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Climate Change Related Simulation Modeling: Research Opportunity for Social Science

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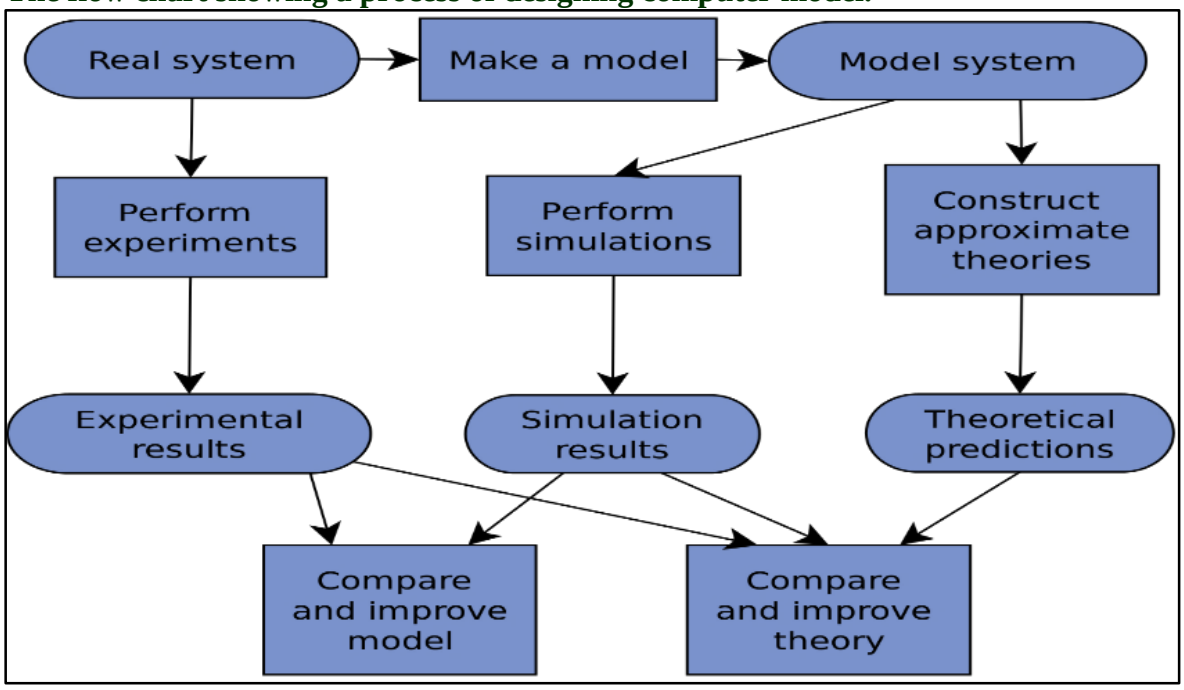
SUMMARY

Indian agriculture is witnessing a wide variety of impacts of climate change. These impacts are responsible for fluctuations in monsoon cycle which affects the crop production scenario at national level. In order to understand the interplay of various climatic factors and their implications for Indian agriculture would be a relevant study for policy makers. Therefore, this article provides glimpse of some simulation models that can be undertaken by the scholars of social sciences for investigating climate change impacts on agriculture.

INTRODUCTION

Invention of computers was probably one of the most revolutionary change for the 21st century. It couched almost all aspects of businesses, science and technology, defense, agriculture, health care and so on. The computing brought lots of ease of doing businesses and the storage and retrieval of information was much convenient. In addition, computing changed the way mathematical experiments were conducted and impossible type of equestrians were solved within few minutes. In fact, the big data analysis was made possible due to the advances in computing only. The computer aided modelling made it possible. Computer modelling is a process of writing or designing computer program with mathematical equations which represent physical, biological or social systems. This allows the user to design and conduct experiment which otherwise need huge amount of money and resources. The computer simulation that run as per the mathematical commands written in program has potential to produce outputs in the form of table, diagram, graph, visualization or a map which cannot be easily done using traditional mathematical analysis or routine natural experiments.

Figure 1. The flow chart showing a process of designing computer model.



(Source: Wikipedia contributors. (2021, May 18), Computer simulation)

At present there are several modeling languages such as graphical as well as textual. And the models can be categorized as mechanistic, static, dynamic, stochastic, deterministic, simulation, and explanatory models

(Murthy, 2002). For the agriculture sector, crop models are very popular. These crop model play crucial role in predicting behavior of crop in presence of various variable such as soil, weather, temperature, water availability, fertilizer dosages, tillage, erosion of soil, etc. In other words the crop models are capable to generate results that consider the interplay of various factors (variables) and quantitative outcome is provided. For example, let's consider a crop model for rice crop. One can use it to study the predictive performance of that crop or a particular rice variety for India. And then User can feed the data for 50 districts related to soil, weather, temperature, water availability, fertilizer dosages, tillage, erosion of soil into the model along with the ideal requirements by rice variety.

After simulation runs, model will produce predictive yield (for instance Quintal / acre) for 50 districts. This would save the cost of conducting experiments for all those locations and results can be obtained for standard conditions. In the second phase, reliability of the results can be tested by choosing multi-location trials at most suitable districts only. Furthermore, researcher can change the values of various variables and see the performance of particular rice variety in different agro-ecosystems such as high temperature, or high rainfall or highly humid or in desert setting etc. and so forth. These simulations would be generating the results at different scales, such as filed level, zonal level, regional level, national level or global level. This enables researchers to extrapolate the results of their model for providing recommendations to the larger scale.

CONCLUSION

The model is an excellent way to study about complex system, transforming important information in knowledge, and transferring this knowledge to others (Neto *et. al.* 1982). So, the scholars of the social sciences disciplines can utilize this opportunity to develop and implement models to study the interplay of various socio-economic variables. In addition, Monteith (1996) has said that crop models can play a key role in developing the quality of products along with sustainable development. So, in this context, development of future models with possibility to integrate socio-economic variables into the same program environment would enable agricultural scientists to decode the interplay of crop model results into the specific socio-economic system. In fact, Jones *et.al.* (2017) underlined that there is a need of focused effort to connect various agricultural systems modeling, database, harmonization and open-access data for ensuring future model development for sustainable food production. Therefore, active participation of researchers from social sciences are crucial to build next generation agricultural system model in an integrative manner. Few years it was very difficult to buy packages of programming languages and to get hands-on training with writing codes for simulation model for agriculture. However, in the present Covid-19 pandemic many resources are available online to learn and acquire skill related to programming. Most importantly promising modeling language and environment like "R" are available now a days and one can utilize without any cost.

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