Mathematical Modeling As A Tool For Sustainable Development

Soumen Chandra Kundu
Assistant Teacher, Hura High School (H.S), Purulia, West Bengal

ABSTRACT *This article describes Mathematical modeling as indispensable tool for sustainable development. Sustainable development is to balance our economic, environmental and social needs allowing prosperity for now and future generations. Mathematical Science plays as tackle the challenges facing our planet. Mathematical modeling plays useful roles towards sustainable development in arriving the understanding, prediction and control of development process. Mathematical modeling can be a powerful tool for understanding and observed phenomena which cannot be understood by verbal reasoning alone. It is conclude that for sustainable development, it is necessary to build mathematical model.*

Keywords: Mathematical Modeling; Sustainable Development

INTRODUCTION

Mathematics plays a predominant role in our everyday life. In Mathematics, Mathematical model is the application of mathematics to solve real life problems. Mathematical modeling is used widely in the natural science, engineering discipline and social science. Mathematical modeling is the process of formulating and improving a mathematical model to represent and solve real world problem. Sustainable development is development that meets the needs of the present, without compromising the ability of future generations to meet their own needs. Mathematical modeling plays useful roles towards sustainable development in arriving the understanding, prediction and control of development process. For sustainable development, it is necessary to build comprehensive math models.

LITERATURE REVIEW

Holbrook. Jack (2009) conducted a study on meeting challenges to sustainable development through science and technology education. Here shown that science and technology education must do more than simply pay 'lip service' to sustainable development and must focus learning on issues of relevance facing society. **Kalu A. Ugwa & Agwu A. (2012) conducted** a study on mathematical modeling as a tool for sustainable development in Nigeria. Here looked at the advantage of mathematical modeling over other types of modeling and classified math models. **R. N. Singh (2014)** conducted a study on mathematical models in sustainable development .Here exponential and logistic equation models as used in studies of growth of population, water quality, fishery and economy. Sustainable development requires designing mathematical models. **Nampally Lakshmi & Nagabhushan Kundarapu(2018)** conducted the study on the role of mathematics in sustainable development. Here reflects social implication of mathematics education for sustainable scientific and technological development. **B. japamala Rani and G. Bala Sowjanya (2018)** conducted a study on importance of mathematics in sustainable society. This paper focus on promotion of mathematical research encourages teachers at all levels of education to raise awareness of the key issues and informing the general public of the essential role that mathematics plays.

Component of Sustainable Development:-

The components of sustainable development divide into three elements social, economic and environmental. Social components-workers healthy and safety, equal opportunity, quality of life, benefits to disadvantage groups. Economic components-creation for new market and opportunities for sale growth, cost reduction through efficiency and improvements and reduces energy and raw material inputs. Environmental components-unpolluted environment, effluents generation, emission into environment, resource management, habitat restoration and preservation, use of renewable raw material, elimination of toxic substances.

Need for Sustainable Development:-

The idea of sustainable development is essential to address the following issues:

1) Prevent the environmental degradation
2) to ensure a human life
3) to check the exploitative technology and find alternative sources
4) to check the cover exploitation and wastage of natural resources
5) to regenerate renewable energy resources etc.

Symbolic representation of mathematical model:-
Symbolically, define mathematical modeling as follows
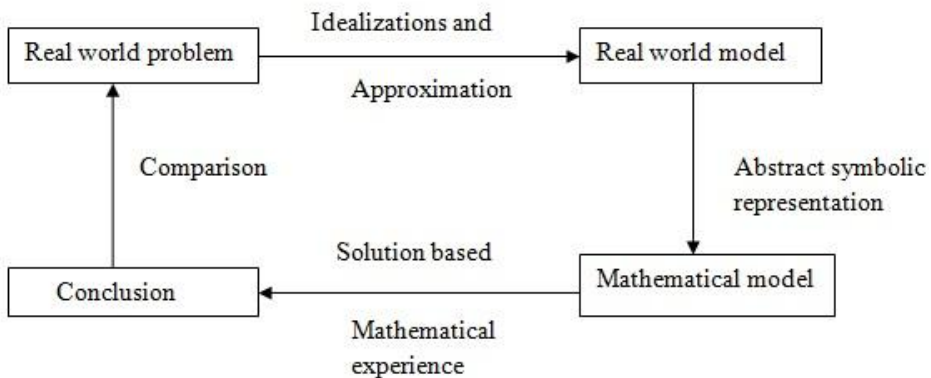
Classification of the model and the forms of model equations:-
Classification of the models and the forms of model equations are given below by Table 1 &
Table 2

Table 1

Group of models	Classification	Criterion of classification
I	Mechanistic	Based on mechanism/underlying phenomena
	Empirical	Based on input-output, trials or experiments
II	Stochastic	Contains model elements that are probabilistic
	Deterministic	Based on cause effect analysis
III	Lumped parameters	Dependent variables not function of special position
	Distributed parameters	Dependent variables are a function of special
IV	Linear	Super position principle applies
	Nonlinear	Super position principle does not applies
V	Continuous	Dependent variables defined over continuous space time
	Discrete	Only defined for discrete values of time/or space
	Hybrid	Containing continuous and discrete behavior

Table 2

Type of model	Equation Types	
	Steady state problem	Dynamic problem
Deterministic	Nonlinear algebraic	ODEs/PDEs
Stochastic	Algebraic/difference equation	
Lumped parameter	Algebraic equations	ODEs
Distributed parameter	Elliptic PDEs	Parabolic PDEs
Linear	Linear algebraic equations	Linear ODEs
Nonlinear	Nonlinear algebraic equations	Nonlinear ODEs
Continuous	Algebraic equations	ODEs
Discrete	Difference equations	Difference equations

How Mathematical modeling is related to Sustainable Development

Biodiversity, climate change, water resources, hazardous waste, nuclear waste, population dynamics etc is the some global sustainable development problem .these problem are describe by mathematical model. The sustainability of planet Earth depends on mathematical science. Every phenomenon on earth is subject to mathematics, which is the only language we can use to describe them. Moreover, mankind must factor mathematics into any approaches it takes to addressing said challenges. Climate change, protecting biodiversity, tackling pollution, controlling epidemics, and ocean sustainability, natural disaster (volcanoes, earthquakes and tsunamis) are all subject to linear and nonlinear differential equation.

Earth interior mantle, terrestrial crust, atmosphere and the life that it sustains are all subject to dynamics process. Mathematical model sustain the majority of human activity on the planet.

Mathematical model are used to solve many real life situations like:

1) Mathematical modeling of launching a satellite.
2) Mathematical modeling of urban city planning.
3) Mathematical modeling of controlling pollution due to vehicles.
4) Mathematical modeling of the traffic flow on highways or the stock market options.
5) Mathematical models to understand the working of heart, brain, lungs, kidneys, and the endocrine system.
6) Mathematical models to estimate the population of India in the year 2050 AD(without waiting till then)
7) Mathematical models to demonstrate the action of medicine in the human system.
8) Mathematical models for global warming.
9) Mathematical models to understand the fluid flow in drains ,lakes, rivers, spillways, and so on

Mathematical model are recognized as effective tool that could help examine economic, environmental and ecological impacts of alternative pollution control and resources- conservation actions, and thus aid planners or decision –makers in formulating cost –effective management policies.

CONCLUSIONS

Mathematics plays big role in sustainable development in all of its aspects: social, environmental and economic. Many developmental challenges could be solved if it is possible to get mathematical models that could describe them. The sustainability of planet Earth depends on mathematical science. Mathematical modeling has a vital role to play for a sustainable development.

REFERNCES

1. Aris, R.(1994). Mathematical Modeling Techniques . Dover, New York.
2. Gershenfield, N. (1998). The Nature of Mathematical Modeling. Cambridge University Press, London.
3. Kapur, J.N. (1994). Mathematical Modeling, Wiley Eastern Limited
4. Upadhyay, R.K. (2013). Introduction to mathematical modeling and chaotic dynamics, CRC press
5. Chidambaram,M. (2018). Mathematical Modeling and simulation in chemical engineering, CAMBRIDGE UNIVERSITY PRESS
6. Odumosu,M. O. & Eguntola, E.G. (2010). Everyday Mathematics for Sustainable development in 21st century: Pre-service teachers perception .In G.A. Ajewole (Eds.), Everyday science connection for Sustainable development in the 21st Century (pp 185-190). Lagos: TOMIC MG INT'L VENTURES.