In the name of Allah the most beneficial and merciful

Development of Nanotechnology in Pakistan:

- International Conference on Nanotechnology for Safe and Sustainable Development and Consultative Meeting on ASEAN Nano Safety Networking Platform

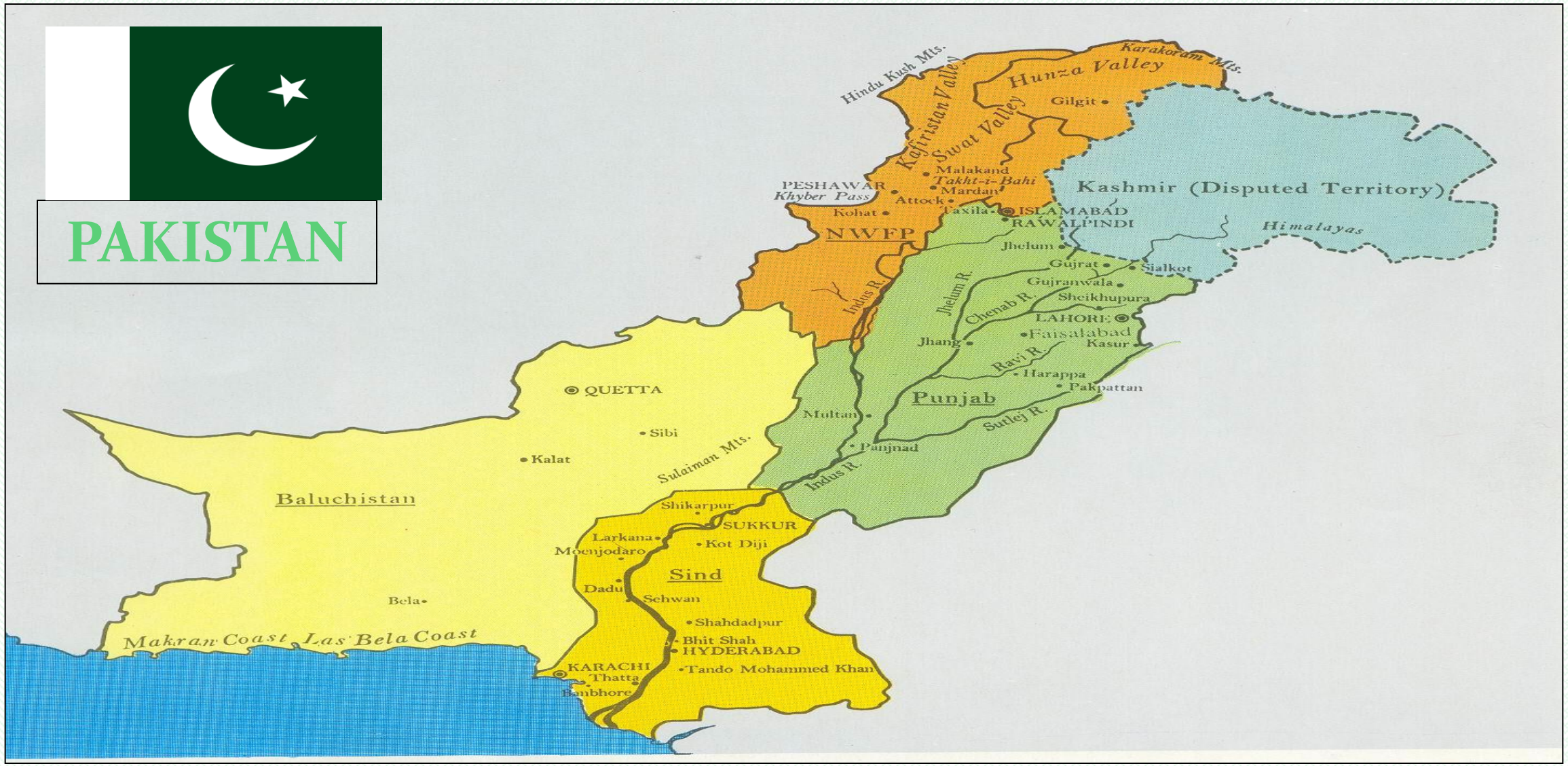
2-4 May, 2017

Kuala Lumpur, Malaysia

Fazal Abbas Maken

Secretary

Ministry of Science and Technology ,Government of Pakistan, Islamabad


PAKISTAN
Hindu Kush Mts.
Karakoram Mts.
Kafiristan Valley
Swat Valley
Hunza Valley
Gilgit
Malakand
Takht-i-Bahi
Mardan
PESHAWAR
Khyber Pass
Attock
Taxila
ISLAMABAD
RAWALPINDI
Kohat
NWFP
Kashmir (Disputed Territory)
Himalayas
Jhelum
Gujrat
Sialkot
Gujranwala
Sheikhupura
LAHORE
Faisalabad
Kasur
Jhang
Harappa
Pakpattan
Punjab
Multan
Panjnad
Sutlej R.
Ravi R.
Chenab R.
Jhelum R.
Indus R.
QUETTA
Sibi
Kalat
Sulaiman Mts.
Baluchistan
Shikarpur
SUKKUR
Larkana
Moenjodaro
Kot Diji
Sind
Dadu
Sehwan
Bela
Shahdadpur
Bhit Shah
HYDERABAD
Tando Mohammed Khan
KARACHI
Thatta
Sambhore
Makran Coast
Las Bela Coast

Vision on Nanotechnology

- Promotion of Nanotechnology figures conspicuously in the Vision 2025 document
- It is an important plank of the Science & Technology Policy 2012
- There is broad recognition of the role of emerging technologies like nano-technology to foster sustainable development and global competitiveness through an innovation-driven knowledge-based economy

Main Features of Previous Policy

- To establish centralized national research facility for development of Nanotechnologies and products to meet national requirements.
- To enhance research capacity of existing nanotechnology Centers
- Human resource development to meet future needs of the country
- Supporting start-ups for developing and commercializing products using nanotechnology

Initiatives
Under
Ministry of Science & Technology

Establishment of National Commission on Nano-sciences and Technology (NCNST)

(Established in 2003 under the administrative control of Ministry of Science & Technology)

- **The Objectives of the commission were**
  - Human Resource Development
  - Infrastructure Development
  - Research & Development
  - Dissemination of knowledge
  - Industrial liaison

Contd.

Research Projects initiated by NCNST

No.	Project/Areas	Lead Institutions
i.	Synthesis and Characterization	Pakistan Institute of Engineering and Applied Sciences
ii.	Nano-magnetism	Qauid-i-Azam, University, Islamabad
iii.	Micro/Nano electronic devices	Comsats Institute for Information Technology
iv.	Nano-Composites	Ghulam Ishaq Khan Institute of Engineering Sciences and Technology
v.	Nano-biotechnology	National Institute for Biotechnology and Genetic Engineering
Vi	Nano-devices, L.E.D. etc	Pakistan Institute of Nuclear Science and Technology
vii.	Nano Coating	Pakistan Council of Scientific and Industrial Research

Current Areas of Nanotech Research

Institutions	Areas of Nanotechnology Research	Relevant industries
PCSIR PhD. 06 Pub. 17	Nano-coatings, Nano-fabrication, Nano-catalysis, Nano-fertilizers, Nano-adsorbents, Nano-filter, Nano-composites, Magnetic materials, semiconducting materials, nano- antiseptic materials	Health care; Agriculture; Textile; Surgical tools; Biomedical; Environment; Electronics; Coatings
NUST PhD. 13 Pub. 95	Nano-catalysis, Photovoltics, Nano-composites, Nano-biomaterials, Functionalized graphenes, nanoferrites	Fuel cells; Petroleum Industry; Health; Defense
CIIT PhD. 24 Publ 106	Carbon nano-composites, Optically active nanomaterials, Conducting materials	Energy, Electronics, Biomedical
University of Peshawar PhD. 21 Pub. 26	Drug carriers for liver cancer , Gas sensors, Antimicrobial agents, Lubricating greases, Cosmetic products, Photocatalysis, Polymer-matrix composites, Wear resistant metal-matrix composite coatings.	Health care, Environment, Transportation, Electronics, Coatings
LU PhD. 04 Pub. 21	Nanomaterials, Nanobiotechnology, Functionalized nanoparticles and nanocomposites	Biosensing Disease diagnostics Bacterial detection Drug/gene delivery

Current Areas of Nanotech Research ...Contd

Institutions	Areas of Nanotechnology Research	Relevant industries
GIKI PhD. 01 Pub. 10	Nano-sensors,	Environment
BZU PhD. 02 Pub. 65	Nanomaterials, Nano-LC in earlier cancer diagnostics	Clinical diagnosis
PINSTECH PhD. 11 Publi.79	Biosensors, Energy storage devices	Li-ion batteries
IST PhD. Nil Pub.04	Composite Thin films, Fabrication of metal oxides	Photovoltaic applications
PU PhD. 04 Pub.29	Thin films, Magnetic materials, Semiconducting materials	Energy, Electronics
NIBGI, PAEC PhD. 04 Publi. 61	CNT composites, Hydrogen storage materials, Photo-luminescent materials, Optically active materials	Electronics, Energy, Fuel cells

Current Areas of Nanotech Research …Contd

Institutions	Key areas of Nanotechnology Research	Relevant industries
NILOP, PAEC PhD. 03 Pub. 50	Quantum devices	LASER
Air University PhD. 05 Publ 12	Nano electro mechanical systems,	Semiconducting
PIEAS PhD. 07 Pub. 54	Nanomaterials, Conducting materials	Electronics, Environment, Catalysis
NCP PhD. 08 Pub. 175	Nano-catalysis	Environment, Petroleum Industry, Edible Oil Industry
UET PhD. 10 Pub. 24	PV Cell Fabrication, Carbon based nanostructures, Graphene Layers cleavage, Magnetic and optical nanostructures	Electronics, Fuel Cells, Energy

…Contd

Current Areas of Nanotech Research

Institutions	Key areas of Nanotechnology Research	Relevant industries
NTU PhD. 03 Pub. 07	Antimicrobial agents, Water-repellant nanofabrics, Self-cleaning fabrics	Healthcare, Hygiene Textile, Protective textiles, Home Textiles
QAU PhD. 03 Pub. 50	Semiconducting materials, Magnetic materials, Nano-catalysis, Polymer nano-composites, Thin layer films, Hydrogen storage materials	Catalysis, Environment, Photovoltics, Electronics, Energy
GCU Lahore PhD. 03 Pub. 09	Nanomaterials	Energy, Environment
University of Karachi PhD. 02 Pub. 09	Self-assembled nanostructures, bio-sensors, lab-on-chip, immunoassay	Medical diagnostics

Education

- **28 R&D labs and Universities offering degree programs in Nanotechnology**
  - **Under Graduate:**
    - PINSAT (BS 4yrs)—2010
    - International Islamic University,Islamabad (BS 4yrs)-2012
    - GIK, Topi (BS 4yrs)—2015
    - KKK University, Karak (BS 4yrs -2016).
    - UET, Lahore (Short courses)
  - **Graduate/ Post Graduate:**
    - CIIT ,Islamabad(MS)--2014
    - CSSP,P.U. Lahore (MS/Ph.D)
    - NUST (MS)--2015
    - IST, Islamabad (MS)—2014

Nano-Products

From Lab to Market

PV

PVD coated Bio-implants


TiCN


TiCN-MP


TiAlN
TiAlN
µAlTiN


CrN


CBC CVIc

From lab to market

Antiseptic bandages

- Antiseptic bandages based on doped metal nanoparticles extracts for effective treatment of external wounds

Nano-filter material

- Nanoparticle impregnated ceramic based nanomaterial for microbial decontaminatio n and chemical treatment of potable water.

Nano-fertilizer

- Micronutrients encapsulated nano-composite NPK fertilizer for slow release of nutrients into soil enabling early flowering of plants

From lab to market

Nano porous materials

- Nanoporous material with enhanced water retention capacity to be used in water shortage areas to promote agriculture

Nano-catalysts

- Nanocatalysts for treatment of water contaminated with organic and inorganic pollutants and microbial contaminants

Nano-adsorbents

- Nano-adsorbents for the adsorption of heavy metals from wastewater

Challenges in Commercialization

Challenges in Commerialisation

- Capacity issues of organizations for developing standards and certifications
- Availability of financial resources
- Inadequate mechanisms for commercialising the technology
- Inadequate human resources
- Legal framework - Patent and copy rights
- Lack of coordination between Industries Universities and Research centers
- Companies prefer to attain technical knowledge from developed countries

Creating an Enabling Environment

- Government support for Nano-manufacturing and institutional infrastructure
- Formulation of standards related to material characterization and standards for device fabrication and testing.
- Regulatory requirements
  - EPA - product risk assessment
  - FDA - Use of products in food and drugs
  - EU - Classification, Labeling and Packaging (CLP)Regulations
  - NIOSH - Managing the Health and Safety Concerns Associated with Engineered Nanomaterials
- Social concerns
  - Use and acceptability of nanotech based poducts

Strategy
To
Promote Nanotechnology

- Collection of database pertaining to identification of potential R&D and Nanotechnological applications in Pakistan.
- Capacity building to enhance the number of researchers in this field
- Strengthening of Nanotech labs in Universities/R&D institutions
- Collaboration of Pakistani researchers with foreign universities/ research groups

Contd…

- **Establishment of National Center of Nanotechnology (NCN)** alongwith Nanotechnology Industrial Park, with the involvement of private sector
  - Centre will act as focal point for Nanotech R&D activities in Pakistan.
  - Center will be multidisciplinary in nature and will cover development of wide range of nano-materials for potential applications spanning from bio-nanotechnology to information technology.
  - Areas of Research will be
    - Identification and characterization of Nano-materials
    - Industrial Nanotechnology / Nano-materials
    - Molecular Nanotechnology for health applications
    - Nano-Biotechnology
    - Nano-electronics
    - Environmental Nanotechnology
  - Center will develop strong linkages with Industrial sector of Pakistan for speedy transfer and utilization of new technologies

International Collaboration

International Collaboration

- Prioritisation of areas of research in the vast field of nanotechnology, keeping in view local needs and capacities
- Collaborative research amongst various countries in the field of nanotechnology
- Joint educational programmes in this field
- Transfer of technology through:
  - Sharing of skills & knowledge
  - Regional workshops
  - Exchange of faculty/researchers
  - Establishment of Joint Ventures

Thank You