SNAK (Smart Nexus for Agriculture in Korea), Experience of Korea on WEF Nexus

2020. 8. 31

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Project Title
Development of Water-Energy-Food Nexus platform associating with climate change impacts (2018-2019)

Goals

- Evaluation of sustainability of water, energy, food through the analysis of food demand according to population & climate change, and of the amount of water and energy resources use
- Provide decision-making system and policy scenarios that consider the linkage of climate change, water, energy, food to policy makers
Basic data collection & set up

Climate change
- Past weather
- GCMs
- Down-scaling

Food resource
- Production
- Soil
- Cultivation area
- Cultivation system

Water resource
- Reservoir
- Surface Water
- Groundwater
- Desalination
- Aquifer

Energy resource
- Electric Power
- Renewable
- Fossil Fuel

Assessment of resource management scenarios by nexus system

Crop modelling
- Crop growth
  - Paddy Rice
  - Cereals
  - Vegetables
  - Others

Physical Modelling
- Irrigation system
  - Hydrological characteristics
  - Energy
  - Greenhouse gas emission

Climate change
- Food resource management scenario
  - Energy resource management scenario

Impact assessment
- Environmental
  - Available Water
  - Energy security
  - Greenhouse gas
  - Food self-sufficiency rate
- Economical
  - Benefit/Cost Analysis
    (Farm income, Cost for water and energy, Opportunity cost etc.)

Nexus modelling
- Inventory
  - Scenario application
  - Model linkage
- Test bed
  - Scenario analysis
  - Trade-offs Analysis

Environmental & economical assessment of resource management scenarios by nexus analysis, and test bed
### Data Collection

- Weather Data
  - Weather Station
  - Historical Data
  - GCM (Climate Change)
  - Etc.

- Water
  - Pumping Quantity
  - Water Supply System
  - Water Use Amount
  - Etc.

- Food
  - Crop Production Amount
  - Crops Characteristics
  - Soil Types
  - Cultivation Methods
  - Cropping Systems
  - Etc.

- Energy
  - Energy Type
  - Energy Use
  - Energy System
  - Etc.

- Reference Data
  - Productivity
  - Unit Cost
  - Unit Value
  - Etc.

### Inventory Construction

<table>
<thead>
<tr>
<th>Nexus Terms</th>
<th>Resource, Types</th>
<th>Relation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>Surface water</td>
<td>Resources</td>
</tr>
<tr>
<td></td>
<td>Groundwater</td>
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<td></td>
<td>Etc.</td>
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</tr>
<tr>
<td>Food</td>
<td>Crops</td>
<td>Crop types</td>
</tr>
<tr>
<td></td>
<td>Etc.</td>
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<tr>
<td>Energy</td>
<td>Electric</td>
<td>Resources</td>
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<tr>
<td></td>
<td>Oil</td>
<td></td>
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<td></td>
<td>Gas</td>
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<td>Solar</td>
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<td>Wind</td>
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<td></td>
<td>Etc.</td>
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<tr>
<td>Water for Food</td>
<td>Water requirement</td>
<td></td>
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<tr>
<td>Food for Water</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Energy for Food</td>
<td>Fertilizer</td>
<td>Unit Amount</td>
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<tr>
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<td>Chemicals</td>
<td>Unit Amount</td>
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<tr>
<td>Food for Energy</td>
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<tr>
<td>Water for Energy</td>
<td>Pumping</td>
<td>Pumping Cost</td>
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</table>

### Analysis, Simulation

- Weather Data
  - Conversion
  - Downscaling

- Water for Food
  - Water Requirement
  - Water Productivity

- Water for Energy
  - Etc.

- Food for Water
  - Etc.

- Food for Energy
  - Etc.

- Energy for Food
  - Unit Energy Use for Fertilizer, Chemical, Machinery, Transportation
  - Unit Cost

- Energy for Water
  - Unit Pumping Energy

### Nexus Construction

- Models
  - Vensim
  - Stellar
  - Simulation Models

- Sustainability Analysis

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**By: Choi, J.Y. (SNU)**
Highlight

https://jabistar.com
Use of SNAK for Agricultural Policy

**Agricultural environment conservation program : Water management for paddy field**

<table>
<thead>
<tr>
<th>Policy Measures</th>
<th>Resources Assessment</th>
<th>Sustainability</th>
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</thead>
<tbody>
<tr>
<td></td>
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<tr>
<td>Irrigation Method</td>
<td>Water (1,000 m³)</td>
<td>Energy (Gcal)</td>
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<tr>
<td>Continuous</td>
<td>8,122</td>
<td>1,142</td>
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<td>Intermittent</td>
<td>6,982</td>
<td>1,106</td>
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<tr>
<td>Change Rate(%)</td>
<td>△14.0</td>
<td>△3.2</td>
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</tbody>
</table>

* Area 1,000ha, Rate of water source (Reservoir 70: Pumping station 30), Amount of fertilizer(9kg/10a)

**Agricultural environment conservation program : Assessment of climate change impact**

<table>
<thead>
<tr>
<th>GCM</th>
<th>Policy Measures</th>
<th>Climate Change Scenario</th>
<th>Resources Assessment</th>
<th>Sustainability</th>
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Use of SNAK for Agricultural Policy

- Response to climate change: Evaluation of performance indicator for GH gas reduction

- Performance indicator: Rate of intermittent irrigation area in paddy field (97%)

<table>
<thead>
<tr>
<th>Policy for Climate Change Response</th>
<th>Irrigation Method</th>
<th>Applying Area (10,000ha)</th>
<th>GHG (t CO₂eq)</th>
<th>Water (10⁶m³)</th>
<th>Energy (Gcal)</th>
<th>Food Production (1,000ton)</th>
<th>Economic Analysis (B/C)</th>
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<td>Change Rate (%)</td>
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<td>△13.6</td>
<td>△3.1</td>
<td>3.06</td>
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Future of SNAK

- Advancement of SNAK: 2 Projects promotion
  - Development of water-energy food nexus technology for agricultural drought impact assessment (2021-2023)
  - Development of evaluation index for agricultural environment conservation program using water-energy-food nexus (2021-2025)

- Future Plan for SNAK: Linkage with Resilience
Development of Water-Energy-Food Nexus
By Cooperation of All
Thank you!