

A development of system dynamics model for water, energy, and food nexus (W-E-F nexus)

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ABSTRACT

Water, energy, and food security already became a risk that threatens people around the world. Increasing of resources demand, rapid urbanization, decreasing of natural resources and climate change are four major problems inducing resources' scarcity. Indeed, water, energy, and food are interconnected each other thus cannot be analyzed separately. That is, for simple example, energy needs water as source for hydropower plant, water needs energy for distribution, and food needs water and energy for production, which is defined as W-E-F nexus. Due to their complicated linkage, it needs a computer model to simulate and analyze the nexus. Development of a computer simulation model using system dynamics approach makes this linkage possible to be visualized and quantified. System dynamics can be defined as an approach to learn the feedback connections of all elements in a complex system, which mean, every element's interaction is simulated simultaneously.

Present W-E-F nexus models do not calculate and simulate the element's interaction simultaneously. Existing models only calculate the amount of water and energy resources that needed to provide food, water, or energy without any interaction from the product to resources. The new proposed model tries to cope these lacks by adding the interactions, climate change effect, and government policy to optimize the best options to maintain the resources sustainability. On this first phase of development, the model is developed only to learn and analyze the interaction between elements based on scenario of fulfilling the increasing of resources demand, due to population growth. The model is developed using the Vensim, well-known system dynamics model software. The results are amount of total water, energy, and food demand and production for a certain time period and it is evaluated to determine the sustainability of resources.

Keywords: W-E-F nexus, System dynamics model, Vensim

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