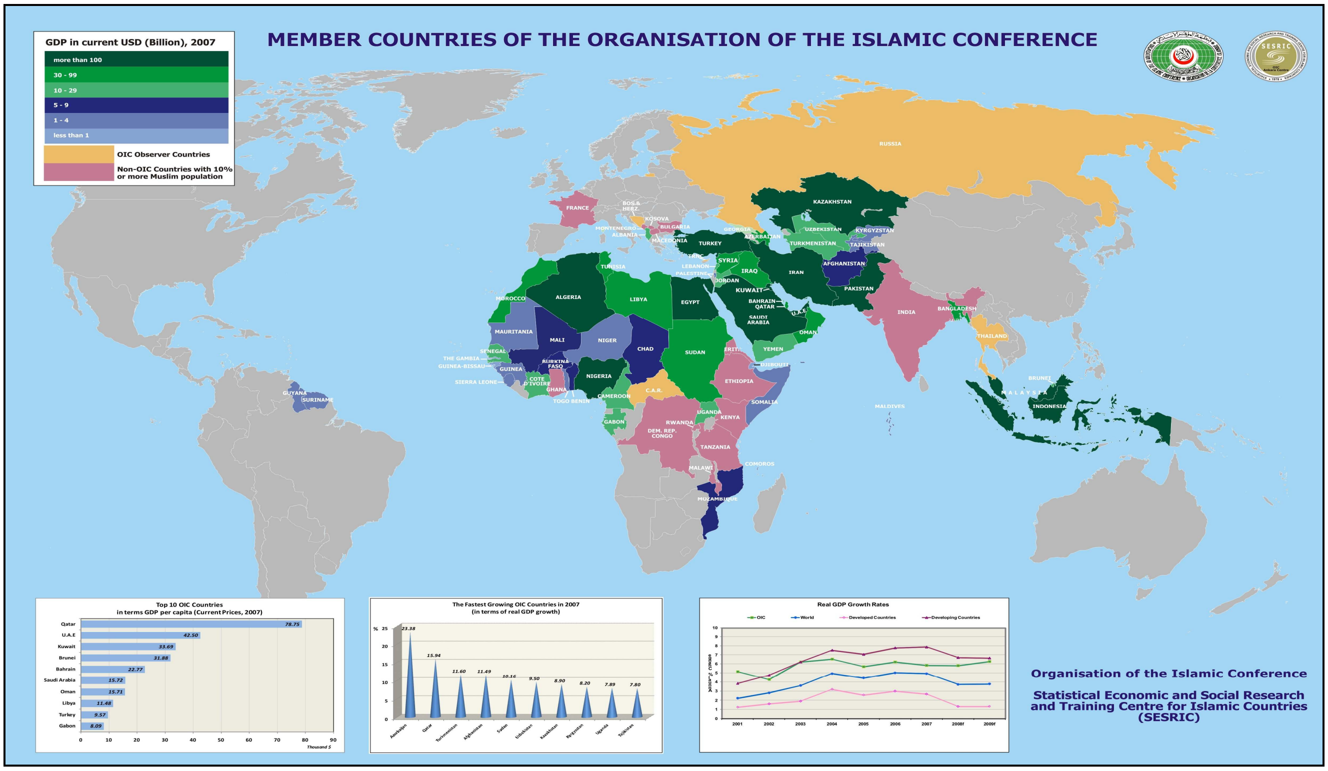
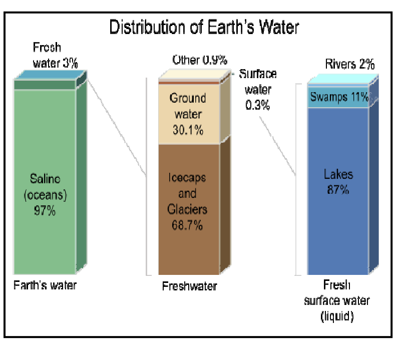
REGION SPECIFIC INNOVATION RESEARCH SYSTEM

(Need For Change)





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Executive Summery:

Innovation is the key to the survival of nations, whether it is technical innovation, organizational innovation, or any societal innovation. We are used to talking about inventions of ancient civilizations such as the discovery of brass, and the construction of great dams, and monuments such as the Egyptian pyramids. However, we rarely talk about the reasons for the decline of these civilizations. Books on Islamic history are full of examples of inventions in mathematics, geometry astrology, and medicine. No one talks about the causes of their decline.

The decline of ancient civilizations can be attributed to periods in which human survival was put at risk due to shortages in resources such as water and food, natural disasters, and the inability of the population to defend itself because they possessed rusted and outdated weapons. Technically advanced aggressors always captured the technically backward nations as shown by history. The west developed on the foundation of scientific and industrial engineering contributions of their scientists. The Muslims in the Middle East and Europe lost their valuable resources of knowledge. The lull in technical and scientific growth could be witnessed for centuries. Pakistan, Turkey, and Iran have produced great scientists but the research and economic environment and lack of institutional support did not allow scientists to compete globally. The last few decades have been the worst for the region and Pakistan in particular due to the burden of debts and falling standards in university education. Not a single university in the Islamic world falls in the first ten or twenty best universities of the world. The falling standards in education have killed research and innovation in Pakistan and the Islamic world.

It is already very late but not too late to start now. The budget allocated to R&D in a country reflects both interest and effort in the right direction but unfortunately increasing the number of patents registered, scientific journals published, and citations attributed, is not enough. Unless research is economically productive and marketable globally, it lacks the momentum needed to let developing countries catch up with the developed world. Developing countries at this stage can only jump-start things by adopting innovative research system suitable to each region and area

Innovation is the act or process of innovating. It introduces something new, such as a new method, a new system or design, a change in the way of doing things to upgrade, alter or renew something such as a change in market conditions, the production of new facilities, the generation of new knowledge or the awakening of convictions that did not exist before. It is not rocket science but an obsession with understanding or creating what makes buyers happy, what delights them, what problems they face, and the creation of a product which captures their needs. It is not about serious people in research, labs but about the common man with some imagination. It is the key to economic and societal survival.

A considerable experience has collected in the field of innovation policy globally; most of that experience cannot be applicable to developing countries like Pakistan because of local challenges, culture, and low-literacy among masses.

Introduction of innovation will depend on the level and quality of education from high school to university. Lower educational levels do not allow for diffusion of innovation. The absence of infrastructure for innovation, insensitivity, lack of motivation, micro-enterprises, limited research community, insecure towers of strength, research programs alien to local realities and market needs, the absence of research and development in the private sector, the preference of key actors to profit from vested interests, the fear of risk along with lack of financial transparency and obstructive bureaucratic and corrupt climate which exists in almost all developing countries will pose major hurdles to cross.

The innovation program should be built-on the available human and financial assets, scientific and technical capabilities, and the conditions of governance of the country. What bad governance can do to technical development is illustrated by the experience Tanzania and Namibia have had.

Innovation can be started by adopting available global technology with minor improvements in existing local technologies, by designing a new product with national recognition by blending local technology with global inputs tapping ancient knowledge, screening foreign technologies including reveres engineering and finally innovation can also be derived from cumulative community experience spread over generations. It is wise to learn from other people's experience rather to repeat their mistakes. In the following paragraph other countries experience is presented.

Uganda made basic low-level technology innovation by cultivating flowers for the European market. A new innovation culture was developed; by producing cotton and coffee and a competitive software industry. The government specially implemented an innovative program touching education, research, finances and trade. Malaysia has moved a long way from rubber exports to new rubber products and bringing basic changes in education and research by sharing global partnerships. The obsolete jute industry in Bangladesh is now utilizing jute in fiber composites and paper and pulp industry. Pakistan has the potential to compete with Netherlands in agriculture and other countries adopted this route by development of self-sustained autonomous innovation promotion bodies. Ireland spent billions in changing its educational infrastructure with massive investments and similar steps were taken by Chile, Korea and Brazil. In large countries the key problem is the identification of innovation needs in different regions, climates and cultures. Pakistan has an infrastructure in the form of well known research organizations like Pakistan Council of Scientific and Industrial Research, Pakistan Atomic Energy Commission, Dr A.Q Khan, Kahutta labs, aerospace research centers, mechanical and aeronautical complexes, defense oriented industries, agricultures institutes and a host of other research centers, but most of them have been limited in their activities by the lack of full support by the public and private sectors and due to lack of creative environment.

In this paper the merits and problems of NIS have been discussed with emphasis on region specificity. It is argued that the assessment of results by Indexing is full of flaws and finally solutions and recommendations have been proposed keeping in view the population explosion and crises in fresh-water, as well as the food, transportation, health and education sectors. A focus on these sectors by no means lowers the importance of innovation in defense to create weapons for deterrent against developed aggressors.

Situation Analysis

Background and history:

Advanced nations are advancing in the technological era and focusing on renewable energy, green manufacturing, nanotechnology, climate change, clean water and biomimetics. The gap between developing and developed countries in technological development is increasing day by day and in the not-too-distant future this will drive these countries to extreme poverty and force migrations as witnessed by the devastation of Nile valley and Indus valley civilizations in the past.

Innovation is the key to survival of nations whether it is technical innovation, organizational innovation or any societal innovation. Scientists talk of great inventions of ancient civilization, such as the discovery of brass, gigantic structures, great dams and colossal Egyptian pyramids. Whereas, thousands of papers have been written on ancient civilizations not many papers talk of the real cause of their decline. Their decline can be attributed to the inability of these civilizations to survive against harsh conditions brought on by war, famine or disease.

Technically advanced aggressors have always subdued technically backward nations as shown by history. Whereas, the west developed on the foundation of scientific and engineering contributions of their scientists in various ages, the Middle East, India and Pakistan lost their valuable resources of knowledge and an unfortunate lull in technical growth was witnessed for hundreds of years.

Since about 1770 technological development has been a major source of global economic growth. The Industrial Révolution in England (1770-1800+) was a notable spur to growth and the start of intensive application of STI to economic production in the West. No such focused attention to technological development and growth through innovation and research has been witnessed in many parts of the Muslim World.

Aims and Guiding Principles:

Our policy recommendations for fostering innovation in OIC member countries are based on the following guiding principles:

- Every country should be free to adopt its own policy but common parameters proposed are to get rid of myths about innovation. All people at all levels have the capability to innovate.
- Build on strengths focused on use of available resources, labor and generate income for investment.
- Protect the indigenous knowledge.
- Create a low-income, medium-income, and high-income research based innovation, investment research and technology system.
- Develop a technical and innovative culture through innovation.
- Move the critical mass of talent, knowledge and a specific set of actors from organizations, entrepreneurs, educationalists and politicians by adopting a dynamic

system of innovation.

- Improve quality of life in our communities.
- Make innovation a buzzword in all member countries of the OIC.
- Each OIC country must have its own National Innovation System.
- Make Pakistan or any OIC country a gateway of innovations at all levels including cultural educational, technical, societal, agriculture, health, medical, organizational and defense including all level of societal activities, encompassing the human needs.
- Adopt innovative policies and strategies to increase a country's technological and institutional capabilities by building on strengths and correcting the inherited weaknesses.
- Provide support as an integrated package at the micro (upgrading) meso (development of specific area) and at micro level (building links with government, industry and creating the innovative environment).
- Replace the outdated with updated in all sphere of societal, technical cultural and organizational activity.
- Work on promising areas with success stories for stimulating dynamics change. Act at global level to achieve international levels of standards and invite the expatriates to work with the innovative workforce.
- Start work on bottom up innovation phases and top down plans.
- Adopt the changing global and local changing economics to industry conditions.
- Invest in the projects that most effectively support industry and business.

Breaking Barriers:

We believe that ivory towers have contributed the most to the decline of technological and innovative growth and a fundamental problem that needs to be addressed is the breaking of barriers between industries, sectors and organizational and institutional groups. Only by doing so can we create a viable National Innovation System with a sizeable impact on the growth and development of our communities. A typical example of missed is given below to emphasize the vital importance of this in the National innovation System of a country or organization.

A joint R&D program (The Cardiovascular Energy Collaborative) between Exxon Mobil, the University of Houston, and the DeBakey Heart and Vascular Center, has been in existence since 2007. This consortium is holding its first international meeting in April of 2012. The following are some statements by the people involved this collaboration:

"Much like moving oil through a pipeline, the heart must pump blood through the body. Both systems need clean, well-functioning pipes (or blood vessels), free of blockages or corrosion, to function efficiently"

"It's amazing the ideas that flow when energy and medicine experts get together. The interaction sparks ideas that would never have materialized if we stayed in the medical center and they stayed in the oil field."

Here two institutions have had their focal point in Houston for over 50 years. Both are essentially trying to solve the same problem. They are moving fluids around in "pipes"; they worry incessantly about friction and pressure drop, Reynolds number, flow uniformity and restrictions, valve integrity and pump curves. Can you imagine where we might be if these two industries had started talking to each other in the 1950-60 when they started investigating these problems rather than waiting till 2007 to pool their resources?

Solving Fundamental Problems:

The greatest need of the hour is to solve fundamental problems with the largest societal impact; problems such as preserving fresh-water supplies. How a simple innovative method can be useful to prevent wasteful use of water will become clear from the example given below.

In a village near Lahore, where there is no running water for ablution a simple hand pump driven by a worshiper helps fill a 200 liter water tank attached to a metallic pipe with 40 taps for worshippers. The cost in the form of piping, and electricity is very little, in this innovative method and the water wasted is also negligible. Similar examples can be given of innovative new source of water in the desert.

Sometimes nature holds clues for our innovative pursuit but these are missed by our renowned scientists and noble-laureates. How the Namibian beetle helps in collecting water in the desert with its hard feathers coated with nano pigment is an eye opener for us.

Knowing the role of nano pigment in helping beetle for procurement of water in the desert we with our hands on availability of nano pigment from KSA a fellow OIC country can be mixed in ordinary paint and a canvas sheet 50 x 100 can be coated by it and placed facing upward in a park overnight where moisture is available in the atmosphere from trees and air. According to one estimate this setup will collect 2500 (liters/ml) of pure fresh-water. Thirty to forty such canvas boards can be installed in each city park and fresh clean water collected in a common reservoir and pumped for our consumption.

Fig1: shows Namibian desert Beatle with its hard wing cover lined by nano pigment.

This innovative method of water source is renewable and will be affordable by every developing country. The idea of giving this example is not to belittle the importance of innovation in other areas of our life and development in areas such as defense, transport, health, food and energy. The role of economy is and will always remain important.

In the present capital system, which is at the verge of collapse, the developing and poor countries must innovate in areas such as micro-economies. Another example where such innovation can draw inspiration is from the centuries old partnership between the tenant and owner of farmlands as practiced in the agricultural sector of Pakistan. Here there is a 50 /50 sharing of costs and profits between the owner and the tenant farmer where cost of seed, water and plowing with 50% share in the cost of yield has been working with average benefit to the investor, the owner of the land around 35 to 40% for centuries. No bank or business can match this innovative method of capital exchange and return on investment. Why can't such arrangements be extended to livestock such as raising goat, sheep, horses, fish and poultry? Such innovation could revolutionize the economic state and wellbeing of a nation and a healthier economy could make available money for innovative research in areas such as energy, transport, food and water.

To foster such innovation fresh and new ideas will have to be constantly collected from religious scholars, social scientists, anthropologists, life scientists, students, and industrialists through regular competitions organized through media and educational bodies.

Historical Perspective on the National Innovation System

Where does the idea of the National Innovation System come from? Most authors agree that it came from researchers like C. Freeman[14], B.-A. Lundvall[20], and R.R. Nelson[30].

In the 1960s, system dynamics among social scientists and system analysis were pretty popular, the latter particularly in the United States at RAND (Hughes and Hughes, 2000). Many researchers, particularly from management, began to use a system approach to study decisions and choices regarding science, technology and innovation (Halbert and Ackoff, 1959; Gibson, 1964; Lakhtin, 1968; Ackoff, 1968). Researchers from France were active promoters of the approach in science policy in the early 1970s.

Technology and innovation studies invented the concept of a National Innovation System. However, the concept also owes a large debt to the old debate (1960s) on technological gaps and competitiveness, as illustrated in Freeman[14] and his analysis of the -Japanese system.

Since World War II, Europeans have been fascinated with the disparities in technological and economic performance between Europe and the United States and Japan (Godin, 2002a). With its emphasis on the ways institutions behave and relate to each other, the concept of the National Innovation System, offered a new rationale to explain these gaps.

According to R. R. Nelson, a National Innovation System "is a set of institutions whose interactions determine the innovative performance of national firms" Nelson[30]. For B.-A. Lundvall[20], it "is constituted by elements and relationships which interact in the production, diffusion and use of new, and economically useful, knowledge". These elements or institutions are firms, public laboratories and universities, but also financial institutions, the educational system, government regulatory bodies and others that interact together.

There are two families of authors in the literature on National Innovation System: those centering on the analysis of institutions (including institutional rules) and describing the ways countries have organized their National Innovation Systems (Nelson[30]), and those who are more "conceptual", focusing on knowledge and the process of learning itself: learning-by-doing, learning-by-using, etc (Lundvall[20]).

From the latter group, the concept of the knowledge economy, first suggested in the early 1960s (Godin, 2008b), re-emerged in the 1990s (Godin, 2006b). The OECD admitted: "there are still concerns in the policy making community that the National System of Innovation approach has too little operational value and is difficult to implement" (OECD, 2002: 11).

"The overall innovation performance of an economy depends not so much on how specific formal institutions (firms, research institutes, universities, etc.) perform, but on how they interact with each other" (Smith[40]). Indeed, "knowledge is abundant but the ability to use it is scarce" (Lundvall[20] and Johnson[31], 1994 :).

To Lundvall, "the most relevant performance indicators of National Innovation System should reflect the efficiency and effectiveness in producing, diffusing and exploiting economically useful knowledge. Such indicators are not well developed today" (Lundvall[20],). Similarly, David and Foray suggested: "A system of innovation cannot be assessed only by comparing some absolute input measures such as research and development (R&D) expenditures, with output indicators, such as patents or high- tech products. Economics has so far been unable to provide much understanding of the forces that drive long-term growth. At the heart of the old theory (neoclassical) is the production function, which says the output of the economy depends on the amount of production factors employed. It focuses on the traditional factors of labor; capital, materials and energy. The new growth theory, as developed by such economists as Romer, Grossman, Helpman and Lipsey, adds the knowledge base as another factor of production".

Outlook on possible future developments of the NIS concept:

Having considered latest trends in the research on NIS, we now propose where we see possible development paths of the NIS approach in the future. Generally speaking, it seems obvious that the systemic approaches to innovation will continue to constitute a decisive framework for empirical studies in the economics of innovation literature, especially in the context of highly industrialized and newly industrialized countries[20].

Concerning the use of the national innovation systems approach as a framework to carry out country-level comparisons of technological performance, it is plausible that some of the recently introduced models will not be put aside but will be applied and further elaborated in future research. This appears likely considering the apparent interest in international evaluations of innovative strength.

However, there is still much room for extension of the NIS concept. At least three areas for broadening the approach shall be brought up here.

First, a clearer and more explicit combination of the NIS approach with economic growth is still lacking. While the linkage between technical change and economic growth has long been studied through distinct models of economic growth, modern[20] Aside from the developments in research work on innovation systems, it is noticeable that the very term "innovation system" has unfortunately become a highly fashionable expression among business editors and other writers dealing with innovation and technical change[12]. Concepts of innovation like that of (national) innovation systems have thus far not been tied with economic growth in an analytical way[21]. We believe that this constitutes a gap in the literature, even though it has been stated elsewhere that the NIS approach per se could be viewed as a means to study economic growth[22].

Second, the interplay between a country's innovation system and other economic subsystems (e.g. the labor market or the financial system) is far from being studied exhaustively. This limitation is even more striking since innovation systems have been defined as being open systems and since it is widely held that the strength of an innovation system depends upon the linkage with other sub-segments of an economy.

A third course to extend the NIS approach has to do with our still limited knowledge on the dynamic properties of national innovation systems, especially with regard to their stability and their structural evolution[23] by studying these aspects, the NIS concept would be more aligned with its theoretical foundation of system theory and evolutionary economics[24]. It is a basic element of this line of economic theorizing to consider qualitative change, implying that dynamic processes have to lie in the center of attention[25]. In addition, the variety of the units of analysis and their observable performance levels are usually given special interest. So if the theoretical foundation of the notion of innovation systems is to be taken seriously, a more subtle understanding of the evolution of the systems is required.

Above all, it appears appealing to retrace different development stages of national systems together with the structural and institutional modifications theses stages entailed in the course of time. By carrying out this type of analysis, it could be demonstrated that different countries have taken different roads to cope with the competitive and technological challenges they have been and still are exposed to. Perhaps, and viewed from a methodological perspective, it may be helpful to build simulation models.

To give the concept of NIS an operational dimension performance measurement / "efficiency" measurement of NIS methods will be required such as the use of innovation indicators, analytical models, calculation of index numbers (ranking of the systems analyzed), institutional frameworks, emphasis on historically grown innovation patterns, and an analysis of the development stage of the national system of innovation. Resorting to this type of model Porter and Stern have shown that the index values of their concept of national innovative capacity strongly correlate with the levels of GDP per head in the sample of countries they have used.

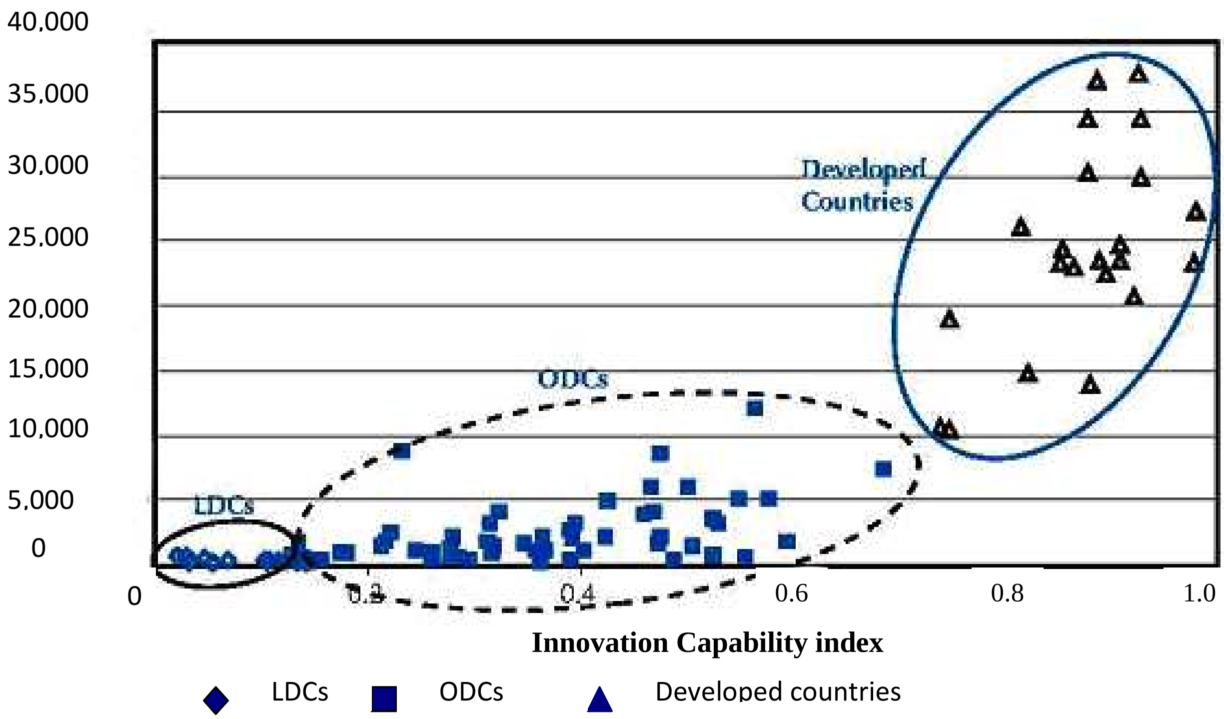

Fig 2: Shows per capita income and innovative capabilities in the developed and developing countries. 2001

Types of Innovation:

The National Innovation System should target the following types of innovation:

- Adoption of available global technology
- Minor improvements on existing local technologies
- Design and production with the national recognition.
- Blending of local technology with global inputs
- Tapping ancient knowledge, screening foreign technologies including reverse engineering.
- Innovation derived from cumulative community experience spread over generations.

Drivers of Innovation:

The main sectors involved in NIS are government, university, industry, non-profit, economic environment and international environment.

The view that the research system is composed of four main sectors goes back to the 1920s when a new type of research got increased importance in the national research effort industrial research. The very first analyses on this new whole, or system were conducted by J. D. Bernal in the United Kingdom in 1939 (Bernal, 1939) and in the United States in the 1940s (Bush, 1945; US President Scientific Research Board, 1947). Linear models of innovation assume that there are two forces driving innovation, one based on academic effort, the "Science Push", and the other based on industrial product development and market needs, the "Market Pull".

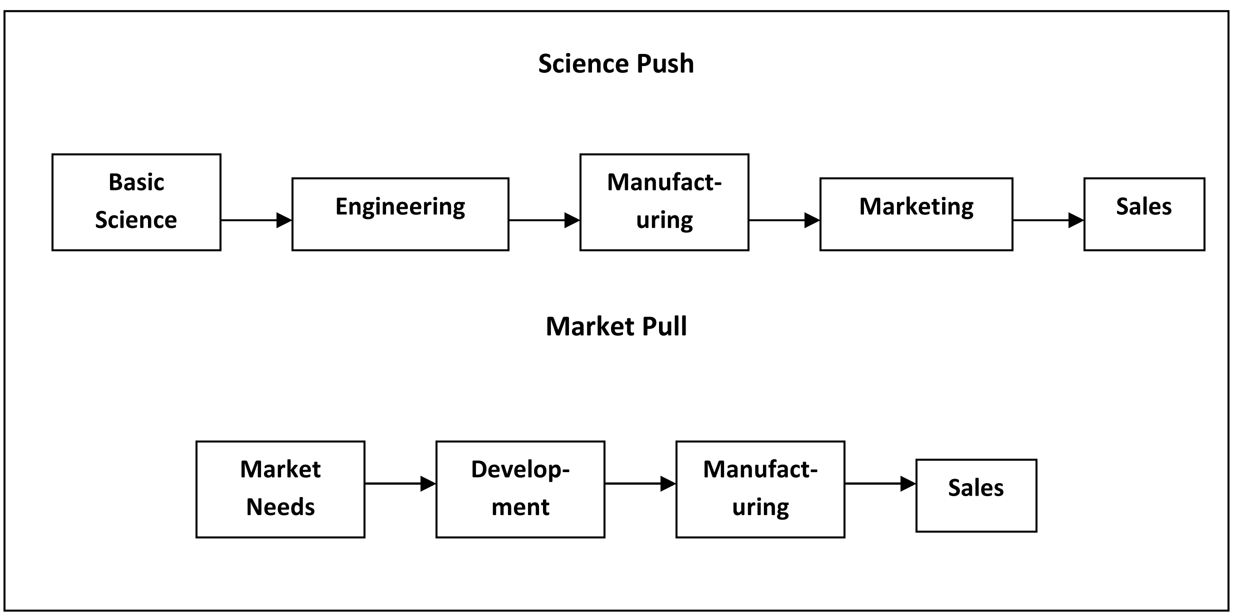

Fig 3. Linear Models of Innovation.

However, most current indicators of science and technology activities, such as R&D expenditures, patents, publications, citations, and the number of graduates, are not adequate to describe the dynamic system of knowledge development and acquisition in our view the views expressed by Lundvall are more relevant to developing countries such as Pakistan. .

The first important driver is the revolution in globalization process spurred by telecommunication which manifests by trade within the global community and has dramatically reduced time and distance linking most remote with most vibrant areas. The second important driver is the unprecedented technological revolution touching life and industrial foundation, societal needs, materials, energy and time.

The current era is the silicon age and miniaturization has made impacts on society never known before. This not only presents a challenge for Pakistan and the developing would but also open new opportunities to fill in the big vacuum which is widening every second. This stupendous challenge requires an entrepreneurial spirit to compete with the inter-global competition.

Neoclassical Versus Evolutionary Theories of Innovation:

Two conflicting theories of innovation, the neoclassical and evolutionary have been used to describe the processes of innovation and what should be the goals of a national policy around innovation. The assumptions and conclusions of both theories are presented in the table below. We believe that the evolutionary theory is better suited for describing and ascribing implementation recommendations for a National Innovation System.

Neoclassical	**Evolutionary**
At firm level, on specificity or variety within technologies. Inter-sectoral difference rarely considered.	Many idiosyncratic features of technological learning at firm level High levels of specificity of each innovation and technological “Trajectory” large number of variants of particular technologies.
At the country level, only differences in technology arise from difference choices of technique reflecting different factor price ratios.	At the country level, there are strong differences based on level of technological capability, skills and institutional structures, effectiveness of absorption and cost of learning processes.
Best way to develop technologically is to have free trade, free flow of investment and appropriate educational policies.	Development of appropriate set of technologies and technological capabilities may require both trade and investment interventions and technology (and other) policies.
In equilibrium, there is no difference between different modes of technology transfer. Free markets yield best set of choices.	Mode of technology transfer matters: externalized modes (licensing or capital goods) may be more conductive to technological deepening than internalized modes (FDI) where innovative functions

	remain abroad.
Externalities	
Externalities arise only from imperfect appropriability of information and vertical technological linkages externalities are limited and sporadic externalities are difficult or impossible to identify.	Externalities are strong and pervasive, Externalities are embedded in collective learning processes, and Externalities are not only technological: they also arise in connection with managerial and organizational learning and from marketing. Some of these effects horizontally straddle sectors and even technologies and many important externalities are technology and cluster specific.
Externalities are not technology specific so should be dealt with by non-selective measures.	Some technologies and clusters yield more dynamic growth and spillovers than other externalities are not very difficult to identify although they should not be defined with reference to static equilibria.
Risk and uncertainty	
A low level of risk and uncertainty in absorbing and using existing technologies innovation involves risk. Which is adequately represented by an innovation possibility frontier" Liberalization does not create additional risk.	High degree of uncertainty in technologies by industrial "latecomers" Risk and uncertainty in predicting economic impacts of learning. Especially in context of liberalization.

Table 1: Shows problems of Neoclassical versus Evolutionary processes adopted for innovation

Framework conditions

- Finandal environment **Trust**
- Taxation and Incentive **Mobility**
- Propensity for innovation and entrepreneurship **Education, Literacy**

Demand

- **Consumers (final demand)**
- **Producers (intermediate demand)**

Business system

- **Companies**
- **Farms**
- **Healthcare.etc**

Intermediate Organizations

- **Research institutes**
- **Brokers.etc**

Education and research system

- **Professional education and training**
- **Higher education and research**
- **Public sector research**

Infrastructure			
Banking, Venture Capital	IPR and information system	Innovation and business, Support system	Standards and norms

Fig 4. Shows a National System of Innovation

Challenges:

Following are the major challenges in the way of implementing national innovation program.

- Level and quality of education form high school to university. Low educational levels do not allow the diffusion of innovation.
- The lack of financial transparency and a high bureaucratic and corrupt climate.
- Absence of an infrastructure for innovation.
- Insensitivity, lack of motivation and micro-enterprises.
- Limited research community, insecure and comfortable towers of strength and the research program, alien to local realities and market needs.
- Absence of research and development in private sector and preference of key actors to profit from vested interests and the inherent fear of risk.

Priorities:

There is tremendous work to be done in setting up an NIS. However, the following are steps that should be made top-priority and undertaken immediately.

- Development of Research Centers of Excellence in Universities in the areas of agriculture, clean water, energy, mining and metallurgy, biotechnology, nanotechnology, transportation, building construction, green engineering, desert engineering, biometrics and, organ implantation.
- Such centers should be designed to attract top international experts to develop innovative goods and products of global standard.
- Establishing graduate-level research universities. King Abdullah University of Science and Technology in Saudi Arabia is a unique example of a university exclusively for graduate studies. It is excluded from cultural restrictions and bureaucratic influence with billion of dollars in endowment funds and faculty drawn from all over the world. In a short span of time it has made its mark globally.
- Development of Research and Development centers by multinational companies to undertake innovative problems related to the needs of the country in their areas of expertise employing local talents.
- Protection of indigenous knowledge and historical artifacts to learn the secrets of survival of pat generations. The secrets behind the survival of structures thousand of years old and notwithstanding harsh conditions need exploration. The oldest tree in the world is four thousand years old for example and learning what allows it do so can lead to innovations in building design, construction of dams, and bridges and better products.
- Launching of special industrial zones close to university for a more frequent interaction.
- Developing and fostering industry-university collaboration and providing incentives to industry for research and development and contribution to innovation centers. A condition for collaboration would be to make 2% investment in innovation for the industry.
- Foreign direct investments in major industrial and developmental sectors such as practiced by China, Brazil and Mexico.

- Making attractive offers to scientists and engineers to work in their countries on better terms and conditions. They can bring home the costly experience gathered in other countries this assumes utilization of their expertise of the individual. It would be however necessary to promote the aspiration of local scientists as well.
- Development of collaboration programs with the country of residence of the expatriates. They may also be called for a period necessary to establish the cooperative programs.
- Development of an innovative culture by recognition of innovative work and giving awards and incentives at all societal levels.
- Organizing a national innovation day exhibition for schools, universities and research centers for public.
- Establishing international funded schools to allow researchers/teachers from advanced countries to work for a limited period in the innovation centers.
- Making an inventory of talents and innovative products and identifying promising marketing potential.
- Establishing district level innovative councils and motivating them (a highly challenging task) to create innovation in societal living and harvesting of local resources in areas such as water filtering, housing and education, and health and health products.
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Fostering Innovation

- Get rid of myths about innovation - It is an act of every day life at all levels. Innovation is the only way to survive in the competing world.
- Act on global national and local issues with national and international network.
- Create a center for a start and appoint a team lead by an expert to identify the industries, groups, organization and individual interested to work with the team.
- Identify a network of international group to provide technical and financial support.
- Identify private non-government and government organization to provide the foundation support and endowment funding.
- Identify major areas of innovation at local national and international levels– make an inventory of these areas. These areas must be knowledge intensive and economically beneficial.
- Identify the order of priority of innovation in different sectors.
- Create a pool of innovators at all societal levels in rural and urban areas.
- Provide short term and long term support to attract spin off companies.
- Invite all talents starting from high school level to university, research organization, industrial organization, to public and private sectors, scientific and industrial organization, and electronic media to participate in the innovative schemes. The invitations should contain the topics for innovation.
- Establish sustainable centers. Sustainability can be achieved if income generated from inventors is invested by establishing a link between originators and innovators with potential financiers to assist in the commercialization of inventions and innovations.
- Announce Presidential awards for outstanding innovators and investors. Lobbying governments and commerce and industry to obtain these supports may be needed. A scheme of lower tax for industries supporting innovation may be launched - A provision

of incentives to staff working on innovative project would boost their morale. All scientific research and organizational institutions needs need to be geared to an innovation network.

Adopting a Management Style and Legal Framework for Innovation

A strong legal framework would be required to protect indigenous local and traditional knowledge. Intellectual property protection would be required to protect the innovations. A top down approach needs to be developed to enter the era of innovations as early as possible. Under this system the management of an organization is a given a dedicated team and resources for strategic development.

These teams perform day-to-day operations and the work of the innovation centre. This approach allows the center to get off the ground and work faster on ideas. The route adopted should lead to the solution of inherent problems with the supporting organizations.

The bottom up centers will have a larger impact compared to top down because of their origin within the organization. They must be staffed with a multi-disciplinary team familiar with local and foreign industry to ensure diversification of approaches to problem solving and developing ideas for business for sustainability.

Creating an Open-Innovation Organizational Culture

Open innovation does not entail the creation of a massive business concept. Instead, it is the transformation of an internal culture, and the development of a process to encourage and promote innovation from every available source.

Rome, as the old saying goes, wasn't built in a day. Likewise, open innovation is not something you can achieve overnight. It is not a single event, but a process and a culture that must grow over time. Rome did not build itself, either, and similarly, open innovation won't just happen. It takes work, commitment and patience to cultivate an effective program. It is a major initiative requiring focus, investment and time.

But the rewards are great. Open innovation takes a company beyond its own R&D capabilities. Through this strategy, a company reaches out to access innovation resources that expand internal capabilities and become an asset for the company. The strategy focuses on outcomes rather than on sources. In today's rapidly evolving business environment, the companies that can adapt and innovate quickly will be successful.

Your company can be one of them, relying on open innovation to keep it on the cutting edge of its industry and accelerate the development and rollout of new products. Here are 10 steps that companies should follow to create and cultivate a successful open-innovation program.

I. ***Create a needs list:*** This is a process that should involve senior innovation leadership, research and product-development leaders, as well as people from the business units. Together, they should create a prioritized list of critical strategic and business needs that can become the starting point to initiate the search for new innovations.

2. ***Define the company's core competencies:*** What knowledge, expertise and technology are unique to your organization? In what areas do you lead your industry (and in what areas do you lag)?

Knowing these answers makes it easier to be honest about where you don't have expertise, and therefore can benefit from external innovation.

3. ***Initiate scouting*** The fastest way to realize impact from open innovation is to scout for new partners and technologies against the identified needs.

This can be through a formal request-for-proposals (RFP) process, or through more informal outreach. Build a scouting team to lead the effort, and identify experts and potential development partners who can help with ideation. Remember that messaging in the RFP requires great care and precision; it's important to "get to the root" of your challenge to find the best partners, who may be from unrelated industries. Innovation partners can be particularly helpful with this messaging process.

4. ***Develop an IP strategy*****:** Companies' standard policies related to intellectual property need to be modified to encourage open innovation. Develop a strategy that facilitates the open discussions and collaboration that will enable your company to move forward and collaborate with outsiders. At the same time, your policies must describe upfront, and in a clear way, "who owns what."

5. ***Broaden outreach to additional stakeholders*****:** For instance, many companies actively engage customers to identify and define their next products (such as Hallmark Cards' use of contests to enable consumers to create new greeting cards). Others leverage their internal "brain trust" to tap into knowledge and expertise that may be hidden across the organization. For example, AkzoNobel, a Netherlands-based Global 500 leader in coatings and specialty chemicals, developed a companywide networked innovation program to help drive strategic innovation across its business units. By issuing internal, cross-business searches, they are able to uncover new solutions and pools of talent not previously considered.

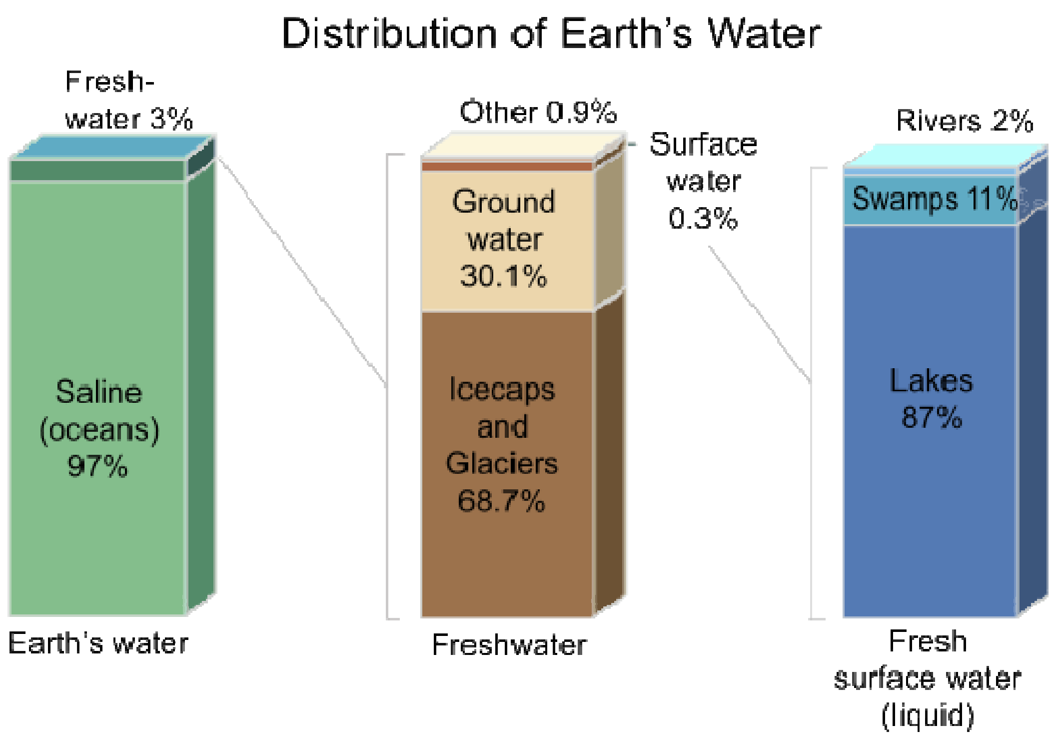
6. ***Let everyone know that the company is "open" to innovation:*** Keep every suggestion alive, both from internal and external sources. Being open to any idea from any source can pay off in surprising ways. Examples of open-innovation portals to encourage new partnerships with external technology providers abound from companies in food and beverage (Innovate with Kraft), consumer products (Unilever Working with Us) and automotive (Johnson Controls).

7. ***Transform existing relationships*****:** Turn the tables on conventional thinking and engage your suppliers and vendors, elevating them to strategic partners. Put agreements in place that guarantee confidentiality in the open exchange of ideas and be open to sharing long-term goals. Your suppliers are on the front lines of where their industry is headed. Move discussions out of the back room and work on building more strategic, trusted relationships.

8. ***Build a knowledge base:*** This happens typically in Year Two of a company's push to open innovation and shows why it is a long-term process. You can't do this at the beginning. Create a repository of best practices and see what kind of metrics you can develop to measure progress. Create mentors in the organization based on who has been able to achieve a track record of success. This also is part of transforming the corporate culture that simply takes time and experience.

9. ***Collaborate with peer organizations*****:** Be the company to articulate the big challenges facing your industry and be willing to take a leadership role in addressing those challenges. Executed correctly, this is an opportunity to work with competitors and deal with industry-wide issues like regulations, safety and sustainability.

10. ***Create accountability:*** This should be a positive, incentivizing part of the program. Celebrate and showcase successful outcomes from collaborative innovation projects. Highlight them as big things, and celebrate individual and team achievements. You need to demonstrate that the company highly values this collaboration, both internally and externally. Open innovation does not entail the creation of a massive business concept. Instead, it is the transformation of an internal culture, and the development of a process to encourage and promote innovation from every available source.



Innovation in Fresh Water:

Developing a technology of rainwater harvesting as a first option. Locate a rainwater harvesting system close to existing large-scale water treatment and distribution system. The stored water may be used for creative wetland. Reducing the volume of runoff reduces the threat of flooding. Adopt top down policies for management. The rainwater storage system is to be installed in all public buildings, public facilities and in new housing schemes. Multipurpose tanks should be designed to serve the requirement for flushing firefighting and emergency uses. A new paradigm for rainwater to mitigate flooding and draught and sustainability is suggested. The recent rains in the parker and areas unknown to rains received a heavy amount of rain but the valuable water was lost because of lack of rain harvesting system. (3, 4)

- There is plenty of fog in Pakistan in the hills such as Nathia gali and other locations in the plains. Fog is also observed in semi-arid regions. This fog could be converted to drinking water by using nanotechnology and micro techniques as done in Asir province and the hilly regions of Oman.
- Morning dew in the deserts can be harnessed to make fresh water ponds and distribute water to inhabitants.

- Using junk rubber for water filtration is an economical method for waist water treatment. Junk rubber from used tires is a better option then using anthracite and sends for water treatment. This would remove pollution and dengue fever cause by used tyres (5). T
- Using U.V radiation (300 to 400 nm) with immobile particles of ZnO, Ag, TiO_2, $Cr_2 O_3$, can kill bacteria and virus. Photocatalytic reactors needs to be manufactured which would offer a substantial design of sustainability and disinfection of water (6, 7, and 8).
- Water Disinfection to prevent diarrhea by sun radiation. At least one third of the population in developing countries has no access to save drinking water. There are about four billion cases of diarrhea per year, out of which 2.5 million cases and in death mostly among children. Putting it the other way one child dies every fifteen second or twenty jumbo jets or 10 Boeing 747 crashing every day. During floods as recently witnessed in Pakistan the problem become acute with the victims and they may drink water from the flooded river. On the spot water treatment can be done by putting the contaminated water in transparent plastic bottles and expose them to sunlight for at least six hours. The UVA radiation of sunlight destroys the pathogens. Synergistic reaction occurs at 45 degree C and destroys all the pathogens and makes the water suitable to drink without any risk of disease.

Innovation in the Control of Epidemics

- The spread of deadly dengue fever goes unabated in Pakistan, South East Asia and Africa. It also touches Middle East. Only temporary measures have been taken to control the transmission of virus. With the photocatalytic effect produced by UV radiation on micro and nano particles of Zn, Ag, Cr, $Fe_2\ O_3$ and Ti has the capability to kill dengue virus. This needs modeling of transmission, Fabrication of photocatalytic to clean the indoor and outdoor air and experiment on human and mammalian tissue to observe the killing.

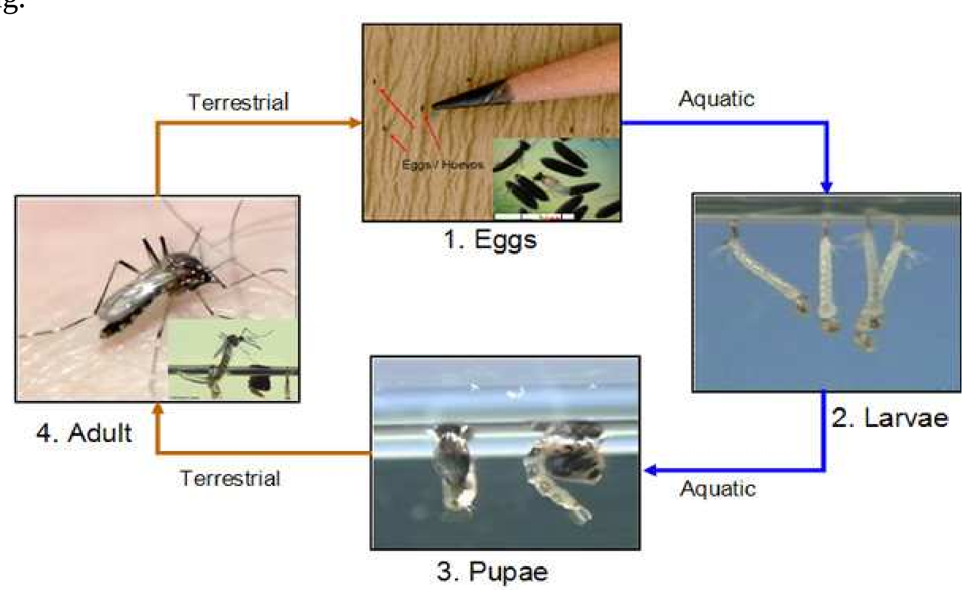


Fig 5: Shows life cycle of Dengue mosquito Innovation to eradicate the epidemic by intervening at different stages of life cycle can help if innovative methods are tried.

Innovation in Agriculture:

- A substantial progress has been made in agriculture in the last two decades. The traditional forming is to be replaced by biodiversity. With the seasonal crops, novel flowers in great demand for local and export use need to be cultivated along with different crops. The growth of medicinal plants and herbs could create forming diversity. The house is near forms need to be modified to clean houses by using adobe bricks and more and more of natural fibres and keeping the animals in separate quarters in clean environment with constant monitoring. Palm civets are native to India, Bangladesh, Bhutan, Nepal, Singapore, Malaysia and Indonesia. The civets eat pulpy fruits such as berries and mangoes, chiku and coffee beans. The length of civets is 17-28 inches and weight 3 to 10 pounds. They produce the valuable musk. The digest the flesh of coffee cherries and their body enzymes work on the beans which create novel aroma and flavor. The beans are collected form the dung and a highly priced aroma are produced by beans. One cup of coffee produced by civets cost 50 pounds.
- On the site of farms, restaurants offering on sight cooked fresh vegetables, meat, farm products and coffee could be sold. The view would also be unbeatable, where the guests would literally gaze at the blooming flowers take fresh airs and see the source of fresh products and get an experience they would never forget.

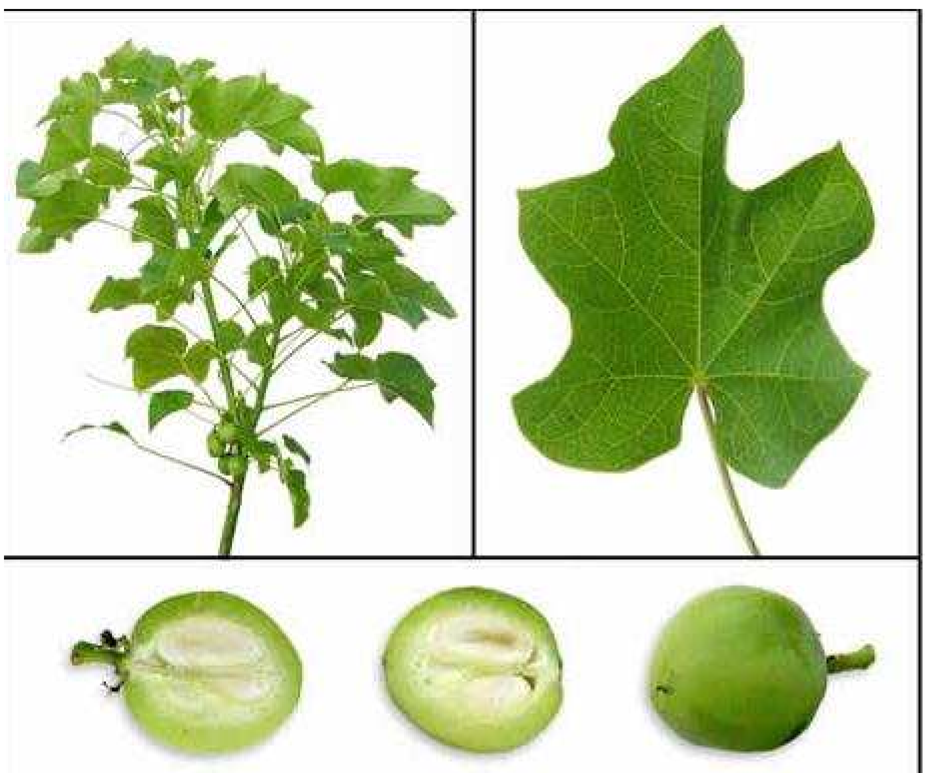


Fig 6: Shows how innovation in our agriculture can be used for bio fuel production

Fig 7: Shows closed door farming using green house and water with little soil a recent innovative way to harvest.

Innovation in Food Industry:

- Innovation in baking bread is requires control during milling. It is well known that most vitamins and minerals are concentrated on the seed skin. A good idea would be to mill the grain directly obtained from the fields without drying. New techniques can be developing by controlling the mixing temperature. Softness and dryness depends on temperatures. Dextrization of starch (dry heat) increases the flavor by changing starch to sugar. Carmelization of sugars changes the structure of sugar by giving off Co_2 and H_2O and become brown. By creating variation in kneading speed, kneading temperature and modifications at milling stages and adding vitamins of D types, a variety of healthy breads can be produced under different names for different categories of people and changes in shape, thickness and homogeneity in baking can create innovative wonders in food industry.

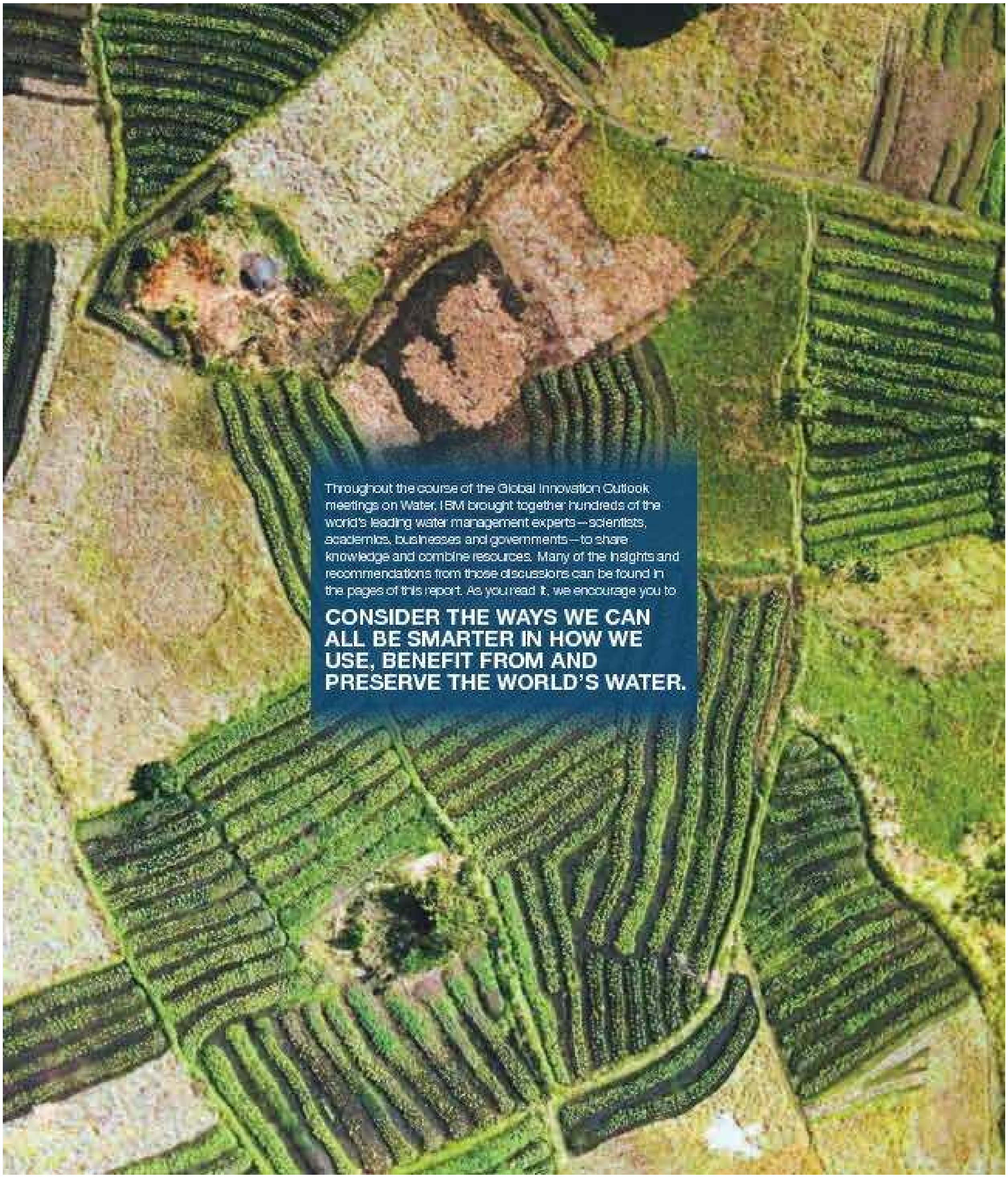


Fig 8: Shows Innovative way in modern agriculture using minimum space with maximum cultivation with little water consumption.

Innovation in the Transportation Sector:

- Not many ideas can be very practical due to the shortage of funds, manpower and tough competition from the West. Due to the failure of locomotives and the dependence of oil, locomotive can be accommodated with rechargeable batteries similar to the practiced adopted by US accommodating 1,080, 12 volt rechargeable acid battery which enable a locomotive to run for 24 hours on a single charge, while pulling the same load as a conventional locomotive. The 1500 HP machine makes use of re-generative braking for extra power.
- Conservation in street lights can be made by devising a command system to switch off the street lights not essential at a particular time. A system of street lights turning automatically when people pass can be devised on pavements.
- Use can be made of nano cement to make roads which are sustainable and offer no hindrance to traffic.

Fig 9: Shows fastest train (Bullet Train) an innovation in modren transport sector.

Innovation in the Health Sector:

In health sector anticoagulant therapy monitoring and blood sugar monitoring by finger prints and finger prick blood tests are just few examples of innovation which can be convenient both for the recipient and the health provider such innovation can also be economically useful Telemedicine holds great potential for innovation in diagnosis and treatment of heart disease diabetes and cancer.

Innovation in the Higher Education Sector:

Innovation in education to strengthen our universities and research manpower is most important ingredient for any innovation policy to succeed. Brave innovative methods of learning have to be devised and tried with rapidly changing knowledge base and availability of information on the internet by using IT at all levels. Self-learning and evaluation must be a strong component of such innovative method.

Measuring The Performance of a National Innovation System

In many of the latest extensions of the NIS concept, international comparisons have been put in the center of attention. By means of system-level comparisons, it is sought to get a better understanding of the functioning of the systems analyzed, and to derive policy implications. Mostly, the functioning of a system is described by such terms like[29] See Maurseth and Verspagen (1999) who find that technologically relevant knowledge does not diffuse easily across all national borders even inside the EU. That it is at this point in time still inadequate to study innovation structures in terms of a supranational, European-wide innovation system is also maintained by Gutowski (2000, p. 235). Innovative performance or innovative efficiency[30]. So basically, the functioning of a national system of innovation is regarded as its ability to generate innovative outcomes or the intensity of linkages between its main elements in innovation processes. Distinctive conceptual frameworks have been introduced in order to capture the functioning of innovation systems empirically. These frameworks rely either on a compilation of descriptive indicators or on higher formalized analytical models.

Another noticeable stream in the NIS literature can be described as the analysis of innovation systems of countries beyond the club of highly industrialized economies. Regarding the geographical dimension, the studies concentrate on countries in Eastern Europe, Latin America, and Asia. Classifying the analyzed countries according to their level of economic development, the spectrum ranges from developing nations to middle-income countries. Even though the very existence and development of a system of innovation in those nations is often a focal point in these studies, cross-national performance comparisons are carried out as well in some cases. In this way, this stream of extending the NIS approach to less industrialized economies is closely related to the above mentioned research stream of performance comparisons on the level of national innovation systems. But, in spite of this relation, it shall be emphasized that the consideration of historically developed organizational and institutional structures plays an important role in (comparative) studies of industrializing countries.

It is difficult to foresee in which direction the concept of national innovation systems will proceed in the near future. But, in our view, in order to answer this question it is helpful to consider the following three aspects: First, the systemic approach to innovation in general - regardless of the analytically selected boundary of the system - is by now established as a useful framework to study technical change and its determinants. Second, the concept of national innovation systems enjoys continuing popularity even though innovation processes increasingly entail an international dimension. Third, the NIS approach still leaves much room for extensions, both in terms of its theoretical foundation and of its empirical application[30].Yet, the expression 'innovative efficiency' can be misleading in the context of national systems of innovation. That is because efficiency is commonly defined as a ratio of output(s) to input(s), abstracting from interactive or systemic attributes of the processes measured. But these attributes are of course at the core of the NIS approach.

Measurement of Innovation Performance:

Measuring innovation: One approach that has often been adopted is to aggregate a large number of indicators reflecting various aspects of science, education and technology and related factors, into a single composite index. However, it is not clear what exactly is being measured on this basis. Research and development (R&D) spending has been widely used as a measure of innovation performance. However, R&D is a measure of the inputs that go in to the innovation process rather than of innovation output or success. A measure of innovation performance should focus on the extent of commercially successful applications rather than on the amount of effort going into developing them. In principle, patenting activity gets closer to this. This is the single best available measure for innovation outputs.

Innovation Performance Index

The first index measure innovation output of performance, and is based on international patents data. When one constructs measure of the sum granted to applicants (by resident) from the 82 economies by three major government patent offices. The European patent Office (EPO), the Japanese Patent Office (JPO), the US patent and Trademark Office (USPTO) expressed in terms of patents per million populations for each country.

A new set of alternative indicators of innovation output consist of:

- High-technology manufacturing output per head in constant 2000US$.
- High-technology services output per head in constant 2000 US$.
- Royalty and license fee receipts as a percentage of GDP. Data are for 2006.
- A survey questions in the World Economic Forum’s Global Competitiveness Report that extent to which companies in 134 countries were adept at or able to absorb new technology.

Direct Innovation Inputs

The innovation inputs index is based on an outweighed average of the following BER indicators: (Business Environment Ranking adopted by Economist intelligence Unit’s).

- R&D as a percentage of GDP
- Quality of the local research infrastructure
- Education of the workforce
- Technical skills of the workforce
- Quality of IT and communications infrastructure
- Broadband penetration

Relevance of Indexing as Measure for Innovative Research:

Between the highly developed, science-based industries of the United States and the explosive development of Russian technology, Europe sits uneasily. True, Europe has the great advantage of the tradition and maturity of its scientific institutions, and particularly those for fundamental research. But this is not enough. Europe has, as a region, been slow to exploit in production the discoveries of its laboratories. It is no longer possible for each of its constituent countries to undertake the amount of research necessary for its security Scientific Affairs, turned to the promotion of national science policies. From its creation in 1961 to the emergence of the literature on National Innovation Systems, the OECD produced several policy papers, and most of them carried a system approach. To the OECD, research was a system composed of four sectors, or components, and embedded in a larger environment:

Conclusion and Recommendations:

We have discussed the importance of innovation to the survival of our nations and a specific orientation and culture of innovation necessary to develop a National Innovation System geared towards solving fundamental region-specific and national problems such as the lack of fresh-water supplies, inadequacies in food production and transportation services. We end this paper with a summary of key recommendations highlighted in this paper. We hope OIC member countries will seriously consider these recommendations in designing their national policies to foster innovation and technological development.

- Replace traditional industrial practice by innovative practices.
- Increase the coordination and cooperation between industrial sectors, organizations and the academia.
- Introduce a culture of innovations in all sectors of society at all levels, adjust innovation as close a possible to entrepreneurial group and adopt a top down management approach to keep in pace with globalization and technological revolution by creating an entrepreneurial spirit.
- Pool entrepreneurial capabilities around the existing scientific and technical assets — Develop centers of research excellence in public and private universities in areas such as clean water and energy mining and metallurgy, nanotechnology, biomimetics and biotechnology, building construction surgical implantation and transplantation.
- Launch industrial zones close to universities and provide special tax incentives to spend and cooperate in innovation activity.
- Pool the expatriate manpower and trust them with innovation tasks on very attractive terms.
- Protect indigenous knowledge and artifacts for scientific exploration.
- Encourage long-term and short-term investment in innovative ideas by publicizing success stories to gain confidence of innovators and investors.
- Introduce a system of presidential awards to boost up confidence and innovations at all levels.
- Remove the myth about innovation. All humans can innovate at all levels at all levels of life in all sectors.

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