diaspora and SETI

Whether forced to leave their homes and become refugees, or displaced from their lands due to economic hardship under the Israeli occupation, millions of Palestinians live in Diaspora.

Most did not lose faith of someday returning home, and the long years of living outside Palestine did not stop many of them from being a part of the lives of their families and communities in the OPT. Whether through sending money and aid or through actively coming to participate in some official or voluntary capacity, Palestinians in the Diaspora continue to be one nation with those living in the OPT.

Over their long years abroad, many have amassed a great wealth, which under a Palestinian State, at least part will come to build the State. In addition, many have become leaders in science and technology in the countries where they live.

It is a national strategic objective of the PNA that all Palestinian living in the Diaspora have the right to return home. Further, it is the policy of the PNA to harness the wealth of experience and encourage investments of Palestinians in Diaspora in Palestine.

In line with this national strategic objective and for the purpose of advancing the stated policy of the PNA, and as it relates to SETI development in Palestine:

1. The PNA shall strives to hold annual or bi-annual conferences in specialized fields of SETI bringing Palestinian science and technology experts from the Diaspora together with their counterparts in Palestine to exchange experiences and to create and foster a network of professionals aimed at advancing SETI in Palestine.
2. The PNA shall encourage the development of programs aimed creating specialized science and technology journals to publish the work of both experts living in the Diaspora and those in the OPT.
3. The PNA shall encourage programs, which support bringing Palestinian SETI experts form the Diaspora to help build the local capacity in the different fields of SETI.
4. The PNA shall encourage programs aimed at building specialized networks of Palestinian SETI experts in the Diaspora to assist in formulating future SETI policies in Palestine, and to actively participate in developing criteria and evaluating programs, and becoming expert bases for peer review of SETI proposals and publications.
5. The PNA shall develop policies aimed at providing incentives to support the investments of Palestinians in the Diaspora in the development of the SETI infrastructure in Palestine.

Chapter 3
Science, Engineering, and Technology (SET)
Performance Measures, Indicators, Policy Constraints & Acknowledging Excellence

Measuring the impacts and accomplishments, or lack thereof, that programs and projects had on the development of SETI in Palestine is an essential part of the continuous cycle of plan development, implementation, monitoring and evaluation, providing the foundation for directing, or redirecting, investments to maximize the benefits, of SETI development, to the Palestinian people.

This chapter focuses on the issues of system performance measures and indicators, which are needed to continuously evaluate the successes and failures of interventions, and their extent, and in determining appropriate actions. Additionally, the constraints facing the implementation of this policy will be discussed. Finally, this chapter includes a note on recognitions and awards as tools aimed at building and sustaining excellence.

3.1 Performance Measures and Indicators

Plan performance measures and indicators are tools used to assess the achievements of goals and objectives, and the effectiveness of the different intervention measures designed to achieve these goals and objectives. These measures and indicators should be developed for both the SETI action plan and for individual programs to measure the overall impact of all interventions collectively, or the overall impacts of individual intervention programs and projects.

3.1.1 System Operational Indicators

The efficiency of the system and how well it develops and operates should be measured, both at the program level and for the overall impact of the action plan. This involves the development of measures and targets for the following:

1. The level of SETI funding by the different partners in the system as a proportion of the GNP.
2. Overall quantity and quality of human resources in the different SETI fields.
3. The quality and quantity of the physical infrastructure used in SETI development.
4. The quality and the extent of cooperation and coordination amongst the different stakeholders in the system.
5. The quality and extent of the Palestinian relationship with the regional and international partners.
6. The quality and extent of the relationship between Palestinian SETI experts in the OPT, and those in Diaspora.
7. The quantity and quality of technology transferred, and the extent of its adaptation by the Palestinian end users of SETI.
8. The quantity and quality of SETI research conducted in Palestine and the extent of the application of its results by the Palestinian end users.

3.1.2 Standards of Living

Measuring techniques and targets should also be developed to assess the impacts that the different interventions collectively and or individually had on improving the standards of living. Such performance measures shall include, amongst others:

1. Improvements in Per Capita and Gross National Product (GNP) due to advancement and adaptation of SETI.
2. Increased personal income and savings of the population.
3. Improvements in life expectancy as a result of SETI development.
4. Increase in leisure time.

Some of these measures may be determined annually such as GNP and personal income, yet other indicators require a longer period of measuring, such as life expectancy and leisure time.

3.1.3 Social Equity

Methods should be developed and targets should be set to measure the impact of SETI development, both in terms of collective and single program interventions, in bridging the gaps between the haves and the haves not in the society. Indicators include the following:

1. The difference of income between the highest and lowest quintiles.
2. The difference in the income gap between men and women due to SETI actions.
3. Access to education in SETI fields and employment in a SETI jobs for both males and females.
4. Access to technology for the highest and lowest income quintiles.

3.1.4 Economic Performance

The impact of SETI development plan on economic performance should be measured and targets should be set for the overall plan of action, and that of a single program of intervention. As such methods should be developed and targets should be set to measure amongst others:

1. Employment rate.
2. Labor productivity.
3. Product and service quality improvement.
4. Levels of capital investments and savings.
5. The balance of trade.

3.2 Developmental Constraints

On the global level, the Israeli occupation continues to be the core constraint to the development of SETI in Palestine. The Israeli system of closure, checkpoints, and control of border crossings has been a detriment to the free movement of educators, researchers,

and students harming the educational and scientific exchange processes at the core of developing a the human resources required for SETI. Further, these same activities caused a great damage to the Palestinian economy and to the revenues, both public and private, required to build the foundation for SETI in Palestine.

Beyond the Israeli occupation, the success of the reform and democratization process carried out by the PNA is of essence to building the institutions needed to assure the success of SETI development in Palestine. The speed of this process also is of essence, and as such the obstructionist Israeli policies undermining the process should end.

Further, without adequate funding there can not be a SETI development in Palestine. Therefore, a major constraint to the process is the ability of the PNA to secure funding through its own resources, which are minimal, much of which due to the occupation, or through successfully coordinating the funding with the donor community, as a top national priority.

Finally, implementation constraints, which involve lack of technical skills or deficiency in the process from lack of communication and coordination amongst the different players, may hamper SETI development.

3.3 A Note on Acknowledging Excellence

Documenting failure is a part of scientific research and development, which is essential for learning and continuously improving the systems, methods and processes. At the other end, recognizing excellence and awarding achievement serves an essential role in encouraging and fostering SETI development.

As such, the MOEHE shall strive to develop awards in the different SETI fields to recognize the successes and achievements of both individuals and institutions. Further, the Ministry encourages the development of such awards amongst and between the different stakeholders in SETI to ensure that all those deserving recognition, are recognized.

Chapter 4
New SETI Opportunities and Economic Imperatives

4.1 An Overview of Current Economic Situation

Following the Oslo Agreement, signed between the PLO and Israel, the Palestinian economy faced stagnation. This was attributed to several factors, including, the continued Israeli occupation, frequent closures imposed on the Palestinian population centers, lack of natural resources, lack of a true export-oriented industrial base, the rapid increase in the Palestinian population, and the high unemployment rate. In 1999, the Palestinian GDP and Gross National Product (GNP) were US$4,493.5 million and US$5,534.1 million, respectively[2]. Between the years 1995 and 1999, the Palestinian per-capita GDP has grown by a meager annual rate of 1.6 percent. During the same period, its per-capita has grown by an annual rate of 1.9 percent. The Palestinian population, on the other hand, has increased by 25 percent during the same period of time.

The second intifada to rid the Palestinians from the occupation, and the extreme Israeli measures of destruction of properties, closures and curfews severely damaged the Palestinian economy. In 2004, the GDP stood at $ 4,254.6 millions, the per capita GDP dropped to $1210.9, while unemployment stood at just under 32 percent, and poverty at 58 percent of the population, furthering the challenges to deal with improving the standards of living.

4.2 The Need for a High-Tech Industrial Development in Palestine

To achieve higher rates of growth, Palestine must restructure and substantially expand its economy by concentrating on those industries in which Palestine posses or potentially could posses clear comparative advantage such as tourism, stone/marble cutting and shaping, and production of some agricultural products such as high value cash crops. In addition, Palestine must embark on a development program that leads to the creation of new high-growth industries that take advantage of the Palestinian human capital and intellect ("knowledge-based industries")[3], Information and Communication Technology (ICT)[4] being one example of these industries. The social and economic advantages of ICT will be discussed in details in Section 4.3.

Palestine must also prepare for the future by creating the human capital and research infrastructure needed for the development of other emerging knowledge-based

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[2] Palestinian Central Bureau of Statistics (PCBS) (www.pcbs.pna.net).

[3] The term "knowledge-based industries" refers to those industries where human knowledge and expertise are the basic commodities.

[4] *ICT is a term that encompasses the design, manufacturing and use of the tools needed to create, store, transmit, manipulates and publishes information. These tools include software, hardware (ranging, from the very basic components, Integrated Circuits for example, to large and sophisticated computers and networking elements), firmware and services.*

technologies such as biotechnology[5], bioinformatics[6], and new materials and advanced manufacturing (including laser technology). These technologies offer explosive growth potential for economies that have the required "human capital" for engagement in these areas.

To this end, and given the richness of Palestinian human resources and the limited natural resources, the creation of high-tech industries, such as ICT and biotechnology have the potential of providing substantial growth to the Palestinian economy, as it did in other countries, and as such should be pursued.

4.3 Why Information and Communication Technology?

The world today is rapidly embracing a new way of doing business, providing services, empowering the disadvantaged, conducting cut-edge training, and exchanging ideas as well as information, thanks to the rapid advancements being made in the area of ICT. In specific, embracing ICT will bring the following benefits, namely:

- Job, exports, and wealth Creation: International experience has shown that the ICT sector itself is a significant source of economic development with regard to job creation, exports, and wealth creation. Between 1992 and 1999, the ICT sector grew from 5.6 to 6.6 percent of the World GDP. The fastest growing sections of the ICT sector have been software and IT services, while the biggest items were hardware and telecommunication equipment.

The ICT sector is an important direct source of job creation. In many countries, employment in this sector has grown by more than 3 percent annually since the early 1990s. During the same period of time, Ireland had exceeded this worldwide average and had an employment increase in the ICT sector of 18 percent annually. Although similar statistics are not available for Palestine, anecdotal evidence suggests that the ICT job market has grown substantially.

- ICT as an enabler of business development: As a "general purpose" technology, ICT plays a fundamental role in creating business opportunities in other sectors or in improving the competitiveness of those sectors. The introduction of information technology (IT)-based systems for enterprise resource planning, supply chain management and a host of other services can take firms and industries to new levels of competitions, provided that the technology investment is accompanied by an investment in human resources. In a recent International

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[5]*Biotechnology is a body of techniques that use biological systems, living organisms or derivatives thereof to make or modify products or processes for specific use. Applications for biotech-produced materials are found in pharmaceuticals, agriculture, specialty chemicals and cleaner production methods.*

[6] *The term "bioinformatics" is a merger between biotechnology and information technology. As such, it deals with methods for storing, retrieving and analyzing biological data. Applications for this field are found in drug design, vaccine design and agriculture.*

Labor Organization (ILO) study[7], a company selling electronic components is estimated to save 29 to 39 percent of its expenditures by adopting Internet-based business-to-business solutions.

In general, those economies, which are able to diffuse ICT rapidly to existing sectors, will be able to improve competitiveness and possibly output performance and employment. Conversely, those economies that do not diffuse ICT effectively will lose ground against more efficient competitors.

- ICT as a means for social development: Even without making a direct impact on the local economy, access to ICT can be fundamental to social development. Some services such as health, banking and government services can be more efficiently delivered using ICT. Realizing this fact, many governments and banks are adopting ICT and transforming themselves to the so-called "electronic Government (e-Government)" and "electronic bank (e-bank)", respectively, with higher degrees of responsiveness and efficiency.

  Technology transfer and learning could also be substantially accelerated using ICT. Moreover, ICT could empower the disadvantaged and marginalized communities by providing them with access to a wealth of information and expertise that can help them improve the quality of their daily lives.

Realizing the impact of ICT and Internet on local economies and social development of least developed countries, the United Nations Development Program (UNDP), together with Accenture and Markle Foundation, has recently lunched the "Digital Opportunity Initiative[8]" with the aim of helping disadvantaged countries to cross the so called "digital divide" and reap the huge benefits of ICT.

Over the past few years, Palestine underwent a true ICT revolution with the establishment of the Palestinian Telecommunication Company (PalTel), providing wired and value-added communication services, and its subsidiary, PalCell, providing mobile telephone services. Over 15 Internet Service Providers (ISPs) have been established and many universities have created training programs with IT as the core subject of study. Networking activities are in full gear with the creation of the 1st government-wide computer network (GovNet).

These activities, presented above, are clear indications of the importance of ICT to the Palestinian economic and social advancements. Strengthening and further development of this industry, therefore, is important and should be pursued as a top national priority.

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[7] ILO, World Employment Report 2001, Life at work in the Information Economy, Geneva 2001, Table 3.1.
[8] Accenture, Markle Foundation and United Nations Development Program, 2001 "Creating a Development Dynamic: Final Report of the Digital Opportunity Initiative."

4.4 Enabling the Development of High-Tech Industries

Creating high-tech industries in a developing country such as Palestine is a great challenge. For it does require the transformation of the whole country into a new NSI[9], setting quality as a top priority. Particular efforts and investments will be required to upgrade areas fundamental to the creation of NSI and high-tech industries, as reflected in Figure 4.1.

Figure 4.1: Summary of the basic foundations for the successful creation of high-tech industries

High-Tech Industrial Development				
Policy/Regulation/ Standards Framework	**Human Resource Development**	**Technology Infrastructure**	**Capital & Financing**	**Enterprise Development**
• SETI policy • Technology-specific policies • SETI strategy • Technology-specific strategies • Standards & regulation • Technology-oriented laws.	• General Education • Academic • Vocational • Research • Continuing Education	• Networking & connectivity • Internet Websites/ portals • Laboratories • Libraries & museums • Distance-Learning Facilities • Research Laboratories • Centers of Excellence • Technology Incubators • Technology Parks	• Technology Funds • Innovation Funds • Venture Capital • SME Loans • Grants	• Business & professional associations • Training Programs (management and Technical) • Incentive programs • Promotion Programs

4.4.1 Policies, Strategies, Regulations and Standards Framework

4.4.1.1 Policies and strategies

In recent years, Palestine has formulated its own policy/strategy in a number of areas critical to the well being of its society and economy. The agriculture[10], water[11], and

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[9] The NSI is defined as "a set of functioning institutions, organizations and policies which interact constructively in the pursuit of a common set of social and economic goals and objectives."

[10] A Strategy for Sustainable Agriculture in Palestine, by Policy Assistance Branch, FAO, Regional Office for the Near East, Cairo, April 2000

telecommunication[12] strategies are some examples of such an effort. However, if Palestine is to enter the arena of high-tech industries more needs to be done. In addition to this first generation SETI policy document, Palestine needs to quickly draft and implement its own SETI strategy as well as some technology-specific standards and regulations. One such policies/strategies that need special attention are those of the ICT.

With regards to standards and specifications, Palestine has the General Authority for Standards & Specification with a mandate to setup industrial standards and to enforce them. It is essential to evaluate the efficiency of the existing authority, and to look into the potential benefits of decentralizing such authority within different departments in the government, each in accordance with their expertise.

4.4.1.2 Technology-oriented laws
The term "technology-oriented laws" refers to the suit of laws that a country must develop and enforce to ensure a stable and secure environment conducive to the creation and growth of technology-oriented industries. At the top of the list are the laws protecting intellectual property rights (IPRs)[13], the investment law and electronic commerce (e-commerce) law including legality and modality of digital signature. It is important to note here that countries which provide for the protection of intellectual property benefit in many ways. Firstly, adequate legal protection fosters investment and trade and secondly, it is crucial in stimulating innovation, which is the driving force behind the new "knowledge-based" economy.

A progressive Palestinian investment law, with generous financial and non-financial incentive schemes, has already been drafted, approved and put to practice. The set of Palestinian laws protecting intellectual property rights, on the other hand, is currently under draft by the Ministry of National Economy.

It is important to note here that, laws and regulations, in general, such those relevant to IPR laws carry a business cost, which is shifted to the consumers in the form of higher service and product prices. While these laws are essential for the creation of high-tech industry in Palestine, it is essential that the impacts of the rise in prices, especially on the lower economic classes be minimized.

As such, and within the context of a national safety net, the PNA through, either business incentives, or direct subsidies to the lower economic classes, shall strive to defray the impacts of the rising prices of products and services due to the enforcement of IPR laws.

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[11] [Insert here a reference to the water strategy report.]

[12] [Insert here a reference to the telecommunication strategy report]

[13] Intellectual property is a collective term for four separate and distinct types of intangible property, namely patents, trademarks, copyrights and trade secrets.

4.4.2 Human Resource Development

A complete discussion on human development, in support of NSI, is presented in Chapter 5 of this document. The interested reader is referred to that chapter for further presentation.

4.4.3 Technology Infrastructure Development

In this paper, the term "technology infrastructure" refers to the basic technical infrastructure (communication and information infrastructure, content development, distance learning centers…etc.) needed in support of high-tech industrial development in Palestine. The different components of such an infrastructure are presented next.

4.4.3.1 Networking and connectivity

To propel Palestine on the path of development, it must become a wired society, that is, the current telephone penetration ratio of 8 /100 inhabitant must substantially increase. The Internet penetration ratio of 9 /100 inhabitants has also to move up. Primary and secondary schools, institutes of higher education, research institutions, and libraries have to be connected to each other and to the outside world through high-capacity connections. This infrastructure is a prerequisite for the establishment of virtual networks among special interest groups such as educators and students interested in mathematics or science. Furthermore, such an infrastructure will encourage collaboration among institutions of higher education and foster training over the net (e-learning).

As such the physical connectivity of these institutions should be expedited, and the PNA should develop an action plan aimed at achieving such connectivity. This shall include an assessment of the existing contracts with the Palestinian telecommunication companies, which may be a hindrance to the connectivity of some institutions. Further, such a national action plan requires the PNA to work with the different beneficiaries to built one grand network. Finally, and in order to implement the action plan, the PNA needs to work on generating donor interest and funding to this national priority, which has a clearly defined objective facilitating the fund raising effort.

In addition, the Palestinian civil society at large must be encouraged to connect to the Internet. Further, to ensure equitable access to all communities, and an equitable distribution of the benefits of the ICT revolution, special attention must be paid to the Palestinian disadvantaged communities, such as refugee camps and Palestinian rural communities.

4.4.3.2 Internet Websites/portals and content

Palestine is performing poorly when it comes to Website/portal setup and content generation. Very few Internet portals have been created in Palestine, one of which is the portal being setup to host business, economic, and governmental data (www.psgateway.org).

New programs must be devised to encourage the setup of websites by the different Palestinian businesses and institutions. The setup of portals should also be encouraged.

4.4.3.3 Distance-learning centers

The only interactive distance-learning center in Palestine is the one at Bethlehem University. The center is linked, via a satellite communication channel, to a French and Moroccan Universities and used to carry out a joint training program in tourism. To reach its students, the Palestinian Al-Quds Open University makes use of older non-interactive distance-learning methods (taped lectures).

Modern distance learning is an important tool for training and technology transfer. Both satellite-based and Internet-based distance learning methods are possible. Palestine must, therefore, develop programs that encourage the setup of modern distance learning facilities to the benefit of higher education Institutes, training providers, technology companies, as well as the civil society at large.

To encourage the development of distance learning centers, the MOEHE in partnership with higher education institutions, shall setup and operate few strategically located centers to the benefit of the community. Further, incentives may be provided to encourage partnerships between training institutions and or non-profit organizations to setup such centers.

4.4.3.4 Centers of excellence

The term "center-of-excellence" refers to an entity within a higher education institution, government or private sector that delivers best-in-class training and research, in support of a specific technology or subject matter.

If the transformation to high-tech industries is to take place in Palestine, centers-of-excellence must be created to insure the production of high quality human resource and research results that will feed into these industries. Therefore, MOEHE in cooperation with higher education institutions and private sector must identify and setup the type of centers that are needed for the future of Palestine. Criteria for the certification of these centers must also be developed. Incentive program should be devised to encourage partnerships between the different institutions and the private sector in creating these centers.

In short, The MOEHE has two important roles in developing Centers of Excellence. The first is setting the criteria for certifications of these centers. The criteria developed by MOEHE should be stringent enough to ensure excellence, yet not impossible to attain. The second role is to identify potential centers at universities, or in partnerships between different institutions, and to work on building them into Centers-of-Excellence, each in their respective field.

<u>4.4.3.5 Technology incubators/parks</u>

While centers-of-excellence build capacity in research and human resource, technology incubators transform research results into new products. Moreover, incubators help new companies during their startup phase by providing them with appropriate infrastructure, marketing and administrative tools at minimum cost.

So far, Palestine does not have any technology incubator. However, the Palestinian Authority of Industrial Zones, in cooperation with the Ministry of National Economy is planning to set up a technology incubator at the yet-to-be built Technology Park planned for Khadouri/Tulkarem.

The term "Technology Park" refers to a physical area enhanced with the appropriate infrastructure and tailored to the needs of the high-tech industry. Technology Parks are set up to attract international technology companies and/or help these companies and the local ones to form joint-ventures taking advantage of the many incentives offered by these parks.

Beyond the incubator at the technology park in Khadouri, it is important to proceed with setting up other incubators. To expedite the process, the PNA shall strive to provide incentives to the private sector, industry in particular, to jointly work with local research centers, both inside universities and outside, to start setting up new incubators to meet the needs of the different industries in Palestine.

4.5 Capital and Financing

One of the most difficult challenges facing the creation of high-tech industries in Palestine is the shortage of appropriate capital and funding instruments. If such an industry is to flourish, funding instruments such as grants, matching funds, technology funds, innovation funds, joint venture capital, and small-medium-enterprise loans must be made available in Palestine (refer to Chapter 2).

As Palestine is marching towards statehood, it should not miss the opportunity of using part of the donor community fund to create the required instruments stated above. While such shift in funding would come at the expense of expenditures on social and certain physical infrastructure and services programs, the shift is essential for economic development.

The PNA believes in a free market economy that is driven by the private sector. As such, funding initiatives in SETI development, based on the needs of the private sector, will meet the strategic objectives of the PNA in supporting it. Further, and as donors start to reduce their levels of funding, without adequate investments in the private sector today, it will be difficult to raise the funds required to meet the recurring costs required to maintain and operate the social and physical infrastructure systems in the future. To this end, the shift in funding is essential for the medium and long term development of Palestine.

4.6 Enterprise Development

To develop sound and strong enterprises in Palestine capable of participating in the national development of high-tech industry, the following programs should be devised and implemented by the appropriate government ministries and concerned stakeholders, namely:

- Incentive programs (financial and non-financial).
- Promotion programs (technology fairs).
- Training programs (management, business and technical).
- Encouraging the development of business and professional associations.

Chapter 5
Human Resource Development and Research Capacity Building

The development of human resources and capacity building in Palestine, on both the individual and institutional levels, is a key element in creating a dynamic and innovative SETI culture, and will ultimately contribute to the well being of the country. Therefore, the polices and strategies of an effective NSI will depend very much on the provision of an adequate number of well-trained and experienced scientific, engineering, and technical staff to instigate maximum and efficient utilization of all resources, including funds, materials, and technology.

This chapter deals with HRD and capacity building in SET education, research, and training, and the role of the different stakeholders in human resource development. It also aims at raising public awareness and understanding of the value of SET as a vehicle for national prosperity, social well-being and sustainable environment.

5.1 Current Status

The Palestinian people have always considered the human resource as the country's basic asset. Throughout their turbulent history, Palestinians have maintained a deep and abiding commitment to education and training as a major tool for HRD and to sustain their survival and development as a nation.

The educational system in Palestine, which is managed by the MOEHE, is composed of general education, (basic, secondary, and vocational) and higher education. The Palestinian educational system occupies a somewhat unique position in the constellation of international educational systems. A high participation rate in the basic education; 30 percent of the total population, a higher education gross enrolment rate of more than 19 percent, and low enrollment rates in Technical and Vocational Education and Training (TVET).

However, for historical and political reasons, the educational system in Palestine has not contributed to the transformation of the Palestinian society from being consumer and dependent oriented society to being a productive and independent; a big challenge for the foreseen Palestinian State. Needless to say that the educational system has not been able to provide a critical mass of scientists and engineers, needed for the creation of sound research and development base. Research and development at Palestinian higher education institutions is not only sparse, but also disjointed, unguided, and not strategic goal directed.

The establishment of an independent Palestinian state will provide a window of opportunity for Palestinians to develop their economy. Although the future Palestinian state will neither have the resources nor the capital to build a heavy industrial economy, its options are limited to the development of manufacturing, light industry, services, tourism, and agriculture. Furthermore, Palestinians could enter and compete in selected industries based on knowledge and high technology. In any event, the economic areas in

which Palestinians could compete will necessitate the development of appropriate skilled and trained human resources to operate it, and the Palestinian education system at all levels should be ready to refocus its academic and scientific orientation to accommodate this economic need.

5.2 General Education

The MOEHE applied the new Palestinian Curriculum in the academic year 2000/2001. A major characteristic of the new curricula was the introduction of English as a foreign language starting at the first grade. Although the new curriculum adopted the Technical and Vocational Education Stream, based on the National Strategy for TVET, no change in the streaming between science and literary streams at the high school level has occurred. There is also no evidence on the improvement of mathematics, science, and technology education in the new curriculum.

Based on the fact that an economy that relies on modern technology requires not only educated workforce, but a workforce that is equipped with a fair amount of mathematics, science, and technology, which may require reforms in the educational policy. This may be important to instigate the change towards improving the Palestinian economic performance within the local, regional and global arenas, and to provide competent human resources as the one prerequisite, not only for nation building, but also for contributing effectively to the well being of the region.

As such, the curriculum should be revisited, and a new curriculum may be developed in cooperation between the government, the research community, and the private sector to determine areas of intervention required in SETI to meet the needs of the private sector and economic development. While the current streaming, scientific and literary, may continue, it is essential that the curriculum includes mathematics and science to all students. Further, developing and adopting new methods of teaching these subjects, aimed at encouraging higher enrollment in the scientific stream, is essential to meeting the future needs of SET. Finally, the training of teachers in the new educational methods is an essential component in the success of this strategy.

5.3 Technical and Vocational Education, and Training (TVET)

Post secondary vocational and technical education is offered by community colleges, which aim at meeting the development of middle level human resources. Study duration is 2 years leading to a diploma in vocational, technical, or academic qualification. There are 29 community colleges in the West Bank and Gaza, 9 of which are labeled as "governmental colleges." The total number of community college students is around 5000, which constiutes 7 percent of the total enrolment in the higher education sector.

Vocational and technical education is percieved by Palestinians as a marginal higher education option, that is not fully appreciated by society, and does not allow for further education. Since 1992, the number of students enrolled in the universities has more than

tripled, and vocational and technical college enrollment began to increase again after dropping sharply.

Recent efforts by MOEHE and MOL has resulted in setting up a National Strategy for Vocational and Tecchnical Education and Training, that provides relevant, efficient, and effective education and training opportunities that meet with societal aspirations. The adoption of a modular system will allow students to choose from a variety of learning programs and will offer qualification profiles suited to meet the changing demand of skilled workforce.

The TVET system aims at providing the community with a skilled labor force and qualified technicians capable of participating in the development and maintenance of the infrastructure as well as the industry, agriculture, services sectors, and others. It also aims at keeping up with modern scientific and technological progress, monitoring its effect on the various economic sectors and coping with its impact on the labor market, confronting the changes in the labor market that arise from economic fluctuations and technological variations through the special training courses and the continuing education programs that increase the individual's opportunities to attain permanent jobs, and increasing the productivity of the labor force. Henceforth, participate in the increase of the national income and in encouraging investments in the country.

To encourage more students to enroll in technical and vocational colleges, the following should be implemented:

- Increase public awarness of the important role skilled human resources can play in the overall development plan. A guidance and career counseling system is to be incorporated starting early stages of education not only to assist potential students in choosing occupations that suit their abilities, but also to match the demands of the labor market.

- Secure all the necessary funds for the implementation of the National Strategy for TVET by the PNA. This would call for expanding the capacity of existing Technical and Vocational colleges, and establishing new ones. It would also call for allocating a scholarship scheme to encourage more students to enroll in community college.

- Implement the National Qualification Profile which identifies the required skills for each profession at the national level. The implication of such an intervention would entail the implementaion of complementary measures, such as professional licensing, code of practice, and national certification system.

- Establish and implement a clear bridging mechanism programs to open up career development opportunities for students wishing to do so, along with those proposed in the TVET strategy.

5.4 Higher Education

The last decade was marked by a fast expansion in the higher education sector. Unfortunately, a parallel process in the area of SETI did not accompany this expansion. Most existing institutions of higher learning sought to meet the rising demand of younger generations for education, and of undertaking the responsibility of providing them with the opportunity to study in Palestine, having been forcibly deprived of the chances to study abroad.

Data shows that 3 percent of all Palestinians are enrolled in higher education. The gross enrollment rate is more than 19 percent. In 1995, the year for which comparative data exists, slightly over 1 percent of the total population was enrolled in higher education, and the gross enrolment rate was about 10 percent.

Although, Palestinians had a higher percentage of the total population enrolled than the average for developing countries and Arab states, the higher educational sector is characterised by a distorted distribution of enrolment. Palestinian students often major in fields that do not fit the needs of the Palestinian economy and society or that of the broader Middle East. About three-fourth of Palestinian students are enrolled in the social sciences, humanities, and education for reasons that include student interest; more space relative to the number of fields of engineering and medicine; and the absence of effective student counseling and guidance at the secondary school level.

5.4.1 Streamlining Higher Education Institutions to Increase SET enrollment

If Palestinians are to achieve economic growth, employment creation, and output, it is essential to focus on addressing the human resource development problem; namely, the unchecked enrolment practice which has led to the proliferation of graduates who are either unemployed (approx. 30 percent) or underemployed, especially among the humanities graduates, whereas the community is seeking qualified graduates in other fields, especially those related to technical skills and knowledge of advanced technology.

To streamline higher education institutions towards increasing enrolment in SET fields, the following mechanisms should be adopted:

- Introduce mechanisms to influence the introduction of new programs, which could drain resources better used for SETI program development. This entails that the MOEHE to exercise its authority in not licensing and/or accrediting new programs of less relevance in any university for a period of time. It also requires the introduction of a quality assurance system to increase relevance and improve the quality of the higher education system. In technical colleges, however, where the needs are clearer, the Ministry will continue to work actively on developing the technical and vocational programs.

- Support existing higher education institutions to expand their current enrolment capacities in SET programs as a rationalized mean of public support. This calls

for the establishment of incentives system to encourage institutions to upgrade their infrastructure, faculty development programs, and update resources.

5.4.2 Increasing Student Enrollment in SET

Public support for higher education should be used as a tool to focus on enhancing the ability of students to pay for higher education, not to sustain institutions. In other words, public funds should be targeted to meet national and regional human resource development by focusing on programs identified as having high priority.

To increase student enrollemnt in SET, a student centered approach should be adopted. The approach would recognize the needs of students by substantially expanding student scholarships and aid schemes or subsidies to those enrolled in fields deemed of national priority. Beyond encouraging students to enroll in SET fields, this policy will encourage institutions to increase their capacities in the SET programs as the demand, and therefore, the government subsidized tuition and fees, would go to those offering more SET fields and capacities.

5.5 Science, engineering, technology, and innovation Capacity Building

Capacity building covers both individual capacity and institutional capcity. The individual capacity deals with the development of high level competencies required for S&T development. Despite the fast expansion of the higher education sector both horizontly (new programs as well as a larger intake of students) and vertically with a large variety of graduate programs, little has been accomplished concerning faculty development programs, even those programs that took place during the 70s and 80s, which were funded by donors. Furthermore, a good number of faculty members left universities to work with the PNA or with the burgeoning number of NGOs that are operating in Palestine. With this situation, and compounded with weak institutional management capacity, the task of improving the quality and quantites of professionals in S&T is difficult.

As such, and to achieve an active faculty development programs in Palestine different approaches would be followed, drawn from existing programs, or from previous experiences. These include available scholarship schemes to the Palestinian people, university networks, and using ongoing development projects funded by the donor community. The following is a summary of these programs:

- Streamline international postgraduate scholarships offered to the Palestinian people to meet the needs for faculty development at universities, research centers, and relevant government staff dealing with SETI. Emphasis would be focused on training in research management. Similiary, graduate scholarships would be oriented towards science and technolgy fields.

- Establish university networks, and utilize existing ones, such as the PEACE program, towards meeting the urgent need for faculty development, faculty

exchange, and training. In addition joint research programs on issues of high national priority would be encouraged. International agreements should include a component in which capacity building in the field of SETI would be realized.

- Attract Palestinian expatriates to contribute to the capacity building process and benefit from their international experiences in SETI opportunities. This requires an evaluation of the Palestinian Expatriates Program (PALESTA) at MOP to be expanded to meet the needs of the S&T community.

5.5.2 A Note on Capacity Building in Donor Funded Projects

While a majority of donor funding over the past decade went into humanitarian and emergency assistane, a good portion went into capacity building. The lack of strategic objectives, poor planning, and implementation of these projects rendered much of the funds wasted.

Over the past few years, the German Cooperation,which is involved in the water/waste water and the TVET sectors, has in cooperation with the PWA, the MOEHE, and the MOL funded projects aimed at developing the technical skill and know-how in operating and maintaing waste water facilities. The approach, while small in scale, is a useful example of coordinated policy directions, and should be expanded to other fields.

Currently, the World Bank is in discussions with the PNA on provisions for capacity building required to form the foundation of an independent state. This SETI policy document is the only PNA document that has a clear indication of the needs for the future development of Paletsine, both the public and private sector with SETI at its core.

To this end, it is essential, and while this policy documet remains in the realm of generality, to stress the importance of capacity building in SET fields as a prerequist for balanced development and private sector lead economic growth. As such the following should be sought after:

- Generate a consensus among all government agencies, NGOs, and the private sector on the importance of fostering S&T capacity building as a major factor to achieve sustainable development. This should also lead to an agreement and understanding of government agencies dealing with international cooperation.

- Establish mechanisms in which any proposal for funding submitted to the donors community should meet an agreed set of standards and requirements that meet the overall development plan of the country, including the capacity building aspect.

- Maximize the role of local human resources in the design, implementaion, and the operation of all donor funded projects. Desimination of project results among various institutions would achieve a favourable effect, strengthen national networks, and foster a supportive research culture.

5.6 The Role of NGOs and the Private Sector

NGOs and the private sector in Palestine are not only major SET education and training providers, but are also users of the skilled human resources produced by the education sector. Although the size of their intervention is relatively small, they form an integral part of the lifelong education and training processes.

In most developing countries, where governments assume a full control over the educational process, the concept of allowing NGOs and the private sector to play a role in the human resource development has not yet been concieved. However, recent trends suggest that involving the private sector will contribute to the creation of a positive competitive environment in human resource development and the capacity building processes. As such, and as much as possible, NGOs and the private sector should be involved in the human resource development processes, in Palestine, to the extent allowed for by the free market.

Further, and within the framework of the free market, the government shall strive to create fair competition between NGOs, institutions of higher education, and the private sector as implementers of HRD requirements for SETI development. Therefore, the government, in partnership with the private sector and NGOs, shall assist in building their capacities to meet the demands of SETI life long traning and eductaion requirement. Further, and through appropriate incentives, the government shall support intership schemes and industry linkages as an integral part of SET education and training.

Finally, it must be stressed here, that despite adverse political and economic conditions, a base of human and physical resources exists within the private sector. Therefore, making use of existing private sector capacity, especially, in regards to those major research programs that are geared over the medium term is of crucial importance to create a critical mass of expertise. As such, incentives mechanisms should be established to induce NGOs and the private sector to work in multi-desciplinary program modes, thus spreading the learning and training throughout the value chain. Further, an essential component is the continuation of the process, which started in the development of this policy document, of active participation of NGOs and the private sector in the policy formualtion and strategic planning, and to reach a common understanding of the roles and responsibilities they can play.

The need for educated people is the fundamental prerequisite in SETI. Investing in people through high-quality education and training, particularly in core areas such as SET, is the most important investment today for long-term economic growth. A framework for human resources development is fundamental to guide public and private investment in education. This framework should be based upon a consensus among educators, university administrators, economic policy makers, and industry and business leaders about the overarching strategic objectives for economic and social development of the emerging state.

Chapter 6
Science and Society: Mitigating the Downsides

Advancement in SETI presents opportunities for economic and social development, yet, and at the same time, presents challenges that the society has to reconcile with in order to mitigate the downside of such developments.

This chapter is devoted to the major down sides, which can arise from SETI development, and proposals are made for minimizing their impacts on the society. Four issues will be tackled in this chapter, namely: (1) Ethics, (2) Public "right-to-know" and participation, (3) Poverty and social equity, and (4) The Environment and public health and safety.

6.1 SETI and Ethics

A constant concern in scientific and technological developments is the impact such developments stand to have on human life, dignity, and the fragile environment. The concern lay at both the research end and its application end in the society or industry.

At the research end, during the process of development, the use of human or animal subjects in research and developments is of concern. Examples include the testing of new medicines or vaccines, and the use of animal testing in the development of beauty products. Other examples, which have dominated the world's media, are the issues of cloning, stem cell research, etc.

At the application end of research, concerns arise from the use of certain products, which my adversely affect the fragile environment. Additionally, the use of certain technology may impact peoples' privacy, such as with the use of ICTs.

While Palestine, today, is by no means a contributor to such research, it uses certain technologies such as vehicles, and has some industry emitting toxins into the air. Further, Palestine, and as it strives to build its base in SETI, there is no doubt that such issues will gain more prominence. Even if it does not chose such a route, none the less, and given the global nature of today's economy, it is essential that Palestine be involved in the discussion of all of these issues, and should develop national policies and positions reflecting the high moral ground, which the people of Palestine share and strive to advance locally and internationally.

As such, Palestine shall strive to develop national positions on the issues of human and animal cloning, stem cell research, genetic engineering, weaponries, etc. Further, Palestine shall strive to set the national standards required to protect the fragile Palestinian environment, while balancing the needs for economic development and prosperity. To this end, Palestine shall embark on assessing the impacts of the international environmental conventions and treaties, on both the Palestinian environment and economic development, and shall establish formal positions, either to join such conventions, or to develop its own policies to protect the environment.

In formulating such positions, the PNA shall include the Palestinian private sector, civil society, and professional associations in an open process, which shall involve of different ad hoc "ethics committees" to deal with these issues. In addition, the involvement of all the players is important in educating the student population and the public at-large on the different issues relevant to ethics and SETI.

6.2 Public "Right-To-Know" and Participation

Public support for SETI development is essential to the success of this policy. An aware public of the importance of SETI in the development of Palestine, and its impact on their own economic situation, will undoubtedly rally behind the policy, and will encourage the involvement of younger Palestinian into becoming the future SETI leaders in Palestine. To this end, the participation of public in the policy and plan implementation is essential. Further, the public has the "right-to-know" of the impacts of SETI development, both the positive, to encourage and advance SETI development, and the negative to assure them of the fact that their well being is at the heart of the concerns of SETI stakeholders.

As such, the PNA and the SETI stakeholder community shall work on promoting SETI development with the general public by taking advantage of all available means. This includes, advancing interest in SETI at the school level, with students, starting at an early age, and promoting scientists as role models. Further, the government shall support the development of SETI organizations and clubs, especially for the young, to encourage their participation in SETI and to promote it with the public. Additionally, SETI stakeholders shall make every effort and take advantage of each opportunity to advance the development of SETI using the existing media to reach the general public, and the government shall strive to provide funding, either directly or through incentives, to train scientists in dealing with the media.

6.3 Poverty and Social Equity

Faced with an ever dwindling middle class, poverty is of major concern to the Palestinian people. SETI can become a major contributor to alleviating the problem of poverty. However, it is important to ensure that the gap between the poor and rich does not rise, and that the benefits of SETI development are distributed to the entire population.

Evidence from developed nations suggest that the new income gap is more and more based on technological literacy and know-how, and less on class. To this end, policies should be developed to ensure access to all classes, in all communities, urban and rural, of the society to technological literacy and know-how. Further, such know-how should be afforded to women to advance the cause of equality, and to ensure equitable distribution of benefits to all in the society.

In implementing such policies, the government needs the participation of the research and educational institutions, both public and private, to ensure equitable access to learning. The government shall strive to develop appropriate incentives, financial and otherwise, to ensure positive involvement of these players. Further, the government shall pursue a

policy of affirmative action, where appropriate, aimed at providing better access to women, without compromising the quality of SETI development.

Also, and given the disproportionate poverty, and the lower access to services, in rural communities, the government shall develop programs aimed at providing incentives to the private sector to deal with both the poverty issue and access to services and technology in rural communities.

Finally, and while recognizing the importance and economic value of economies of scale, competition should be at the heart of SETI development, especially at the application end. Therefore, the government shall strive to end business monopolies, and shall strive to develop a tax system aimed at promoting small businesses through appropriate incentives to larger ones.

6.4 The Environment and Public Health and Safety

While the ethical component of the issue of environment was discussed in section 7.1, dealing with SETI and Ethics, this section is intended to further focus on the environmental issues, and the impacts on public health and safety.

Protecting the fragile environment and the public health and safety shall be pursued, in balance with economic development, through two different policy approaches. The first is an approach aimed at regulating the extent of emissions and pollutions of certain industries, and vehicular traffic by developing clear standards and criteria of operations. In addition, the government shall provide suitable incentives for the private sector to meet these standards, and to minimize the business costs.

The second approach is based on the belief that the protection of the environment and the public health, and economic development are not, necessarily, contradictory. Development of clean technologies and technologies in the area of environmental protection and cleaning has the potential of becoming a major Palestinian industry, especially with the availability of the nucleus of such research.

The government shall, therefore, in cooperation with the other stakeholders in the system work on developing legislations aimed at regulating environmental pollution and setting standards for public health and safety, while providing incentives to the private sector to overcome the business costs associated with such regulations. Further, the government shall strive to provide incentives for research in the area of clean environmental technologies to further advance its development in Palestine.

Chapter 7
Women in science

Education is a core value to all Palestinians, and it is socially important, and advanced, to both men and women alike, up to a certain level and through different ways, which adversely and unjustly undermine both women, and the economic development of Palestine. Across the educational spectrum, and despite the many socio-cultural challenges, women excel, and their achievements surpass that of their male counterparts. The percentage of women passing the National Standard Exam (Tawjihi), which is a requirement for graduating at the end of the 12th grade, is always substantially higher than that of their male counterparts. In 1997, by no mean a limiting example, the percentage of females passing the exam, in the scientific stream was 71 percent, as compared to 55 percent of their male counterparts. Further, and in that same exam, the number of females placing in the top ten in the nation was higher than that of males.

The enrolment rates of both sexes in general education is equal up to the end of the compulsory cycle, which extends to the 10th grade. From there on, the enrolment of females decreases gradually to 40 percent at the undergraduate level of university education, as per PCBS report of 1997. A sharp drop in enrolment is further noted at the postgraduate level.

Gender-biased structural imbalances affect the participation of women in the different SETI fields, and deprive them of opportunities for expressing their aspirations and meeting their needs. The participation of women in SETI is an essential tool in advancing the cause of gender equality, which is a canon of human rights, and indeed, shall lead to a stronger more economically viable Palestine.

Challenges faced by women in SETI start at home and continue to propagate through the education cycle, workplace, and in the society.

7.1 Women in Education

7.1.1 Literary and Scientific Streams

At the school level, gender bias have been documented in the math and science curriculum, and in the methods of teaching these subjects, which affected the choices of study and future careers of women, steering them away from the different SETI fields. The lack of awareness and understanding of this problem, by most teachers and counselors, further complicates it, as proper advice is not provided to students. In addition, the split of school education into literary and scientific streams, at the end of the 10th grade, add another factor contributing to this problem.

As students approach the 10th grade, parents tend to advise their daughters not to enroll in the scientific stream, which is perceived, by society, as a harder subject "beyond the comprehension of females" and "time-demanding", which could lead to a deviation from the existing division of labor, and the traditional role of women of "dedicating themselves

to their families". As such, their future careers will be limited to working environments that are exclusively dominated by women.

The problem is more severe in rural areas due to lack of female secondary schools or co-educational schools, which are not socially acceptable, especially in these areas. Further, mobility restrictions impact rural female students most, as they are less likely to be able to travel to urban centers to complete their high school education.

The combination of all of these factors culminates in lower female enrollment rate after the compulsory 10th grade, especially in the scientific stream, necessary for SETI education and future SETI careers. In this regard, a 1997 PCBS report indicated a 40 percent enrollment rate of females at the secondary cycle compared to 52 percent at the primary level.

Given these conditions, it is essential that policies be developed to create the conditions required to providing equal opportunity for women involvement in SETI. As such, and to adequately deal with this problem, the PNA, in cooperation with all stakeholders in SET and women organizations, shall strive to raise the public understanding and awareness of the need to involve women in the development of SETI, as women involvement will undoubtedly contribute to improving the quality of life to all Palestinians.

Further, to achieve concrete results, the PNA shall devise a program of action aimed at funding female secondary schools in rural areas. In addition, the PNA shall strive to develop appropriate measures to overcome the social bias, which resulted in low women involvement in SETI. Specifically, the PNA, either through direct funding or through incentives to the other players in SETI development, shall actively seek to recruit women researchers in SETI, and shall strive to develop a special fund aimed at promoting women scientists and training women leaders in science. Finally, the curriculum, especially in math and science, should be revisited to ensure gender neutrality, and to stress the contributions of women in SET, to overcome the bias created by the negative stereotyping of women.

7.1.2 TVET

In addition to scientific and literary education, the PCBS report indicated an enrolment rate of 51 percent women in TVET. However, careful analysis revealed that this relatively high percentage is due to high enrolment in courses related to the service sector, such as nursing, and secretarial specialization, while women enrollment in agriculture, paramedical courses, engineering, and computer remained relatively low. Among these, women were especially marginalized in the engineering sector.

To ensure women's equitable participation in all TVET fields, it is essential to advance a policy of counseling and career guidance that is free of gender bias, which is open to both men and women. In addition, the PNA shall, either through direct funding or through incentives encourage the enrollment of women in SET based TVET.

7.1.3 Higher Education

At the higher education level, female enrolment in SET fluctuates between the different fields. Women constitute 86 percent in the paramedical courses, 58 percent in pharmacy, 45 percent in both sciences and medicine, 34 percent in nursing, 26 percent in engineering, and 25 percent in computer sciences. One reason for the relatively high percentages of women enrollment in certain subjects can be attributed to the fact that Palestinian male students tend to study these subjects abroad, thus, increasing the risk factor of draining the national brains.

7.2 Women in the workforce

The challenges discussed under education influence the participation of women in the workforce, where women are concentrated in, and occupy, low ranks in service oriented jobs including governmental, non-governmental, and private sectors. They are often excluded from management and decision-making positions in SET and other related institutions. Further, women's contribution in the private sector is limited to few small and micro businesses. They are almost excluded from management and ownership of Palestinian industry and firms. The "glass ceiling" phenomenon in SET is obvious at universities, research centers, associations, and the industry. While there are no legislations, which prevent women from occupying top level positions, there are no legislations to support women in overcoming these socio-culturally induced obstacles, which prevented them, in the first place, from moving into such positions.

7.2.1 Women Scientists and University Educators

Women scientists have proven themselves to be of equal caliber to that of men, and indeed to supersede their male counterparts. In Palestine, women scientists, as opposed to men, are less likely to study abroad, and are more likely to stay in the country, and as such contribute to SETI development.

With regard to faculty positions in Palestinian institutions of higher education, women are underrepresented. PCBS report on educational statistics, Educational Statistic Yearbook #3 for the school year 1996/1997, reported that women represented 14 percent of MA/MS and 5.8 percent of Ph.D. degree holders of faculty members. The statistics also show that in SETI related fields only 2 percent of the faculty were women Ph.D. holder. Further, an inverse relationship with academic ranks (assistant, associate, and full professors) is evident. The absence of women is also noted at the decision-making levels (chairpersons, deans, vice-presidents, and presidents), and there are no women as directors of research units, scientific councils, scientific journals, editorial boards, etc. As such, the number of publications contributed by women in SET is affected.

To counter these imbalances in the representation of women in the workforce, in general, and as they relate to SET, in particular, the South African experience during the transformation in using affirmative action to secure jobs at middle and top managerial levels for a period of ten years, may be of relevance.

In line with the PNA policies relevant to the educational system and women, national strategies should be developed to foster the involvement of women in middle and top management positions related to SET. The PNA shall encourage the development of women professional associations to monitor the progress and promotion of women in SET related employment.

Further, the PNA shall strive to provide incentives for the promotion of women in SET related jobs, and in some cases, the PNA shall consider affirmative action as viable a resort. Beyond such policies, the PNA shall strive, and within the context of the development of a social safety net, to meet the needs of families with regards to provisions for employer provided daycare services, provisions for maternity and family leaves, flexible working hours, and provisions for continuous education aimed at continuously upgrading the skills to meet the needs of the market. These policies, which are intended to support women in the work force in general, and in SET in particular, shall be developed with adequate provisions to protect employers, by using appropriate incentives to defray the costs associated with their implementation.

Finally, while women have equal pay rate in education and government institutions, evidence suggests that women are at a disadvantage in the private sector. To overcome such an unfair practice, labor and women unions and organizations should identify such practices and where appropriate participate in rectifying the situation, wether through direct contact with employer, judicial actions, or through lobbying for appropriate legislative remedies.

7.3 Women in Society

Women in Palestine suffer from socio-cultural gender stereotyping related to their mental, physical, and cognitive abilities and potentials. Many stereotypes have familial and cultural basis, which hinders women's access and involvement in different functions and roles, including those related to SET, which are seen as "a man's world."

Cultural factors including early marriage, gender stereotyping in economic roles, child bearing, the physical access to, and the equitable distribution of, schools offering the scientific stream to females, parental preferences, the misperception of suitability of SET career for girls, and the perceived necessary level of education for men and women to perform their duties are all obstacles in females involvement in SET.

Understanding these stereotypes, the extent of their entrenchment in the culture and the society, and devising approaches to mitigate and overcome them is an essential role, which should be entrusted to social scientists. To this end, research in such areas should be encouraged, and the government shall strive to provide adequate support to conduct the necessary research.

Chapter 8
Terms of Engagement in Regional and Global Context

8.1 New quality of international co-operation in SETI

Nowadays, in the era of knowledge-based societies, a genuine development policy requires a clear policy and framework for international scientific and technological cooperation. A knowledge-driven approach to development also recognizes that no country can achieve significant progress by relying only on its own stock of intellectual capital and technology applications.

Science and technology, and in particular knowledge, have become the main driving forces of economic growth, social development and job creation, and the primary source of competitiveness in the world market. Palestine as a country will only be represented on the world arena in fields of scientific and technological cooperation by means of coordinated actions and initiatives on a national level and harnessing sizeable funds. Institutionalizing research activities, promoting inner-institutional as well as cross-institutional teamwork, interdisciplinary cooperation in research and inter-sectoral mobility, e.g. between business and academia and vice versa, are precondition for, as well as, part and result of international cooperation in science, technology, and innovation.

8.2 Development of Palestinian participation in international cooperation in SETI

It is worth noting that, for the most part, and prior to 1993, the only chance for Palestinians to have access to higher education and research was to go abroad, due to the Israeli occupation. Even though a number of Palestinian academicians individually became involved in international research, there was no chance for the Palestinian community to be partner in any international agreement or convention etc. Only after the Oslo Agreement (1993), Palestine was invited to some extent to be represented in a number of the international forums dealing with research issues (like the Monitoring Committee for Science and Technology that was established following the Barcelona Conference for Euro-Mediterranean Partnership in 1995).

From that time on, different international research funding institutions encouraged the participation of Palestinian researchers in joint research projects, leading to a number of activities aimed at supporting "regional co-operation." These activities started without a national structure or network and with no strategy for development on the Palestinian side. To a large extent, these projects were politically motivated by the foreign funding agencies and reflected the imbalance of conditions and possibilities for research between the partners (in particular between Israelis and Palestinians). The Israeli policy of closures, restriction on movements including scientists to participate in international conferences, workshops etc. reflected the real character of occupational policy, meaning limited sovereignty, as well as, human rights of Palestinian researchers. These developments underline the urgency of a clear decision of the Palestinian government in addressing conditional barriers to international research cooperation.

Today, Palestinian institutions are official partners in different international and regional organizations and have several bilateral relations with regard to research cooperation.

On the regional level, Palestine is represented within and receiving support from: ALECSO (Arab League for Education, Culture and Science Organizations), ISESCO (Islamic Society for Education, Science and Cultural Organizations), ESCWA (Economic and Social Commission for Western Asia of the UN), Union of Arab Universities, etc.

Internationally, mainly the following countries and international organizations supported research projects or signed co-operation agreements with Palestinian institutions:

UNESCO, UNDP, European Union, USA, Belgium, France, Germany, Great Britain, Netherlands, Republic of South Africa, Poland, Norway, Italy, and Switzerland.

8.3 Access to international knowledge and technology

One of the main tasks of the Palestinian stakeholders of international co-operation in SETI (see chapter 2) will be to enable Palestinian researchers and companies to access the knowledge and technology produced outside Palestine as well as the experimental fields needed for Palestinian research.

Palestinian decision-makers need to focus on gathering and disseminating information about international agreements and conventions, the structure, objectives and capacities, policies and practices of international and regional research, and funding institutions, networks, databases, etc. This information needs to be examined, benchmarked and evaluated. Concurrently those scientific and technological sectors that are meeting priority needs for sustainable development in Palestine have to be identified and the character and forms of partnerships, which are advisable in the interest of Palestine, have to be defined. Based on this information, mutual priorities for future co-operation are to be fixed to prepare the negotiating platforms of the Palestinian government in bilateral as well as multilateral governmental consultations through technical committees.

The formation of strong international linkages with strategic partners, e.g. with equivalent institutions and networks that are at the leading edge of their field, will have to direct international activities. These partnerships are to attract international expertise and investment into Palestinian priority fields, to assure access to internationally available equipment as well as to find possibilities through joint projects that will develop the domestic capacities through offering scientific services to foreign partners.

To this end, bilateral and multinational agreements should be revised with the aim of focusing on Palestinian priorities. The mandates, responsibilities, and management procedures of Palestinian stakeholders in the field of international co-operation have to be defined clearly at ministerial as well as at institutional levels.

Therefore, to meet the needs of international relations in science and technology cooperation it is essential that Palestine clearly defines its SETI policies and set national

priorities clearly delineating the roles of the different SETI stakeholders in achieving these priorities, as prerequisites for successful international cooperation at all levels.

Further, to adequately engage international partners, and to effectively and optimally respond to new developments in SETI, Palestine needs to develop mechanisms and designate centers, including Centers-of-Excellence, as the focal points for gathering, evaluating and disseminating of the new developments in SETI.

8.4 Integration of research and development aid with special emphasis on HRD

Internationally, there is a clear trend towards integrating research with development aid and modeling complementary synergistic schemes between research and foreign policies. For Palestine, it is imperative to combine such an integrated approach with a systematic policy for capacity building, in particular for HRD (see also chapter 5). Activating and increasing the knowledge capacity of the society will be crucial to facilitate its participation in the process of transition from resource based to knowledge based economies. International co-operation in science, technology and innovation is indispensable for Palestine in this context in different directions:

- To absorb knowledge from around the world for the development of a sound science and technology base and domestic innovative capacity,
- To assimilate the know-how through learning by doing and learning by research (including management skills),
- To enable Palestinians to produce innovative products (material or immaterial) for the international market, meeting international standards and, thus, ensuring sustainable development.

As such, the integration of aid and SETI needs to be addressed at governmental and institutional levels. The responsibility for coordinating such activities on the national level shall be entrusted to the HCST in addition to a representative from MOP, which is mandated with aid coordination on behalf of the PNA, and a representative from the MONE, which is mandated with development of the private sector.

Mobility of researchers and access to **training** facilities for senior and especially young scientists are fundamental. They have to be developed systematically and as integrative parts of development as well as research programs and projects. Consequently integrating research with development aid will have to guarantee that the enlisting of scientific and technological resources in regional and international initiatives will respond to significant problems of concern to the community, such as environmental safety, food safety, health or major diseases.

Therefore capacity building should address HRD, in particular scientific fields and in management skills. To meet this challenge, it is essential that the National Development Plan, which defines the national priorities, and which is the vehicle used to solicit donor funding, should reflect the requirements for private sector growth based on the needs for SETI development.

Further, and as Centers-of-Excellence are being planned, a Palestinian fellowship system should be developed to build the capacity required for these centers, which shall eventually bear the responsibility for the system, in cooperation with the MOEHE.

8.5 Internal preconditions for efficient participation in international SETI co-operation

Governing international co-operation in SETI includes the political, administrative and executive levels. Several internal factors will be decisive for the efficiency and effects of Palestinian participation and representation in the international research and market competition. To catch up with more advanced countries requires a more robust framework than that of simply acquiring technology and learning from others. To assure a long-term technological performance with high standards, a sound science base and domestic innovative capacity are indispensable. Training, networking management, and investment have to be directed towards meeting the challenge of moving from imitation to innovation. Absorbing S&T from around the world and upgrading the indigenous technology base have to be complemented by stimulating the growth of localized **innovative clusters or competence centers.** The innovation process stems from interactions within networks of firms and knowledge based organizations. This general shift is fuelled by advances in information technologies, towards more business interactions. Networking with, and between, innovative clusters (combining interdependent firms, knowledge producing institutions, such as universities and research institutions, bridging institutions, e.g. providers of technical or consultancy services, and costumers), also reflects the increasing **interdisciplinary** that is at the core of today's technical change. Nowadays, the necessary knowledge and expertise for innovative products are rarely found within one company or country. Manufacturing firms are increasingly interacting with knowledge intensive services, which might become a competitive advantage for the Palestinian society.

Policies for SETI should, therefore, focus on the ability of the relevant enterprises and institutions to interact by:

- Securing appropriate framework conditions (development of HRD in S&T, financing innovation),
- Building an innovative culture (reduce asymmetry in information, diffuse best practices in innovative management, and promote the creation of innovative firms),
- Enhancing technology diffusion (improve linkages between SMEs and public research),
- Promoting networking and clustering (ensure a better match between S&T infrastructure and industry needs),
- Leveraging research and development (increase economic return from public research),
- Strengthening international co-operation (increase the country's attractiveness as a location for knowledge based activities),

- Improving policy making (enhancing policy coordination and improve policy evaluation).

Finally, the development of NSI is a prerequisite for equal partnership in international cooperation. Institutions, such as Centers-of-Excellence and technology incubators shall be the bridge linking scientific institutions and businesses, and shall have the mandate to act internationally for purposes of gathering, evaluating and disseminating information regarding latest SETI developments, in addition to promoting and marketing new ideas and products, where applicable.

Glossary

CHE: Council for Higher Education
DSETI: Directorate of Science, Engineering, Technology and Innovation
GDP: Gross Domestic Product
GNP: Gross National Products
HE: Higher Education
HRD: Human Resource Development
ICT: Information and Communication Technology
ISP: Internet Service Providers
IPR: Intellectual Property Rights
IT: Information Technology
MOE: Ministry of Education
MOHE: Ministry of Higher Education
MOHER: Ministry of Higher Education and Scientific Research
MOEHE: Ministry of Education and Higher Education
MOF: Ministry of Finance
MOL: Ministry of Labor
MOP: Ministry of Planning
MOPIC: Ministry of Planning and International Cooperation
MONE: Ministry of National Economy
NGO: Non-Governmental Organization
NSI: National System of Innovation
OPT: Occupied Palestinian Territory
PALESTA: Palestinian Expatriates Program
PalTel: Palestinian Telecommunication Company
PAST: Palestine Academy for Science & Technology
PCBS: Palestinian Central Bureau of Statistics
PDP: Palestinian Development Plan
HCST: Higher Council of Science and Technology
PITA: Palestinian Information Technology Association
PLC: Palestinian Legislative Council
PLO: Palestine Liberation Organization
PNA: Palestinian National Authority
PWA: Palestinian Water Authority
R&D: Research and Development
SCADA: Supervisory Control and Data Acquisition
S&T: Science and Technology
SET: Science, Engineering, and Technology
SETI: Science, engineering, technology and innovation
STPU: Science and Technology Planning Unit
UNDP: United Nations Development Program
TVET: Technical Vocational Education and Training