Water, Energy, and Food Nexus in Pakistan: Implication for Adaptation

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Food, Water, and Energy Security

• Pakistan’s agriculture depends on irrigation
• Agriculture uses over 90% of water resources
• 80% of cultivated area irrigated
• 90% of agricultural output from irrigated land
• About 50% households depend on irrigated agriculture for their livelihood
• Wheat & rice are the main staples; both are highly water intensive
• Increased demand for water for food & energy
Food, Water, and Energy Security

- Pakistan stands 76th of 107 countries in Global Food Security Index
- 58% of households food insecure, 19% moderate hunger, 9% severe hunger
- Water stressed – 1/3 people lack safe drinking water
- 30% of population lacks electricity, 50% rely on biomass for cooking
- Shortfall in electricity more than 5,000 MW
- Climate change – additional impact on WEF
Increasing Food Demand

- Population growth, urbanization, economic growth, growing middle class, changes in lifestyle & resource use patterns

- By 2030:
  - Population **240 million**, Cereal demand up by **60%**
  - Food production need to be increased ~ **2%**
  - Water demand up by **55%**
  - Increasing water & energy intensity in agriculture

- Changing dietary patterns
  - Per capita consumption **of rice, meat**, fruit, vegetables increasing; wheat consumption slightly decreasing
Increasing Water Stress

- Growing demand for water for agriculture, energy, industry, environment & domestic water use
- Declining water availability
  - Current annual per capita water availability ~1,090 cu.m
  - By 2030, may decrease further
- High water withdrawal (74%) leads to environmental risks
- Groundwater depletion in certain areas
- Water shortage may become a limiting factor for food production
Population growth vs Water Availability
Intensifying Energy Crisis

- Electricity shortfall now about 25%
- Energy shortage has crippled economic growth
Pakistan’s irrigation becoming energy intensive
- **Surface water irrigation decreasing**
- Groundwater irrigation & mixed (surface + groundwater) **irrigation increasing**
- Over 60% of irrigation is either groundwater or mixed
- 11% of irrigation is use

Increased use of groundwater for irrigation leads to higher energy demand
Fuel Mix 2012-2013

- Oil: 35.9%
- N Gas: 28.2%
- Hydro: 31.1%
- Nuclear: 0.1%
Adaptation Issues & Challenges

- Increasing population pressure
- Shrinking water resources
- Climate change - uncertainty in water availability
- Ageing irrigation infrastructure
- Inefficient irrigation
- Overexploitation of ground water
- Shortage of electricity - High diesel cost
- Energy intensity high, efficiency low
## Adaptation Issues & Challenges

### Cereal yield (t/h)

<table>
<thead>
<tr>
<th>Country</th>
<th>Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>France</td>
<td>7.60</td>
</tr>
<tr>
<td>Egypt</td>
<td>6.0</td>
</tr>
<tr>
<td>China</td>
<td>5.9</td>
</tr>
<tr>
<td>India</td>
<td>2.9</td>
</tr>
<tr>
<td>Pakistan</td>
<td>2.7</td>
</tr>
</tbody>
</table>

### Productivity of water (kg/m³)

<table>
<thead>
<tr>
<th>Region</th>
<th>Productivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>America</td>
<td>1.56</td>
</tr>
<tr>
<td>China</td>
<td>0.80</td>
</tr>
<tr>
<td>India</td>
<td>0.39</td>
</tr>
<tr>
<td>Pakistan</td>
<td>0.13</td>
</tr>
</tbody>
</table>

Increasing water intensive crops

### Utilization of water in major crops

<table>
<thead>
<tr>
<th>Crops</th>
<th>Area (million ha)</th>
<th>Water (million cu.m)</th>
<th>Water intensity (cu.m/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice</td>
<td>2.4</td>
<td>70.5</td>
<td>29.2</td>
</tr>
<tr>
<td>Cotton</td>
<td>3.0</td>
<td>51.4</td>
<td>17.4</td>
</tr>
<tr>
<td>Wheat</td>
<td>7.6</td>
<td>51.4</td>
<td>6.8</td>
</tr>
<tr>
<td>Sugarcane</td>
<td>1.1</td>
<td>48.9</td>
<td>46.2</td>
</tr>
</tbody>
</table>
Adaptation Options

- **Supply side options**
  - **Increase water storage capacity** - Mangla & Tarbela have lost 25% storage capacity.
  - Sustainable use of hydropower potential (micro & macro), (60,000 MW)
  - Repairing, maintaining irrigation infrastructures
  - Multipurpose use of water
  - Diversifying energy resources - Solar pumped irrigation
Optimum use of water storage & hydropower potentials

Potential Hydropower sites in KPK
Potential Hydropower Sites in Gilgit-Baltistan
Demand Management

• Demand management of Water & Energy
  – Water use efficiency - In Pakistan, by increasing 10% irrigation system efficiency could bring about 2 million ha land under irrigation
  – Productivity Enhancement
  – Adoption of water saving technologies/practices

• Increasing water use efficiency:
  – China increased irrigation efficiency by 20% -
  – In Malaysia, farmers increased water productivity 45%
Demand Management

• Engage private sector- In Australia, Coca Cola company invested in water use efficiency both in operation & management of watersheds- reduced per unit of water use in beverage production & improved quality of watersheds

• Switching to less water demanding crops

• Break Sectoral Silos- From sectoral approach to a holistic approach
Break Sectoral Silos

Life in a Matrix

I'm looking for help on this, virtual team...

Land: It's not part of our remit

Water: We are fully committed

Energy: We want to help but...

Traditional silos getting in the way?
Demand Management

• From sectoral approach to a holistic approach
• Complementarities & synergies among the three sectors
• Systemization of planning & decision making at national level
• Nexus smart infrastructure, multifunctional ecosystems & innovative technologies
Towards a policy framework for adaptation in food-water-energy nexus

Harmonize public policies
- Shared policy goals – joint visioning and planning
- Integration of nexus perspective
- Horizontal and vertical consistency
- Resolve policy conflicts and inconsistencies

Align Strategies
- Screen strategies through nexus lens
- Mutually reinforcing adaptive strategies
- Identify and quantify trade-offs
- Manage trade-offs
- Exploit synergies across the sectors

Converge incentive structures
- Screen instruments through nexus lens
- Align incentives towards shared goals and remove inconsistencies
- Target incentives towards nexus smart investment and technologies

Regulate/promote nexus smart investment
- Regulate unsustainable use of resources
- Mobilize public awareness, engage multiple stakeholders
- Encourage investment to exploit win-win opportunities in nexus solutions
- Remove barriers to nexus smart investment

Strengthen cross-sectoral coordination
Strengthen institutional capacity
Mainstream the nexus approach in development planning processes
Thank you