

**Türkiye Bilimsel ve Teknik Araştırma Kurumu
Scientific and Technical Research Council of Turkey**

Science and Technology Policy of Turkey
a brief review in respect of the agricultural sector

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**AERI
Agricultural Economics Research Institute
Conference on Science and Research Policy in Turkish Agriculture
December 21-22, 1998**

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Summary

In this paper, I will explain the general framework of the Turkey’s Science and Technology Policy. I, in particular, will deal with the concepts of ‘innovation’ and the ‘national system of innovation’ because *‘setting up the national system of innovation with all necessary building blocks and to improve the existing ones’* is the focal point of this policy. In this respect, I will try to point out the main approach at the designing of this policy in the matter of gaining innovation ability and national system of innovation. I dealt with the same subject a very short time before, at the NATO-Advanced Research Workshop held in Sofia, Bulgaria on October 28-31, 1998, but now, I will also try to put forward whether Turkey’s Science and Technology Policy involves any suggestions, especially for developing the agricultural production in Turkey, and to explain this policy in terms of agriculture.

Overview of the Current Age:

Towards an Information Society...

We are witnessing today a historical process that is considered by some, in respect of its social, political, and economical effects, as a new revolution equivalent to the British Industrial Revolution. Some calls it a transition period to a new age, namely, age of information, thereby, to the post-industrial society -the information society. This new age has been characterized by the radical changes in technology basis of the production and labour process. Information technology based on improvements in microelectronics, computer and telecommunication technologies is playing a determinant role in these changes.

Information technology has been accompanied by its offspring-technologies such as flexible production and flexible automation technologies, and by the other new, pervasive generic technologies such as advanced material technologies, and **new biotechnology based on comprehensive developments in molecular biology, genetics and biochemistry**. And, it is expected that **new biotechnology**, particularly, **genetic engineering**, is likely to play a key role in the **21st Century**, that is comparable to the role of information technology of today.

Radical changes in the technology basis of labour process (it can be red as ‘**Fordist** labour process’) are leading to radical changes in the pattern of mass production, which is the dominant perception of production system in market economies. The changes in the Fordist labour process are so comprehensive it has been argued that the Fordist labour process, and, thereby, the production system based on it, are evolving into new ones ¹.

In addition to the changes in technology basis of the production and labour process, the technology content of this process and the products is increasing gradually. Technology has become a productive power substituting muscular power completely and brain power to some extent. It is also changing the nature of all production forces including raw materials and means of production. Therefore, its relative importance among the forces of production is increasing gradually.

All these remarks are valid for agricultural production system, too. Advances in science and technology are also creating radical changes in agricultural production techniques and the pattern of agricultural production itself, indeed. These radical changes, as it is known, commenced with the mechanisation -especially, with the introduction of tractors- at the beginning of this century. And, after the Second World War, the introduction of some other modern inputs such as chemical fertilizers, herbicides and pesticides accelerated the changes in the pattern of agricultural production. Utilisation of these modern inputs including tractors and other farming machinery and equipment has enabled farmers to use land extensively for mass production of the standard products but also to raise the productivity by saving labour and increasing the yield per acre ² on the basis of

¹ In Piore and Sabel’s terms (1984), ‘**mass production**’ is evolving into a new production system, namely, ‘**flexible specialization**’. According to Kaplinsky (1989), we are witnessing the transition to a new era, namely, the era of ‘**systemofacture**’ and, thereby, to a new labour process: ‘**systemofacturing labour process**’. In Freeman’s terms (1989), “*The effects of information technology are so universal, affecting every single sector of the economy, that they may be legitimately described as a change of ‘techno-economic paradigm’ providing scope everywhere for renewal of productivity increases through a combination of organizational, social and technical innovations and for a broad range of new and improved products and services.*” And, as a consequence of this change, some radical “*changes in organization and structure of both firms and industries, which accompany the introduction of information and telecommunication technologies*”.

² In the United States “*agricultural output has increased by 75 percent since 1970 with no increase in the number of*

capital-intensive techniques. In other words, after the Second World War, Fordist norms dominating industrial labour process became ideal norms or dominant perception in agricultural labour process, as well.

Now, we are witnessing that the post-Fordist norms, which have started to dominate industrial production system, have also introduced into agricultural production system as ideal norms, or a vision at least. As Dr. Gözen said (1997):

“The ‘post-Fordist’ system emerges in agriculture as an alternative system parallel to the constraints in land using, the demand heterogeneity in consumption and the developments in the phytosanitary and seed industries in the developed countries. Currently, the basic rationale of the system is still mass production but the techniques are becoming more flexible... While the emerging biotechnology is currently used as a solution to some of the problems created by the ‘Fordist’ system, the potential of biotechnology in producing healthy and heterogeneous products in accordance with the societal preferences are welcoming a post-Fordist system in agriculture.”

Revolutionary transformation in the agricultural production system is not merely depending on the new biotechnology, namely, the genetic engineering but also on the advances in informatics.

An OTA Report (1995), in respect of the “*changing environment for agricultural research*”, points out that: “*New biotechnology and **information technology in particular** [underlined by us] are yielding powerful research tools that can be applied to questions in a wide range of scientific disciplines.*”

National Environmental Technology Strategy Document of the USA (NSTC, 1997), under the motto of “**Bridge to a Sustainable Future**”, puts the matter explicitly:

*“...Farmers will belong to a broadly diversified agricultural business community. From 1995 to 2020 they will have shifted from single crop commodity production to speciality crop and integrated farming systems. **The electronic age farmer will have increased the use of information systems** [underlined by us] to guide crop selections and production decisions. **Computerized farm equipment using global positioning systems and remote sensing** [underlined by us] will facilitate precision farming with a greater reliance on environmentally benign fertilizers and pest control methods. In general, farm equipment will be less polluting, crops will be adapted to a wider range of climactic conditions, and farmers will produce a wider variety of food, fiber, energy, and crops for industrial use while using soils, water, and fertilizers efficiently.”*

In context of those technological changes, it is obvious that the countries having superiority in technology and science are progressing towards an absolute domination in industry, in agriculture and all other economical activities. In short, technology has become the only key to the international competitive advantage. Thereby, superiority in science and technology is the determinant factor in increasing the welfare of society and improving the standard of living.

“Globalisation”

Another process that we are witnessing today is “globalisation”. The most remarkable milestone of this process is the **Final Act of the Uruguay Round**³ aiming at liberalization of the trade all over

acres under cultivation.” (NSTC, 1997)

³ The Final Act covers

- Agreement Establishing the World Trade Organization

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the world: *“The Final Act Embodying the Results of the Uruguay Round of Multilateral Trade Negotiations is 550 pages long and contains legal texts which spell out the results of the negotiations since the Round was launched in Punta del Este, Uruguay, in September 1986. The Uruguay Round was a global negotiation with a global result. (GATT, 1994)”*

In respect of the science and technology policies, the most important agreements covered by the Final Act are **the Agreement on Trade-Related Aspects of Intellectual Property Rights** and **the Agreement on Subsidies and Countervailing Measures**. The former brings about an international law system that protects intellectual property rights globally. The latter settles for which economical activities a government shall grant subsidy, or under what conditions and to what extent subsidies may be granted. It covers the subsidies (‘assistance’) for research activities conducted by firms or by higher education or research establishments on a contract basis with firms, and also contains the **countervailing measures** applicable globally for the states that do not follow the rules. In respect of agricultural activities, it should be noticed that The Final Act includes an **Agreement on Agriculture** *“providing a framework for the long-term reform of agriculture trade and domestic policies and including the concessions and commitments that Members are to undertake on market access⁴, domestic support and export subsidies⁵ (GATT, 1994).”* (The Final Act also includes an “Agreement on Sanitary and Phytosanitary Measures”.)

In a world where the conventional protectionism has been broken up, the determinant factor in international competition will be the ability of *“the transformation of an idea into a marketable product or service, a new or improved manufacturing or distribution process, or a new method of social service”*, namely, **the ability of innovation** (EC, 1995). This ability, in last analysis, depends on the ability of nations in science and technology.

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- General Agreement on Tariffs and Trade
 - Agreement on Agriculture
 - Agreement on Sanitary and Phytosanitary Measures
 - The Decision on Measures Concerning the Possible Negative Effects of the Reform Programme on Least-Developed and Net Food-Importing Developing Countries
 - Agreement on Textiles and Clothing
 - Agreement on Technical Barriers to Trade
 - Agreement on Trade-Related Investment Measures
 - Agreement on Anti-Dumping
 - Agreement on Customs Valuation
 - Agreement on Preshipment Inspection
 - Agreement on Rules of Origin
 - Agreement on Import Licensing Procedures
 - Agreement on Subsidies and Countervailing Measures
 - Agreement on Safeguards
 - General Agreement on Trade in Services
 - Agreement on Trade-Related Aspects of Intellectual Property Rights, Including Trade in Counterfeit Goods
 - Understanding on Rules and Procedures Governing the Settlement of Disputes
 - Decision on Achieving Greater Coherence in Global Economic Policy-making
 - Trade Policy Review Mechanism
 - New Agreement on Government Procurement

The Agreement, signed in April 15, 1994 by the parties of Uruguay Round of Multilateral Trade Negotiations, was approved by the Grand National Assembly of Turkey in January 26, 1995 by the Law: no 4067.

⁴ In the area of market access non-tariff border measures are replaced by tariffs that provide substantially the same level of protection. Tariffs resulting from this “tariffication” process, as well as other tariffs on agricultural products, are to be reduced by an average 36 percent in the case of developed countries and 24 percent in the case of developing countries, with minimum reductions for each tariff line being required. Reductions are to be undertaken over six years in the case of developed countries and over ten years in the case of developing countries (GATT, 1994).

⁵ For example, Members are required to reduce the value of mainly direct export subsidies to a level 36 percent below the 1986-90 base period level over the six-year implementation period, and the quantity of subsidized exports by 21 percent over the same period. In the case of developing countries, the reductions are two-thirds those of developed countries over a ten-year period (GATT, 1994).

Another Global Process Progressing Concurrently with “Globalisation”: Regional Polarization

While the “globalisation” process is progressing, it seems that a political process based on **national motives** is gaining ground all over the world. Moreover, the nations perceiving that they could not be competitive one by one in world market place are tending to form regional blocks. (The European Community’s R&D policy is a remarkable example for this approach.⁶)

It seems that when the blocks accomplish the political and legal infrastructure of organizing their in-block single markets, countries those are not involved in any block and, furthermore, have not any competence in science and technology will hardly have a chance to survive.

Only Strategic Choice for Turkey in Context of Global Processes: Gaining Ability in Science and Technology

In regard to the global processes talked about, it can be said that, science and technology have become the key factors in competitive advantage of nations as well as in competition among the firms. Thereby, the countries having superiority in science and technology are progressing towards dominating the information age and the future world, too.

The countries, such as Turkey, do not have any active role in those processes that carry the seeds of 21st Century, but they are directly affected by the consequences of them and they, inevitably, will continue to be influenced deeply. Turkey, in respect of those global processes, has to cope with many problems. Among them, the most vital one is to catch up with technological changes of the age. However, Turkey’s challenge has two fronts in this respect. Turkey, which inherited the Ottoman Empire that had missed the evolutionary process towards an industrial society after the British Industrial Revolution, has not surpassed the industrialization threshold yet. Now, while the industrial societies are evolving into information societies, it has to face the problem of keeping up with technological changes leading the new age as well as the problem of overcoming that historical gap. **The performance of Turkey in solving these two problems simultaneously will determine her future.**

To cope with these two formidable problems at the same time necessitates gaining ability in science and technology. **Improving the scientific and technological ability of Turkey and creating a country that dominates science and technology is the only strategic choice. The policy that would lead to realization of that strategic choice is the National Science and Technology Policy of Turkey.**

Concept of Innovation Ability...

Gaining ability in science and technology does not only mean acquiring excellence in scientific and technological research. It also covers gaining ability ‘**to transform the scientific and technological findings into economical and social benefit**’. A nation can gain an advantage over others in the world market place if only she has such ability.

⁶ For this policy see: “Common Position (EC) Adopted by the Council on 12 February with a View to Adopting Decision of the European Parliament and of the Council Concerning the Fifth Framework Programme of the European Community for Research, Technological Development and Demonstration Activities (1998-2002); Annex I” (<http://www.cordis.lu/uk/en/src/c-decis1.htm#decision>)

In the design of Turkey's Science and Technology Policy, the ability '**to transform the scientific and technological findings into economical and social benefit**' has been taken as the **innovation ability**. To be prim and precise, it can be said that the definition of '**innovation**' concept proposed by OECD has been modified to some extent.

According to the definition proposed by OECD (1992; 1993), innovation, as a process, involves *"the transformation of an idea into a marketable product or service, a new or improved manufacturing or distribution process, or a new method of social service."*

In the definition, the emphasis is on the '**marketability**'. The created innovation can be incremental or radical, but it has to be marketable.

Another remarkable point in the definition is that there has not been any implication on the '**idea**'. The idea, as long as a marketable result is obtained, can be related to conventional technologies as well as be related to advanced or high technologies. It can never even be related to technology. Nevertheless, in our era, scientific and technological contents of almost all products, methods, or services, which will probably be the subject for an innovation process, have increased considerably and, it seems that, are increasing continuously on the basis of generic technologies such as information technology, advanced material technologies and new biotechnology. Many evidences of this fact can be found in all the fields of economic activity but the most striking ones can be seen in agricultural sector (for some remarkable examples from agricultural sector of Israel see Box I). Under these circumstances, innovation process itself is increasingly becoming more linked to technology and, of course, to science as the source of modern technology.⁷

In other words, the new ideas and new findings in science and technology have become the main source of innovation. So, the innovators/entrepreneurs are to understand, adopt and use the new technologies, sooner or later. On that account, we can say that, in the final analysis, **innovation, as a concept, denotes the transformation of science and technology into an economic or social benefit 'just in time' for the market and the needs of society** (Göker, A. 1998a,b). In this context, gaining ability in technological innovation is crucial. This is the challenge for all the producers including farmers, and for the nation in our era. Turkey has to accept this challenge and the National Science and Technology Policy has been devised for it.

⁷ A recently issued OECD Report has cited (OECD, 1998): *"The innovation process is drawing more and more on advances in knowledge by the science base, although there is no linear relationship between the two. Analysis in the United States shows a threefold increase in publication citations in patents delivered over the period 1987-94, an indication of stronger links between science and innovation."*

Box I

Technology-intensive Innovation in Agricultural Sector... Some Examples from Israel (*)

The agricultural sector is based almost entirely on R&D implemented by cooperation between farmers and researchers.

Israel's dairy cows are, on average, the world champions in milk production, having increased the average yield per cow from 6,300 liters in 1970 to 10,000 liters today **through scientific breeding and genetic testing** carried out by the Volcani Institute. By harvesting sperm and ova from cattle of superior bloodlines, Israel is able to upgrade its own herd as well as share its advances in their field with other countries.

Israeli agriculturists have pioneered agricultural biotechnology, trickle-drip irrigation, soil solarization and the sustained use of industrial wastewater for agriculture. These advances have been applied to marketable products, ranging from **genetically engineered seeds and biopesticides** to light-degradable plastics and **computerized irrigation/fertilization systems**.

Making optimal use of scarce water, harsh land and a limited labour force has led to revolutions in agricultural methods. The search for water-saving techniques spurred **the development of many types of computer-controlled irrigation systems**, including the drip method, which directs water flow straight to the root zone of plants. **As the result of intensive research**, the huge underground reservoir of brackish water under the western Negev is now being successfully exploited to produce crops such as prime quality tomatoes for European and American winter markets. **Research relating to the electromagnetic treatment of water to improve animal health and crop yields** is also producing promising results.

Israeli-designed and manufactured **computers are widely used to coordinate the intricate activities of daily farming** such as guiding fertilizer injection while monitoring all environmental factors; supplying feed for livestock mixer according to tested, least-cost, best-yield proportions; and providing a temperature and humidity controlled environment for poultry. In addition, a variety of [computer-controlled] equipment designed for tilling, sowing, planting, harvesting, collecting, sorting and packing has been developed, manufactured and implemented.

Agriculture has also benefited from a broad range of general scientific research and R&D developments, including automated plant tissue culture, biological insecticides, disease-resistant strains and biological fertilization.

(*) Israel Ministry of Foreign Affairs, 1998, "Science and Technology: Agricultural R&D, <http://www.israel-mfa.gov.il/facts/sci/fsci5.html>

General Framework of the Turkey's Science and Technology Policy

The Supreme Council for Science and Technology (SCST) (see the Box II) approved the "Turkish Science and Technology Policy: 1993-2003" (TÜBİTAK, 1993), at its meeting of 3rd February of 1993. This is the basic document of Turkey's current Science and Technology Policy. The policy expressed in this document was elaborated and based upon a solid ground with "**The Project of Impetus for Science and Technology**" (TÜBİTAK, 1996) within the scope of Structural Transformation Projects involved by the **Seventh Five-Year Development Plan** (1996-2000).

Box II

Policy-Making Body in Science and Technology in Turkey

The Supreme Council for Science and Technology (SCST), authorised by the law as the highest policy-making body, has a key role in Turkish Science and Technology System. It was established in 1983.

The SCST is chaired by the Prime Minister and comprised of the Ministers of Defence, Finance, Education, Health, **Forestry, Agriculture and Rural Affairs**, Industry and Trade; the President of the Higher Education Council; the Under-secretaries of the State Planning Organisation, Treasury, and Foreign Trade; the President of the Scientific and Technical Research Council of Turkey (TUBITAK) and one of his deputies; the President of the Nuclear Energy Council of Turkey; the General Director of the Broadcasting Corporation of Turkey; and the President of the Union of Chambers of Commerce and Industry of Turkey.

TUBITAK acts as the general secretariat to SCST. Preparatory studies on the issues taking place on the SCST's agenda, following up the implementation and evaluating the impacts of the SCST's decisions are conducted by TUBITAK.

TUBITAK was established in 1963. Its range of activities covers physical, engineering, medical and agricultural sciences and technologies.

TUBITAK, as a body authorised by the law:

- ◆ Provides financial support and acts as a fund management agency for R&D activities performed by the universities and the industrial enterprises;
- ◆ Performs basic and applied research, and experimental development in its affiliated research centres and institutes;
- ◆ Provides scientific and technological support through its facilities such as National Academic Network and Information Centre, National Observatory, Wind Tunnel and Metrology Labs.
- ◆ Supports promising science and engineering students, on the undergraduate and post-graduate levels, and researchers through fellowships and awards on TUBITAK grants;
- ◆ Provides information services in the fields of science and technology;
- ◆ Conducts and supports scientific and popular-scientific publication;
- ◆ Collaborates with foreign and national institutes and organisations in the fields within its range of activities;
- ◆ Acts as policy-making and advisory body to government in the fields of science and technology, and research; and
- ◆ Acts as general secretariat to the Supreme Council for Science and Technology.

Turkish Science and Technology Policy: 1993- 2003

At its meeting of 3rd February of 1993, the SCST, emphasising the determinant role of S&T in respect of

- ◆ surviving the vividness of national economy,
- ◆ sustaining economic growth,
- ◆ upgrading the living standards, and
- ◆ international competitive advantage,

approved the National Science and Technology Policy for the next ten years.

Within the framework of this policy, in order to attain the economic and social goals of the nation, it has been suggested some measures to be taken in the fields of S&T.

These measures have been generally associated with the rational using of the resources and with the pursuing an integrated strategy for

- ◆ enhancing the intellectual capacity of the country,
- ◆ upgrading the R&D ability of the country in the new pervasive generic technologies,
- ◆ focusing this ability in the fields of economic priority,
- ◆ encouraging the activities aiming at the transforming the scientific and technological findings into economic and/or social benefit immediately,
- ◆ accelerating the diffusion of new generic technologies in all fields of economic activity.

In this context, the **SCST** has put forward some targets for the same period such as

- ◆ Increasing the number of R&D personnel to 15 per 10,000 labour force (7.5 in 1992);
- ◆ Increasing the GERD to 1% of the GDP (0.5% in 1992);
- ◆ Increasing the business enterprise's share of R&D expenditure to 30% of the GERD (24% in 1992);
- ◆ And raising the Turkey's rank (38 in 1992) in journals scanned by the Science Citation Index.

Taking into account Turkey's capabilities and the scientific and technological trends and forecasts, the following generic technologies, in general, have been accepted as priority areas of activity:

- ◆ Informatics,
- ◆ Advanced materials,
- ◆ Biotechnology, and
- ◆ [Aero]space technology.

The Project of Impetus for Science and Technology

Main suggestions within the framework of the **Turkish Science and Technology Policy: 1993-2003** have been elaborated by the **Project of Impetus for Science and Technology** within the scope of Structural Transformation Projects involved by **VIIth Five-Year Development Plan**, at the beginning of 1995.

This project has proposed seven specific fields of investment in order to create a concrete base for enhancing the S&T capability (it can also be read as **innovation** ability) of the country. These specific fields, converging the priority areas suggested by the **Turkish Science and Technology Policy: 1993-2003**, are

- Construction of the National Information Infrastructure needed for the 21st Century and related Telematic Services Networks;
- R&D in Flexible Manufacturing / Flexible Automation Technologies for learning these technologies by research, and for enabling the Turkish Manufacturing Industry to innovate its labour process;
- Upgrading the Existing Railway System on the base of High-Speed Train Technologies;
- Aviation Industry, and related R&D on the base of selected products;
- R&D in Genetic Engineering-New Biotechnology, and project based applications;

- R&D in Environmentally Sound Technologies, Energy Conserving and Efficient-Use Technologies, Environmentally Sound Energy Technologies; and related nation-wide applications;
- R&D in Advanced Materials; and related industries.

As it can be seen, some of these investments reflect a demand-pull strategy while the others reflect a technology-push strategy, and it can be said that there has been a certain approach of harmonisation in these suggestions.

The impetus for science and technology will not only serve industrial sectors' development but also all other fields of economic activity and social services as well as the development of agricultural sector in Turkey.

Amongst the seven specific fields of investment mentioned above, the first one and the fifth one at least, are also crucial for the agricultural sector in fact.

As the Cooperative State Research, Education and Extension Service (an affiliated organization of the United States Department of Agriculture) puts it (USDA, 1998): *“National Information Infrastructure, which is embodied by the cutting edge-information technologies and applications, is used to provide the critical community access to the research, education, and extension knowledge that empowers the citizens to be active participants in reshaping society and solving complex problems at the local level”*. The agricultural community of Turkey will have been provided with the same possibility after the construction of the National Information Infrastructure and the necessary networks proposed by the Project of Impetus.

As it is known that The Ministry of Agriculture and Rural Affairs have more than 50 research institutes scattered geographically all over the country. Similarly, there have been approximately 30 faculties of agricultural engineering and veterinary having a similar, scattered geographic allocation. A network linking them each other and giving them all access to other research institutes and faculties related to agricultural research⁸, and to agricultural and industrial producers⁹ will enable them to conduct cooperative research in spite of the geographic distances between them. This network will also provide them, wherever they are, access to national/international scientific and technological information resources, policy makers, consumers and the students. Thus, it will be possible to enhance the scientific and technological abilities of the agricultural research institutes and thereby their contribution to the Turkish economy.

In respect of genetic engineering or new biotechnology, it is obvious that gaining ability in this field is much more important for agricultural sector than for the other sectors. The possibilities created by new biotechnology will enable humanity to harness the forces of nature in agricultural production as in the industrial production, and to create new agricultural products designed by human kind. The nations dominating new biotechnology will dominate the agricultural production of the Future's World. For Turkey, as a country that has launched the **South Eastern Anatolian Project**, which is an agricultural restructuring mega project in a sense, gaining ability in new biotechnology is not only critical but vital.

⁸ For example, access to the faculties of medicine (*“agricultural research is as much about human health as it is about growing corn”* [USDA, 1998]).

⁹ *“Agricultural research is also as much about development of industrial products such as printing ink from soybeans and other crops as it is about development of high-yielding wheat varieties”* [USDA, 1998].

In addition to those investment suggestions, the Project of Impetus, in regard of the enhancing **S&T ability**, and, thereby, **the innovation ability** of the nation, includes some crucial measures pertaining to legal and institutional restructuring.

In this respect, it should be pointed out that the process of gaining ability in **innovation** is not a technical or linear process, and it cannot be limited to learning and absorbing the new technologies -i.e. technology transfer. It is much more complex than this. Gaining ability in innovation also involves many cultural, social, economical and political aspects and components, interactions amongst those components, and mechanisms for interaction; in shortly, it necessitates a specific system, namely, a **national system**¹⁰ of innovation, and, therefore, a systemic approach.

National System of Innovation: The Backbone of the Productive and Innovative Society

Science and Technology System and the Innovation System...

In this point, it should be noticed that the science and technology system and the innovation system are not identical. The innovation system, in a sense, is a product of the interaction between the science and technology system and the production system. And, as the innovation system develops, interaction between other two systems increases and the innovation ability of the nation rises. If the science and technology system, namely, Higher Education and the Research and [Experimental] Development System, has been isolated from production system, we cannot talk about the existence of any innovation system. In other words, innovation system necessitates the very existence of other two systems and the interaction between them.

Furthermore, we need some mechanisms -or some interfaces or transition zones- and intermediary agents for this interaction. University-industry corporate research centres, incubators, technoparks, technology centres, technology counsellors and consultants, information networks are the well-known examples of them. But the innovation system is still not so simple and has not completed yet. At these interaction zones, we will encounter the human problem; e.g. 'corporate research' is a matter of culture and we need training. Furthermore, creating the building blocks of the innovation system, such as 'corporate research centres' and 'incubators', and the activities conducted there, need financial support and, generally, public assistance, at least, at the beginning. This requirement list goes on to great extent.

Concept of National System of Innovation...

I think that it will be helpful to reach an understanding on 'concept of national system of innovation' because this subject was the focal point in design of the Turkey's Science and Technology policy.

Regarding the concrete circumstances of Turkey and the starting point, in this policy design, this concept¹¹ has been taken in a broader sense and deliberately descriptive manner as follows (TÜBİTAK, 1997):

¹⁰ In this point, in regard to the "globalisation" process, it can be asked whether there has been any need for a **national** system in fact. For this discussion see Göker (1998b).

¹¹ For further explanation or discussions on the 'concept of national system of innovation' see Lundvall (1992); Patel and Pavitt (1994); Freeman (1987; 1995). For a comparison between the definitions of this concept see Göker, A. (1998b).

“A system comprised of national institutions that have the following abilities:

- *Ability to acquire, diffuse, assimilate and utilize new technologies,*
- *Ability to improve existing products, and to design new ones,*
- *Ability to improve existing production processes, and to design new ones,*
- *Ability to design and produce the means of production or capital goods required by the improved or newly designed production processes,*
- *Ability to maintain technological R&D activity that feeds the mentioned improvement, design and production processes; and ability to conduct scientific research -i.e. basic research- that is the source of those technologies,*
- *Ability to improve existing organization methods [soft technologies] arranging the relations within and between research, development, design, production, and marketing compartments and reproducing those relations at a technologically higher level.”*

It is obvious that national system of innovation contains all of the institutions necessary for creating and maintenance of those abilities. In other words, **the system is comprised of not only**

- Enterprises conducting innovative activities or providing engineering, consulting and design services;
- Mechanisms for technology transfer (diffusion, assimilation and utilization);
- Universities conducting basic research, and the public research bodies conducting mission-oriented basic research;
- Professional research bodies such as laboratories of the enterprises conducting in-house research, and contract research centres, corporate research centres or corporate research consortia, generally, conducting industrial research and pre-competitive development activity;
- Education-training institutions;
- Quality assessment institutions on education and research;
- Technological facilities such as wind tunnels, simulators, accelerators, and so on.

But also includes

- Information networks, and centres providing special information services;
- Institutions related to standards and quality control; national metrology system; national notification-accreditation-certification system;
- Incubators, technology development centres, technoparks, science parks, advanced industry parks, allocated near by the universities or public research institutions, creating an **interactive and conducive environment** between research potential of universities or research institutions and creative-innovative entrepreneurs / enterprises based on advanced technologies;
- Demonstration centres for diffusion of tangible technologies;
- Technology counsellors and technology centres that will meet the technology requirements of enterprises and carry on the new scientific and/or technological findings to them in a **conceivable form** so that they can use these findings for improving their production or convert them into marketable products.
- Patent offices and the other institutions protecting intellectual property rights;
- Technological attachés;
- **Consulting bodies and firms** for consultative services on following special subjects:
 - Evaluating the feasibility of new business ideas and assessing the viability of new business opportunities;
 - Developing the business strategy/business plans;
 - Organizing the funding and access to financial resources;
 - Marketing, particularly, for the enterprises operating in international markets;
 - Patenting;
 - Technology auditing to help companies become more competitive in the market place and so enable them to achieve growth and develop their businesses;

- Operations auditing aiming at improving the operational performance of companies and inculcating them a permanent process of continuous improvement;
- Assistance in the implementation of a range of concepts such as ‘Just-in-Time’ and ‘Total Quality Management’;
- Software development, data processing, and/or software and information procurement;
- Innovation management, management and exploitation of R&D, and human resource development;
- Assistance in identifying, gathering and dissemination of information on global best practices, and in developing appropriate benchmarking practices.
- Financial institutions providing **seed capital funding** to highly skilled individuals or teams, and new businesses with relatively long development phase, often involving new technology;
- Incentive mechanisms for technological innovation investments;
- Grant mechanisms for scientific research conducted by universities and in-house R&D activities of enterprises;
- Assistance or grant mechanisms for setting up contract research companies or centres, cooperative research centres or consortia, and for encouraging enterprises to conduct corporate research and to participate in corporate research programs;
- Assistance or grant mechanisms for creating interactive and conducive environments such as incubators, technoparks, demonstration or exhibition centres, information centres and networks;
- Institutions or foundations sharing the risks of the enterprises, on the base of their technologically innovative and creative projects, through credits repayable provided that the resulting product is commercialised successfully;
- Financial institutions for provision of additional equity funding through the **venture capital funds**, which have the resources and management skills to make commercial investments in growth oriented enterprises.

All institutions or mechanisms mentioned above are the necessary components of national system of innovation, and the second group is, at least, as important as the first group in creating innovative capability in the country.

Furthermore, governments have significant responsibilities in designing national science and technology policies -and national innovation policies that go along with- and in policy implementation. In last analysis, national science and technology policies mean reorganization of national resources, especially public resources, according to the priorities determined by those policies. And this requires, in the process of designing those policies, a consensus among different interest groups. The role of government starts here.

Many diverse institutions, individuals and sectors participate in policy implementation. The success of this multi-actor play depends on orchestration, which is mainly on the government’s responsibility.

In this respect, it can be said that the government herself is a main component and has a key position in national system of innovation.

For a country, such as Turkey, that has not established all the necessary building blocks for a national system of innovation the role of government becomes very important in creating the suitable environment and climate, and the appropriate policy tools, for encouraging innovation.

In shortly, creating a national system of innovation and gaining ability in innovation is a matter of new arrangements related to scientific, technological, educational, financial, legal, administrative institutions and infrastructure. As a much more important point than this, it is a matter of restructuring the enterprise itself, furthermore, transforming the entrepreneur or the farmer himself

or herself. Science and technology policy should respond all these requirements in a systemic approach.

Focal Point of Turkey's Science and Technology Policy and the Actual Agenda for Policy Implementation

It has said above that gaining ability in science, technology and innovation **is the only strategic choice for Turkey**. And it has emphasized that gaining this ability does not only involve scientific or technological aspects, but also includes many cultural, social, economical and political aspects and components, interactions amongst those components, and mechanisms for interaction; in shortly, it necessitates a specific system, namely, a **national system of innovation**.

Thereby, **establishing the national system of innovation** with all basic components and restructuring of the existing ones is the focal point of the **Turkey's Science and Technology Policy** aiming at creating a Turkey that

- has enhanced her ability in science and technology, and
- has gained capability of transforming science and technology to economical and social benefit,
- has got the respectability among the countries that contribute to the World's science and technology, to that common inheritance of humanity.

At its meeting of 25th August of 1997, the Supreme Council for Science and Technology (SCST), taking into consideration this agile requirement, has come to some crucial decisions related to **establishing the national system of innovation**. These decisions has constituted the **Turkey's Agenda for the years 1997-1998**, that can also be called as an 'action plan', in Science and Technology Policy Implementation. At its meeting of 2nd June of 1998, the SCST made some additions and amendments to these decisions (see Box III for the main articles of the Agenda).

Box III

Turkey's Agenda for the Years 1997-1998

in Science and Technology Policy Implementation (*)

1. Devising a Master Plan for Establishing the National Information Infrastructure
2. Establishing The National Academic Network and Information Center
3. Legal, Administrative and Technical Arrangements for Spreading The Electronic Trade in Turkey
4. Issuing The Law of Technology Development Districts
5. New Legislative and Institutional Arrangements for the Management of Brainpower Resources:
 - Improving all Universities to a Level of Universal Quality on Higher Education and Scientific Research
 - Preparation of the Research Personnel Legislation
 - Training Academic Personnel; Encouraging Research; Improvement of Scholarship Systems for Doctorate and Post-Doctorate
6. Stimulating the Researches in the Fields of Social Sciences and Humanities
7. Issuing the Law of National Accreditation Council of Turkey
8. New Legislation for Restructuring the Public Research Institutes, including those affiliated with The Ministry of Agriculture and Rural Affairs, The Ministry of Forestry, and with The General Directorate of Rural Services.
9. Constituting National Research and Development Budget
10. New Arrangements Pertaining to the Decree of Government Assistance for R&D Activities Conducted by Industrial Enterprises
11. Measures for Spreading the Venture Capital Investment Partnerships
12. Technology and Innovation Support for the Small and Medium Sized Enterprises (SMEs)
13. Establishing University-Industry Cooperative Research Centers
14. Reviewing the Government Procurement Policy in Respect of Encouraging the Industrial Research in Turkey
15. Establishing the National Aerospace Council for Improving the Scientific and Technological Ability of the Country in this Field
16. Supplying the Required Funding Support for Turkish Partners to Participate in International Joint Research Projects and Developing Additional Mechanisms for This Purpose
17. Determination of the Regulatory Rules on the Studies of Biotechnology and Genetic Engineering
18. Determination of the National Policy on the Effective Use of Energy and Environment Friendly - Renewable Energy Technologies
19. Determination of the National Policy on the Environment Friendly Technologies
20. Determination of the National Policy on the Technologies of Marine Sciences; Technologies for Utilizing the Marine and Submarine Resources
21. Determination of the National Policy on Megascience
22. Innovation Policy Researches; Spreading the Techniques of Technology-, Innovation-, and Quality-Management; Assisting Innovation at Sectoral Level
23. Technology Development in Industrial Sector
24. Issuing a Decree on Supporting the Expenditures of Patent, Useful Model, and Industrial Design Registrations
25. Establishing the National Museum of Natural History, and Science and Technology Centers for popularising the science and technology issues

(*) Some of the articles of this Agenda have already been accomplished or will have been accomplished soon.

Conclusion

The societies built on Industrial Revolution are evolving into a new age, thereby, a new society, namely, the information society. The challenge of the societies of today is said to equal that of the societies witnessing the Industrial Revolution. The process of transition into this new age has been characterised by radical changes taking place at the technology basis of production and labour process, following the emergence of new pervasive-generic technologies led by the information technology. The social and cultural adaptation process led by the change of techno-economic paradigm is going on. The prospect of securing social and economic development therefore calls for new policies and strategies.

Other processes that we, in global scale, are witnessing today are “globalisation” and regional polarization. They are progressing concurrently with the revolutionary changes summarized above.

The particular challenge faced by Turkey is twofold:

- to cope with the unfinished process of industrialisation and industrial society restructuring, and
- to cope with the new process of evolving into information society.

Hence, any development strategy for Turkey has to respond to these formidable tasks in all.

The crucial point for Turkey is to gain ability in science and technology that have become the primary resource of economic growth and social prosperity. Gaining ability in science and technology does not only mean gaining ability in scientific and technological research. A nation can gain an advantage over others in the world market place if only she has the innovation ability, i.e. the ability to transform the scientific and technological findings into economical and social benefit just in time for the market and the social needs. Her place in new international division of labour will depend on this ability. An important response to this urgent need has been provided by devising a national science and technology policy.

In policy design, the national system of innovation has been assumed as a fulcrum for Turkey enabling her to gain ability in science, technology and innovation, and to evolve into the information society. This assumption clarifies why the establishment of the national system of innovation constitutes the focal point of the National Science and Technology Policy aiming at creating a Turkey that

- has enhanced her ability in science and technology, and
- has gained capability of transforming science and technology to economical and social benefit,
- has got the respectability among the countries that contribute to the World's science and technology, to that common inheritance of humanity.

It must be underlined that the key point of success is to handle the issue of **establishing the national system of innovation** with all its economical, political and social aspects as well as to handle it in systemic integrity, continuity, and decidedly. □

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