

Full Length Research Paper

Identification of future environmental challenges in Pakistan by 2025 through environment foresight

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Accepted 15 August, 2011

Technology foresight is defined as “the process involved in systematically attempting to look into the longer term future of science, technology, the economy and society with the aim of identifying the areas of strategic research and the emerging generic technologies likely to yield the greatest economic and social benefits.” Technology foresight on environment sector was carried out under the supervision of Pakistan Technology Board on the theme “Environment 2025: Our future, our choices”. Social, technological, environmental, economical, political and values (STEEP) is an internationally recognized tool for brainstorming used in conducting technology foresight worldwide and was used by environment panel for collection of issues and drivers, opinions, policies and projects for future of environment in Pakistan. More than 20 experts participated in the expert panel brainstorming workshops. A diverse panel was formed with representation from R and D organizations, Ministry of Environment, researchers and professors in universities, NGO and private sector organizations. A consensus was achieved by the panel on top four most important issues in environment sector which include; (a) water (b) loss of biodiversity, (c) solid waste and (d) energy. Furthermore, the causes, remedies, policy recommendations and project proposals were identified for each of the four issues.

Key words: Technology foresight, environmental degradation, water as a resource, biodiversity loss, solid waste, energy, panel discussion, STEEP, priority areas.

INTRODUCTION AND LITERATURE REVIEW

Technology foresight involves systematic attempts to look into the longer-term future of science and technology, and their potential impacts on society, with a view to identifying the emerging change factors, and the source areas of scientific research and technological development likely to influence change and yield the greatest economic, environmental and social benefits during the next 10 to 25 years (UNIDO, 2005).

The term foresight came to be known in its present form in 1980s, and it is used to describe the future-oriented activities connected with science, technology and innovation. Originally, there was no clear difference made between forecasting and foresight (European Commission, 2006). The tools used for forecasting are Delphi survey method and system analysis and were used in BRAND Corporation and USA defense sector in back 1950s. The companies at that time were mainly interested in forecasting method for business purposes

for example, Shell during 1960s; although, the need for forecasting also increased when oil crisis took place in the 1970s (Cuhls and Johnston, 2006). In Japan the technological development took place in late 1960's and on-wards (UNIDO, 2005). France and other European countries started the foresight initiatives in the early 1980s. After a decade, Sweden, Australia and Canada experimentally started technology foresight in late 1980s and before 1990s. Today the technology foresight has gone far and several countries are engaged in technology foresight exercise that is, UK, USA, Australia, Sweden, Finland, China, India, Taiwan, Malaysia etc. Keeping in view the huge gains achieved through this exercise, the technology foresight project was initiated by Pakistan Technology Board, Ministry of Science and Technology which include the key major areas which are playing vital role for socio-economic development in country, these include; agriculture, energy, education, environment, information and communication technology (ICT), industry etc. This paper exclusively focuses on environmental challenges faced by country or will be faced in coming fifteen years.

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The foresight allows individuals to think/understand ahead and consider, model, create, and respond to, future eventualities. The strategic foresight group India reports on environmental cost of Middle East conflicts. It was noticed that ten million barrels of oil were spilt at sea as well as forty-five million in the desert during first Gulf War. Although Kuwait also suffered extreme land degradation with more than twenty percent of trees being lost and perhaps the most dreadful were releases of carbon dioxide from burning of oil fields. Moreover the first Gulf War also increased the share of carbon dioxide emission about 1.5% globally in 2003 and the share of the countries like as Saudi Arabia was 1.17% of the world's carbon emissions, while Egypt, Israel and Jordan share much less than Saudi Arabia which were noted between 0.5 and 0.7% (Strategic Foresight Group Reports on Environmental Cost of Middle East Conflicts by Gitanjali Bakshi, February, 2009).

These types of unnatural activities will diminish the planet in near future. The environmental degradation is increasing day by day in different countries, but the most vulnerable countries are Group 77 that includes Indonesia, China, Philippines, Columbia and other fifteen countries. Pakistan is also in the list of environmental vulnerable countries. The environmental issues and challenges being faced by Pakistan include; natural resource degradation, depletion and pollution of renewable fresh water resources, use of pesticides, noise and air pollution, solid waste pollution, soil degradation, desertification, biodiversity loss, improper discharge of industrial waste etc. (Islamic Republic of Pakistan, 2008). Pollution due to the ineffective management has emerged as a major environmental concern in Pakistan. Its natural resources are increasingly under pressure with rapid population growth and environmentally unsustainable and ineffective practices and its fresh water resources are being fast depleted which has pushed Pakistan into the category of water stressed countries.

Industrial discharges are continually contaminating the country's best soil and water resources (surface and ground water) and solid waste dumped on low-lying land or burnt in open air generates dust and carcinogenic pollutants with adverse health implications (Islamic Republic of Pakistan, 2008).

Pakistan also faces other severe environmental issues and challenges caused by natural hazards such as, floods, earthquakes, droughts, and cyclones. Pakistan is also in the list of those countries which are damaged by cyclone and flooding. Cyclones cause significant damage in the coastal areas as well as destroy standing crops several hundred kilometers inland. Additional environment challenges due to climate change are expected to directly impact on Pakistan's economy which results in loss of 6% of GDP (Pakistan Strategic Environmental Assessment Report, 2006). For coping and devising an effective strategy for upcoming environmental challenges, the environment foresight study has been conducted in

Pakistan under foresight project for giving some suggestions and recommendation on most important issues.

METHODOLOGY

Expert panel discussion using STEEPV

Expert panel was formed on Environment sector which was represented by members from academia, industry, R and D organizations, private sector, NGO's and civil organizations UNIDO (2005). The panel met for about five times during a period of six months. The members were identified through face to face meetings and co-nomination process. The experts selected were mainly the heads of their respective organizations such as: Chief Environment, Planning Commission, Director General, Ministry of Environment, Head IUCN, Islamabad, Head UNDP, Energy and Environment section, Regional Manager, Pakistan Wetlands Program, Dean Faculty of Applied and Basic Sciences, International Islamic University, Dean Biological Sciences, Quaid-i-Azam University, Manager Technical Assistance, ASIANICS, CEO of strengthening participatory organization, Islamabad, Deputy Director, National Biosafety Center, (Pak EPA), Director, Pakistan Environmental Protection Council, Chief Wild life Planning Commission.

There were about twenty members who were part of the panel, while many experts responded through e-mails. The proceeding of each workshop was shared between all panel members through on-line groups. The panel assessed the current situation of environment in Pakistan and identified key trends and opportunities on the horizon of 10 to 15 years. The standard method of STEEPV, UNIDO (2005) was used by panel members for the brainstorming sessions to identify a number of issues and drivers, recommendations and key areas of technological intervention.

Social

- (1) Environment oriented research and development should be promoted.
- (2) Environment conscious society needed.
- (3) Increasing population is a big social factor.
- (4) Literacy rate is a big issue.
- (5) Awareness regarding environment should be created.
- (6) Youth population trend.
- (7) Environment oriented education for youth required.
- (8) Social cohesiveness needed.
- (9) Youth can be a change agent for Pakistan.
- (10) Cross sectoral socialization required.

Technological

- (1) Use of environmental friendly technologies lacking.
- (2) Male dominant technologies.
- (3) Environmental friendly fertilizers.
- (4) Role of media to create awareness.
- (5) Reliance on foreign resources.
- (6) Technology for environment for example GIS.
- (7) Youth access to IT needs to be ensured.
- (8) Dissemination of knowledge.
- (9) Solutions should be based on logic.

Economy

- (1) Poverty a big issue.

- (2) Per capita availability.
- (3) Economy of environment.
- (4) Distribution of wealth.
- (5) Incentives for media.

Environmental

- (1) Controlled pesticides usage.
- (2) Minimum use of pollutants.
- (3) Rural urban shift needs to be considered.
- (4) District wise study of environment.
- (5) Water issues to be solved.
- (6) Pilot projects should be initiated.
- (7) Environment technology parks and incubation centres required
- (8) Green labeling should be introduced.
- (9) Water pollution (surface /underground).
- (10) Biodiversity destruction/extinctions/deforestation/ecosystem degradation.
- (11) Land use changes/land degradation/ soil pollution.
- (12) Solid waste pollution.
- (14) Population growth.
- (15) Climate change and global warming.
- (16) Introduction of genetic modified organisms (GMO'S).
- (17) Devastation of natural habitats.
- (18) Diminishing natural resources.
- (19) Air pollution.
- (20) Noise pollution.
- (21) Thermal pollution.
- (22) Pesticides pollution.
- (23) Radioactive waste (pollution).
- (24) Industrial pollution.

Political

- (1) Lack of political will and vision.
- (2) Need to exploit human resources.
- (3) Political choices and awareness regarding environment friendly technologies.
- (4) Enforcement and implementation problems.
- (5) PEMRA should be forced to allocate 10% of time for public service messages.
- (6) Green journalists forum should be established.

Values

- (1) Ethical issues.
- (2) Gender issues.
- (3) Psychological slavery.
- (4) Equity and equality of distribution.
- (5) Religious aspect needs to be considered.
- (6) Mindset needs to be changed.
- (7) Involve media, parents and teachers in creating awareness.
- (8) Message oriented advertisements and environment impact assessment of advertisements required Voting for the Identification of top environment issues.

After the identification of issues and drivers, the next step was to list down the top four issues in environment sector.

The top four most important issues highlighted by members were;

- (1) Water
 - (i) Resources
 - (ii) Pollution
 - (iii) Drinking Water

2. Loss of biodiversity

- (a) Forestry
- (b) Wildlife
- (c) Rangeland
- (d) Invasive species

3. Solid waste

- (a) Industrial
- (b) Urban waste
- (c) Hospital

4 Energy

- (a) Residue burning
- (b) Alternative energy resources
- (c) Energy related pollution
- (d) Inefficient use of energy

The most important issue was identified as water which was discussed in detail and was further classified into three main categories that is resource, pollution and drinking water (potable water). The expert panel discussed the major challenges in water related issues. It was discussed that water scarcity is becoming a serious issue all around the world and Pakistan is no exception. Historically, the water crises originated in the Middle East and naturally it lead to arm conflict over the resources. The water resources, including fresh and ground water has shrunked fastly and water availability per capita is going to be reduced also (Chietigj, 2006).

Pakistan, India and China have been sharing same water supplies originating from Tibetan Plateau (Figure 1) (Yang and Du 2004), Tibetan China, India, and Pakistan's status has gone near to water-scarce countries list quickly. If we go back into history, we find that in 1951, India's annual water availability per person was 5,277 m³. In the 1990s, it fell to 2,464 m³. By 2025, it is projected to fall dangerously close to the 1,000 cubic meters level (Vandana, 2002). As for China; its water availability per person was 4,597 in 1950 and 2,427 in the 1990s – slightly above the sufficiency threshold level. However, by 2025, it is assessed that China's water availability will plummet to 1,818 m³, an alarming number for an approximate population of 1.5 billion (Charles et al., 2003). Finally, Pakistan's water availability per person in 1950 was an amazing 10,590 m³ per person. However, it fell drastically to 3,962 in the 1990s and is projected to level out at 1,803 by 2025.

RESULTS AND DISCUSSION

Water related Issues

The expert panel on environment highlighted the causes, remedies, policy recommendations and projects on water, which includes water as a resource (surface, ground and coastal water), water pollution (industrial, municipal, agricultural and mining) and drinking water (depletion etc.) The causes which were identified include; mismanagement, climate change, deforestation, population increase, poverty, lack of political will and vision, enforcement and implementation problem, unequal distribution of wealth, lack of media role in environment awareness among masses, less proportion of literacy rate, lack of youth population trend towards environment, lack of social cohesiveness towards environment, use of environmental friendly technologies

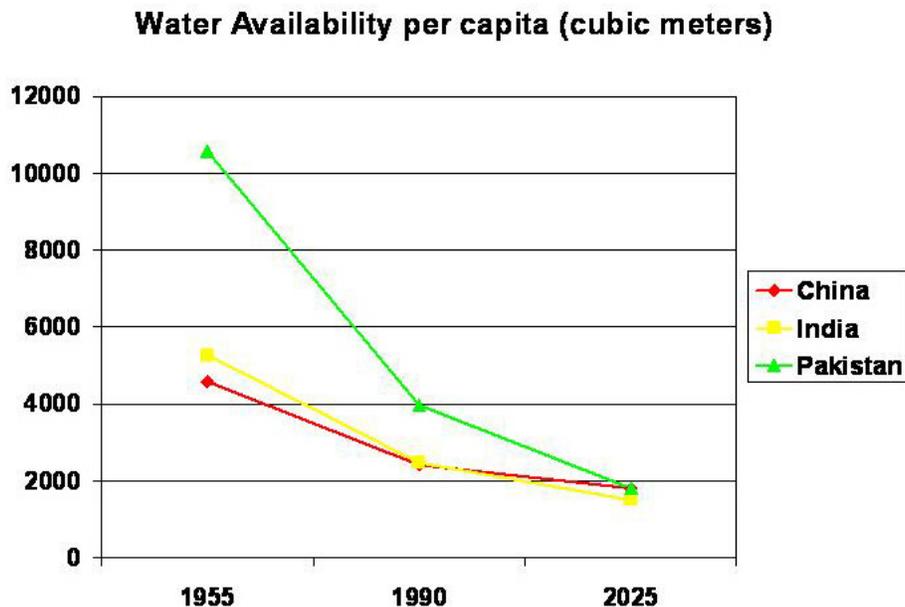


Figure 1. Water supplies originating from Tibetan Plateau.
Source: The China –India –Pakistan water crisis. Prospects for interstate conflict (James F. Brennan Lieutenant United States Navy B.A; Wabash College, 1997),

lacking, ethical issues, lack of women consciousness in environment related issues, lack of religious aspects towards environment, lack of mindset changes towards sustainable environment, inequitable water distribution and management in irrigation sector, in-efficiency in water distribution (water losses, theft, channeling etc.), droughts, lack of public participation, lack of latest technologies, lack of co-ordination among organization which are already working in water related issues, improper water supply, lack of water recycling and reuse, ground water contamination, excessive ground water harvesting, subsidies in electricity for tube-wells, ground water pumping, industrial demand, mangrove destruction, lack of understanding of coastal waters and coastal ecosystems, bleaching of corals due to climate change impacts, fishing of endangered species such as some sharks, cutting and lopping of mangrove forests, pollution risks from oil pouring in the sea, discharge of untreated waste in water bodies, lack of collection, disposal and management of domestic and industrial waste, excess use of pesticides and agriculture runoff.

Remedies

A number of remedies were listed down for the above mentioned issues which include; construction of reservoirs, water audits and licensing/water pricing, watershed management, forestation because forest play vital role in biological re-charge mechanisms, water recycling, rain water harvesting, through introduction of rain water collection system by using rain water barrels,

regular monitoring of water quality, awareness about water conservation with respect to religious and technical aspect, controlled pesticides usage and encouraging the natural organic farming, minimum use of pollutant, rural urban shift needs to be considered, district wise environmental study needs to be conducted to cope these issues, environment technology parks and incubation centers needs to be required, message oriented advertisements on water conservation strategies, political choices and awareness regarding water should be promoted, needs to exploit human resource in water conservation and management, water conscious society needed, water oriented education for youth required, youth can be a change agent for Pakistan, use of technology for water management for example G.I.S, introduction of water metering system, make efficient use of residential indoors and out door water by introducing water saver kits, education on water conservation, Pakistan Standards and Quality control authority should develop standard for clothes washer and make ensure implementation throughout the country, zoning of the coastal belt, afforestation of mangrove, control over fishing, reduced oil pouring into sea, implementation of ramsar, convention, minimize waste wherever practicable, use products designed to enable cost effective waste, reuse and recovery material where feasible, use products manufactured with minimal resource, consumption in the first place, use products efficiently and according to best practice, comply with waste legislation, enforcement of the waste management licensing regulations, waste minimization (reduce, re-use and re-cycling), promotion of bio-degradable waste for example replacement of

plastic shopping bags, Regulation of drinking water use for purposes other than drinking for example car wash with it.

Policy recommendations and projects

An integrated national water policy which encompass surface and ground water, water conservation strategies in selected cities of Pakistan based on the use of efficient technologies and other conservation measures to achieve greater water efficiency and increased sustainability within their jurisdiction, Installation of water recycling plants in selected cities of Pakistan, desalination of the brackish ground water by reverse osmosis, to establish Islamabad as a "water conservation conscious city.

Causes related to loss of biodiversity

Loss of biodiversity was recognized as the second most important burning issue by the panel which includes forestry, wildlife, rangeland and invasive species.

According to the experts, the causes for loss of biodiversity include; deforestation, population growth, desertification, land degradation, exotic species, diseases (for example Shisham die back in Pakistan), conversion of forests lands, over grazing, trampling, and other livestock grazing impacts on forests (clearly observed in scrub and thorn forests), in-effective management of forests at state and community levels, de-linking social aspects of forestry, hunting, land use changes, lack of planning, lack rule and regulations, lack of awareness, lack of policy implementation, cartagena protocol exists only for living modified organisms.

Remedies

Conserving natural forests with ecologically viable management, forests policy and management at national and provincial levels, forests harvesting within allowed scientifically proven incremental limits, re-forestation, and afforestation of degraded and denuded forest lands, controlling and regulating livestock grazing through rotational exclusion of grazing, promoting rainwater harvesting techniques, discouragement of ground water harvesting for irrigation in water stress areas, reclaiming waterlogged and saline lands with the involvement of local communities/private sector; and rehabilitation of degraded.

Policy recommendations and projects

The policy recommendations should encompass the following areas for sustainable range lands, biodiversity,

and forestry sectors in Pakistan.

(a) Population planning

The population planning agencies in Federal, Provincial and Local Governments and NGO's shall formulate and implement culturally appropriate strategies and action plans of invigorating population planning programmes in critical ecosystems such as the wooded mountain, arid, coastal and estuarine environments.

(b) Promotion of education in forest areas

The education departments in Federal, Provincial and local governments and NGO's shall intensify their activities for promoting education particularly female education in and around the forest areas. This will help in curtailing early marriages, reducing child bearing age and complement population planning efforts.

(c) Reducing firewood, fodder and timber use pressure on forest.

In order to reduce the use of firewood, fodder and timber the following steps should be taken for healthy and sustainable environment:

(i) All the concerned government agencies and international and national firms shall extend the supply of piped natural gas, LPG, Solar energy and micro-hydro power to areas of critical ecosystems, especially the wooded mountains and coastal areas, so as to reduce the use of firewood, fodder and timber, which play an important role in environment rehabilitation.

(ii) All agencies which are carrying out research on domestic energy shall be assisted to focus on key priority research so as to reduce the cost and increase the acceptability of substitutes to firewood such as solar energy, bio gas, local coal etc.

(iii) Planting of multipurpose trees on the farmlands and wasteland shall be encouraged and promoted for use as fire wood, fodder and construction timber.

(iv) Plantations of multipurpose tree species shall also be promoted on communal wastelands.

(v) The import of timber and timber products shall be liberalized in order to reduce timber demand on meager forest resources.

(vi) Growing of fodder crops on farmlands shall be promoted in order to reduce grazing pressure on the forest and help establishment of natural regeneration.

(d) Reducing poverty

(i) In the poverty alleviation and other development programs high priority shall be given to integrated land use projects for the sustainable rehabilitation of natural resources with the participation of organized local communities. Such projects not only provide employment to the rural poor but also increase household income

from agriculture and live stock thereby reducing dependence on meager forest resources.

(ii) The sustainable utilization of non wood forest products like medicinal plants, mushrooms, honey, gums wild fruits and nuts shall be promoted as income generating activities for the rural poor.

(iii) Eco tourism shall be promoted in the mountain areas by way of identifying and publicizing the sites for rock climbing, trekking, wildlife spotting/sighting, and photography, trophy hunting and fishing.

(iv) Federal, Provincial and District Governments shall create job opportunities through skill development in the mountainous areas of the country.

(e) Reducing political interference in Forestry and Wildlife Departments:

(i) Government shall maintain and improve the status of professionals relating to forests, rangelands and wetlands for ensuring the realizations of the goals of this policy. Interference of non professionals in their management of the respective natural resources shall be eliminated.

(ii) Raising of awareness of the general masses about natural resource management and use

(iii) Ensuring the civil society has a say in natural resource planning and management through the creation of round tables at provincial, regional and district level; and,

(iv) Creation of independent forestry commissions at provincial level for monitoring and overseeing the affairs of the forestry sector.

(f) Biodiversity

(i) The provincial governments and other administrative units shall be encouraged and assisted in establishing national protected area system covering all types of ecosystems including juniper forest and chulghoza forest of Baluchistan and spruce forest in Northern areas and some samples of primary forest.

(ii) It shall be ensured that at least 12% of land area of all representative ecosystems in Pakistan is protected.

(iii) Such protected areas shall be surrounded by buffer zones and linked by biological corridors where necessary.

(iv) Overlap between the protected area system and biosphere systems shall be avoided.

The local people having rights in any ecologically sensitive area shall be involved in decision-making process of including the area in national protected area system.

(v) Areas included in national protected area system shall be managed with active participation of the communities.

(vi) Conservation, sustainable use and farming of wild species shall be given priority in development planning.

(vii) Appropriate incentive measure shall be provided to improve local livelihoods supporting biodiversity conservation.

(viii) The traditional knowledge of the local people shall be documented for protection of intellectual property rights under an improved proprietary rights regime as protected areas system wide management plans shall be drawn up.

(ix) Conservation of bio diversity shall be integrated in to all sectoral and cross-sectoral national and provincial, level strategies.

(x) The federal government shall provide financial, technical and operating support to the provincial wildlife departments in conservation efforts and implementation of inter national treaties and conventions ratified by the government of Pakistan.

(xi) The approach of collaborative management and trophy hunting shall be extended to other areas.

(xii) The capacity of the department staff and communities shall be built in different disciplines of wildlife management.

(xiii) Measures shall be taken for the captive breeding of wildlife, particularly the endangered species.

(xiv) To ensure proper conservation uniformity shall be brought in wildlife laws and rules presently in vogue in different provinces and administrative units.

(xv) Check posts shall be established at all airports and seaports to check the illegal trade of wild animals, birds and their products.

(xvi) It shall be made obligatory for the custom staff at airports and seaports not to allow trade in wildlife species and their body parts with out valid documents from the competent, governments.

(xvii) All the wetlands falling in forest and grasslands shall be conserved in accordance with the obligation of Ramsar convention on wet lands of international importance.

(g) Semi-arid and arid range lands

(i) The government and civil society institutions shall undertake a sustained awareness raising campaign about the importance of rangelands.

(ii) The government of Pakistan shall provide financial assistance for rehabilitation and sustainable management of these ranges – a part of the poverty alleviation funds in the districts will be dedicated for this purpose.

iii) Range management and rehabilitation plans shall be developed and implemented through community participation.

(iv) Proper incentive measures including assured tenurial and usufruct rights, legal reforms and financial mechanisms would be designed to compensate the pastoral communities for restoring and maintaining the ecological health of the range lands.

(v) The local governments shall develop effective periodic closures of rangelands to rehabilitate them and ensure sustainable livelihood to range dwellers.

(vi) Integrated development projects shall be initiated in these areas with focus on restoration of community

based management systems.

vii) Alternate approaches shall be tried for rehabilitation and sustainable management of rangelands.

(viii) Planting of multipurpose tree species shall be encouraged in order to meet the local needs of fodder, firewood and timber.

h) Sub alpine and alpine pastures

(i) The restoration and sustainable management of these pastures shall get priority in development planning.

(ii) The restoration process shall be executed through grazer's participation.

(iii) The awareness level of the grazers shall be raised and their capacities built in sustainable management approaches and techniques.

(iv) Rotational grazing shall be introduced for restoring the health of the pastures.

(v) Suitable fodder tree species shall be planted on the boundaries and along the ravine for increasing the fodder supply.

(vi) Where soil erosion is taking place, suitable soil conservation measures shall be adopted.

(viii) In depleted pastures, ecological balance of species will be restored to enhance the fodder and nutritious value of the pastures.

(ix) Corridors will be identified and secured for the passage of the migratory livestock through the natural forests in transit to the pastures, especially where security of regeneration of a forest(s) may so warrant.

The panellist emphasized launch of the following projects in biodiversity sector of Pakistan:

(1) Aggressive afforestation and reforestation programmes with plantation suited to the looming climate change.

(2) Biological control of forest pests by maintaining viable populations of predatory birds and insects through restricted use of chemical insecticide.

(3) Preservation of rangelands through Increase of grasslands using appropriate varieties of grass in saline and waterlogged zones to prevent their degradation.

(4) Assisting genetically impoverished species or those that have important ecosystem functions by providing natural migration corridors as well as assisted migration.

(5) Use of gene banks, seed banks, zoos and botanical gardens for preserving genetic diversity and conserving species.

Issues related to solid waste and energy

Other issues such as solid waste and energy were also discussed by panel; they highlighted that solid waste and energy problem is also creating alarming condition in Pakistan. The sectors contributing in solid waste and

energy identified by expert panel were Industrial, Urban, and Hospital waste while in terms of energy residue burning, alternative energy resource, energy related pollution, and inefficient use of energy were identified. They found that in present situation water and biodiversity both are very critical and in coming fifteen years their condition will become more worsening than present. Moreover, the biodiversity sector can also help to overcome the energy crises. Therefore, experts focused and stressed on water and biodiversity related issues for creating sustainable economy in Pakistan.

Conclusion

From the environment foresight, Pakistan faces some serious challenges on the horizon. Amongst which water and loss of biodiversity are the most significant. The panel agreed to the fact that Pakistan will become a water scarce country if urgent steps are not taken to tackle the issue and already it is considered amongst the most water-scarce countries in the world. Per capita availability of water has reduced significantly over the years. A large number of population does not have access to clean drinking water with more than 90% of water being consumed for our Agriculture. In addition to water, other issues such as loss of biodiversity, solid waste and energy were considered to be major challenging areas for Pakistan on the horizon of next ten to fifteen years and a collaborative and a coordinated approach on part of all stakeholders will be needed to overcome these issues in an effective manner.

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