Water-Energy-Food Nexus In the Indus Basin of Pakistan: Role of Technology Transitions, Organizational Change, and Policy Reform

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A lack of understanding of the emerging inter-linkages between critical water, energy, and agricultural systems is contributing to serious resource shortages in many countries in the short term and is impeding optimal infrastructure planning for the long-term. In developing countries, there is often incomplete and inaccurate information regarding availability and use of resources. Furthermore, pace of institutional and policy change lags behind that of technology transitions. These factors are creating new challenges for public agencies in ensuring energy, water, and food security for growing populations. This seminar highlights these issues for Pakistan, the sixth most populous country (with approximately 180 million people) that is facing stagnation in agriculture, low productivity of water, and rising energy intensity. Pakistan's Indus Basin Irrigation System consists of 3 large dams, 19 barrages, and 60,000 kilometers of gravity-based distribution channels that serve 44 million acres of contiguous cultivated land. This large-scale system was originally created to distribute the waters of the Indus and its tributaries over arid plains for agriculture, however it now implicitly serves as well to recharge aquifers that provide groundwater on demand. Irrigation in the region has evolved into a conjunctive system where ground water increasingly augments surface water supplies. An important consequence of this transition has been increased dependence of agricultural production on direct energy (through consumption of light diesel oil and electricity by irrigation pumps). In Punjab province alone (the country's largest agricultural region) there has been an exponential growth in the groundwater pumping installed base – expanding from 0.23 to almost 1 million wells – and a tripling of installation density from 50 to 150 wells per irrigated hectare. This increased dependence on energy for accessing irrigation water has created an intensified coupling of water, energy and crop production in the basin that has important socio-economic implications for the country. This case will be used to discuss the implications of resource couplings, and the needs for new policy paradigms and organizational change.