Understanding the Water-food-energy nexus in the Cauvery River Basin, India

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Background:

- Addressing the scale of the nexus in a large growing economy such as India is a challenge, but this is a country where the nexus problem is very “real”.
- Investment in irrigation technology (when available) is driving a change in crop production to more high value commodities at the expense of staples .
- Subsidised energy and fuel potentially drive over exploitation of groundwater resources.
- Urbanisation will significantly impact on the supply markets and chains
- Understanding the tensions between desirable centrally planned ‘sustainability’ targets and the economic realities that individuals/farmers face (that in turn drive resource consumption and choices) are critical.

Aim:

To evaluate the identified links within the WEF nexus and with the social, economic and environmental changes in the study area using the existing data and literature in order to develop a socio-ecological system approach for assessing trade-offs generated from resource use in various sectors.

Methods:

- Collecting and analysing spatial and non-classified datasets of projected climate change, gauging station, weather station, agriculture, land use, and demographic changes in the study area from web based sources, government agencies and research institutes using spatial and statistical tools.

Figure: Use of electric motor pumps in agricultural fields for extracting ground water

Water for food/fodder/fiber

- Irrigation
- Water for processing and consuming food
- Water for livestock, poultry and fisheries

Impact of food sector on water resources:

- **Increasing food demand resulting in overexploitation of ground water and changing hydrology**
- **Dietary habits- low water efficient food items (e.g. animal based food)**
- **Food export and import- virtual water transfers**
- **Waster water generation from food processing industries**

Impact of water sector on food sector

- **Development of water structures has changed the geomorphology impacting the nutrient flow essential for agriculture.**

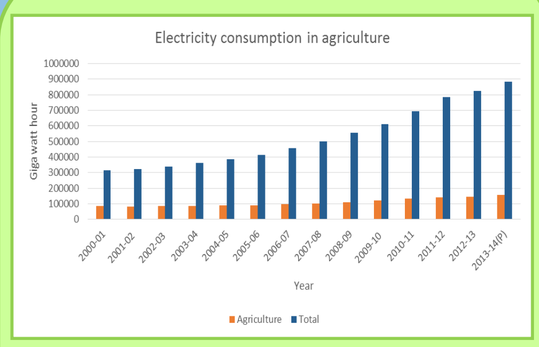

Figure: Chart showing the steady increase in the electricity consumption in the agriculture sector in India from 2000 to 2014.

Energy for food/fodder/fiber

- Agricultural machinery
- Producing and processing agricultural inputs (e.g. pesticides, high variety of seeds)
- Transportation, storage and processing crop and animal products.
- Consumption of food

Food/fooder/fiber for energy

- For bio energy production
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Energy sector and food sector competition for water and land

Figure: Aerial view of Mettur Dam, Cauver River, Tamil Nadu. Catchment area is 42217 km^2 , storage capacity is 2708.8 MCM, purpose-irrigation and hydro-electricity. The figure shows the obstructed natural river flow and morphological alteration of the stream

Energy for water

- Extraction and transportation of water
- Water and waste water treatment

Water for energy

- Hydro-power generation
- Coolant in power plants
- Extraction and refining of fuel

Impact of energy sector on water resources

- **Large hydro-power projects-changing hydrology and geomorphology**
- **Increasing abstraction of ground water-increasing consumption of fuel (diesel, coal, electricity**
- **Subsidised electricity supply-exploitation of ground water**

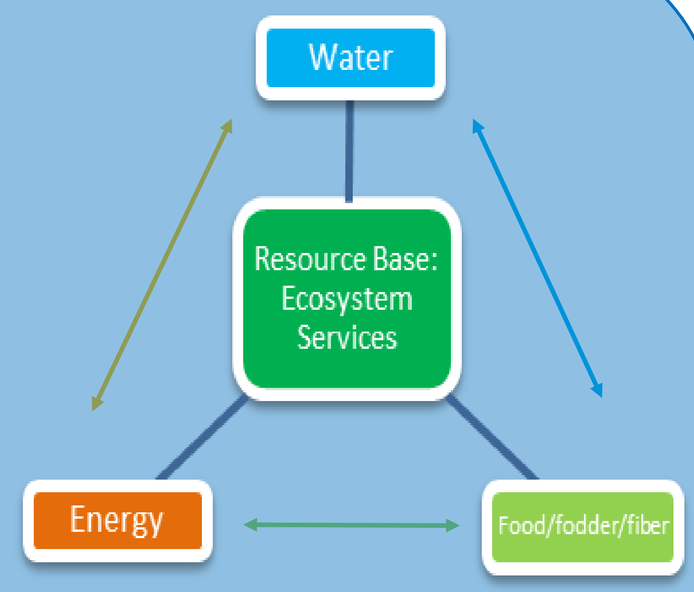

Figure: Interlinks in the Water-food-energy nexus Source: Adapted from FAO Nexus approach

Water-food-energy-climate change

- Consumption high water consuming meat diet and processed food items is increasing the water and carbon footprints and GHG emissions per person.
- Increasing prosperity may increase the amount of food waste, hence wastage of energy and water.
- Emissions due to consumption of conventional sources of energy for agriculture production and thermal power production is adding to the atmospheric carbon.
- The projected impact of climate change on precipitation is not certain, the negative impact of global warming has been assessed for rice, maize and wheat production in tropical region.
- Climate change tends to increase energy and water demand for cooling.

Water-food-energy-ecosystem

- Provisioning and supporting ecosystem services are the resource base for water, food and energy and regulating services provides carbon sink.
- Human interventions posing threats on ecosystems and deteriorating the ecosystem services leading to resource insecurities and increased competition between sectors.

Study Area: Cauvery River Basin, India

- Area: 81,155 km^2
- Administrative boundaries: Tamil Nadu and Puducherry (54%), Karnataka(42%), Kerala (4%)
- Climate: Semi arid tropical
- Average annual water potential: 21.36 Billion cubic meter
- Mean annual rainfall: 1075.23 mm
- Number of water structures: dams(96), barrages(10), anicuts(16), lifts(9), power houses(24)
- Number of irrigation projects: 66
- Number of hydro-electric projects: 15
- Major land use: agriculture(66.21%), forest(20.50%), waterbodies(4.09%), built up land(4.01%), wasteland (3.9%), grassland(1.3%)

Figure: Cauvery Basin Drainage map and Sub-basins Source: ISRO, 2014