Available online at http://www.journalijdr.com

IJDR

ISSN: 2230-9926

International Journal of Development Research
Vol. 08, Issue, 07, pp.21756-21758, July, 2018

ORIGINAL RESEARCH ARTICLE OPEN ACCESS

A SYSTEM APPROACH TO NATURAL RESOURCES UTILIZATION

***Dr. Hussein M. Reda**

Industrial Engineering Department, University of Business and Technology, Saudi Arabia

ARTICLE INFO

Article History:
Received 29st April, 2018
Received in revised form
20th May, 2018
Accepted 20th June, 2018
Published online 30th July, 2018

Key Words:

System Modeling, Resources Utilization,
System Dynamics, National Development,
Resources and Technology,
Resources and Transportation.

ABSTRACT

Natural resources are substances deposited by nature within a defined geographical region and used by man. They have a major economic significance in any national economy. However, their economic contribution is only a function of how they are fitted in a multi sector economy. A system approach to natural resources utilization is defined as one which treats resources as a sector in a system of many sectors such as technology, production facilities (e.g. transportation network), manufacturing, trade, and others. Some of the dynamic interactions between the resources, technology, and transportation sectors are discussed. Then, a structure of a system dynamics model is presented including its basic objectives and features. Finally, two examples of feedback loops are presented, followed by general recommendations for further investigation and research.

Citation: Dr. Hussein M. Reda, 2018. "A system approach to natural resources utilization", *International Journal of Development Research*, 8, (07), 21756-21758.

INTRODUCTION

Resources can be defined as the function which a substance performs or participate in to reach a goal or purpose (Cody *et al.,* 1980). Oil was not a resource to early man, for he had no use for it; but in today's society, oil serves as an important resource because it fulfills various important functions as energy or lubricant for machinery and as raw material for man-made products. In each case, it serves a functional purpose. If the day comes when other substances can achieve these goals more efficiently, and oil no longer performs a function, oil will cease to be a resource. Thus, resources are the creation of nature and man. Natural substances exists on earth but only when man finds a function which they can serve or a need which they fulfill that they become resources.

Natural, or basic resources may be grouped into two categories

Fund or exhaustible resources, for which nature has set an outer limit on the amount available: and Flow or renewable resources, for which usually there is a continuing supply in nature.

****Corresponding author:*** **Dr. Hussein M. Reda,**
Industrial Engineering Department, University of Business and Technology, Saudi Arabia.

Natural Resources: The role that natural resources play in the economy of a country is very much dependent on the country's structure. Natural resources alone cannot bring prosperity unless coupled with national strategy that mobilize all available resources (natural and human) to provide the social and physical infrastructure needed for industrial and other development. However, natural resources provide many opportunities for the achievement of development goals. Fund resources of high market value such as minerals, coal, petroleum and natural gas can be exported in exchange for capital which can be used to gain access to technology, to develop basic physical infrastructures, and to finance other development projects (Dorner *et al.,* 1980). Furthermore, development of the basic resources in itself induce many changes in the infrastructure and institutional facilities of the country. For example, transportation, and communication networks are usually needed to provide for the movement of material and the transfer of information. Other benefits include the contribution to the gross domestic product and to government revenues through direct government ownership or taxation which allows for the financing of public projects (Badiru and Adedeji, 2018). Another function that basic resources may play in a national economy is that of extending primary metal or resources processing downstream based on domestic resource production, thus providing added value income. Flow or renewable resources provide another source of national income and means for domestic development. Land, inland water bodies, and oceans are rich yet largely abused or neglected resources. Land that is developed and utilized can play a significant role in the achievement of national objectives. Resources which are tied to the land include crops production, livestock grazing, and forests. Basic products from land (food, wood, etc.) can provide for local consumption and in many cases for export. With adequate preparation and proper use of technology, land productivity can increase significantly. Food processing, and wood products and by products industries offer many economic added value possibilities (Dustin Chambers and Jang-Ting Guo, 2009). Water is another source of valuable resources. Besides the obvious human needs for water, many other functions are served by water. Such uses include industrial, municipal, recreation, irrigation, and energy production. Thus, it is evident that natural resources is an integral part in a system of multi sectors and any plans for their utilization should treat them as such. Some of the sectors in national economies which can be identified as closely tied with the resources sector include the countries technological and physical infrastructure bases. The importance of these two sectors in a system of national economy and their interaction with the resources base is briefly discussed next.

Technological Systems: A technological system refer to the network of possible interactions among basic research, applied science, engineering, production of goods and services, and other sectors of knowledge, skill, and society. Technology play an important role in any national resource utilization development plans. The specific technological patterns selected for use in agriculture, industry and mining for example are among the essential factors in balancing the relative contribution of these sectors and in deciding upon national utilization plans and strategies. For example in countries of limited agriculture lands, technologies of reclamation, cultivation, irrigation, and settlement can help to expand arable lands and assure more productive use of agricultural resources. Other technologies can be stimulated by demands from small industries, farmers, and handicrafts workers. Such simple technologies especially those which rely on renewable resources offer many opportunities for better utilization of indigenous raw material (Prasenjit Mondal and Ajay Dalai, 2017). For many decades, industry and modern agriculture have become more and more dependent on exhaustible resources. Dependable estimates of basic resources supplies in the physical sense and extent of their economic availability are critical to resource policy planning. Technology contribution is vital for resolving the issues of resource utilization and associated factors such as conservation, distribution, and pricing. Technology is represented in production by the choice and design of the process and hence the equipment, the specification of raw material inputs, and the quality of the product. It exists in the skill of workers, the capacity of management, the planning and control of operations, and in the economic aspects substitutability among the factors of production. In a modern society where prices, wages, raw material, energy, competition, consumer preferences, and market shares are continuously changing, national management cannot afford to neglect the influence of its technological systems in maintaining successful operations.

Physical Infrastructure: Similarly, the physical infrastructure base plays a major role in the utilization of natural resources. Facilities of production, transportation, and storage are considered as components of the physical infrastructure that a nation may possess. Of all the various infrastructure facilities, transportation plays a dominant role in promoting economic utilization of indigenous raw material. Its importance has long been recognized and is reflected in the development programs of most countries. An expanded national transport system can trigger a process of self-sustained growth. The development of a transport network links different regional markets of an economy and leads to better allocation of resources through a more rational distribution of material. In the short run, reduced transport cost resulting from system expansion create demands for both regional products and resources too. In the long run, new investments are encouraged in different locations particularly in backward areas, partly because idle resources are redirected into new enterprises. Increasing the speed and scope of the transport network also has beneficial effect on factor mobility, allowing material resources to be transferred more readily to places where they can be employed most productively. Other sectors that interact directly with the natural sector include for example labor, manufacturing, and trade. The complexity of their interactions as illustrated for the technology and transportation sectors requires the resolution to a systematic modeling procedure to provide a comprehensive coverage of the issues involved in natural resources utilization schemes. One approach that is particularly suited for modeling such complex issues is system dynamics.

Systems Dynamics: Generally, system dynamicsrefer to modeling of the feedback loop structure of complex systems. Itis a methodology that integrates complex components through a structured mathematical modeling procedure. Its main objective as an analytical tool is to understand the system behavior and the interactions between its components in order to examine and design various modes of strategic policies and trends. Jay W. Forester, provides some of the system dynamics features and principles are as follows (Forester, 1961):

Features and Objectives: A mathematical model of a system dynamics should aid in understanding that system. It should be useful guide to judgement and initiatives decision to help establish desired policies. Further, using a model implies that we have some knowledge about the detailed characteristics of the system. These known facts interact to influence the way in which the system will evolve with time. However, our intuitive ability to visualize the interaction of the parts is less reliable than our knowledge of the parts individually. Thus by constructing a model and observing the interplay of the factors within it we can reach a better understanding of the system with which we are dealing. Hence, a useful model of a real system should be able to represent the nature of the system and demonstrate how changes in policies, structure, or external events influence the system behavior.

Principles of the approach: The structure of a system dynamics model is seen as having four significant hierarchies: closed system boundary, feedback loops, levels and rates, and policy substructure. System dynamics deals with closed systems for which the behavior modes of interest are generated within the boundaries of a defined system. Components of the system are grouped into sets of feedback loops which interact to produce the system behavior. Loops are composed of two classes of variables: levels and rates. Levels define the state of the system, while rates change the values of these levels. The rate variables represent the rules or policies whereby the state of the system changes.

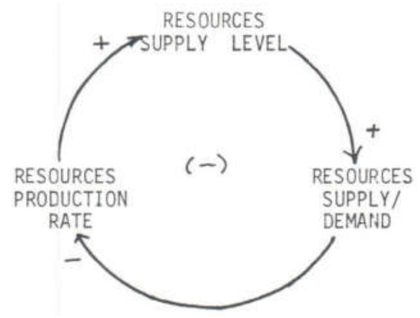

Figure 1. Example of a Negative Feedback Loop

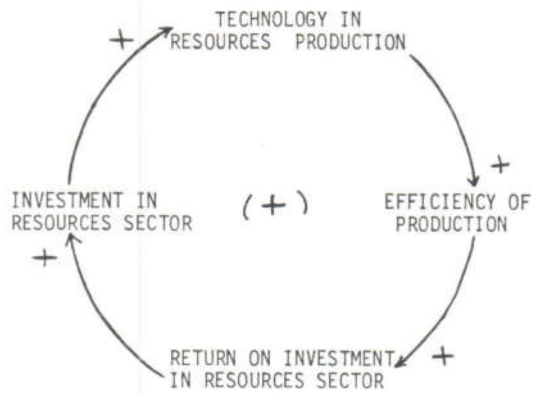

Figure 2. Example of a Positive Feedback Loop

Therefore, the appropriateness of a system dynamics approach for modeling natural resources utilization comes from the correlation between the modeling objectives and the principles of the approach. The common features are delineated as follows: A mathematical model is valuable because it can be manipulated more easily than descriptive models. Its logical structure is more explicit, thus it can be more readily used to trace assumptions to their resulting consequences. A dynamic model represent situations that change with time. It deals with time-varying interactions. A transient behavior describes those changes where the character of the system changes with time. A system that exhibits growth would show transient behavior since transient responses are one-time phenomena as compared to the repetitive pattern of a steady- state behavior. A closed model is one that internally generates the values of variables through time by the interaction of the variables one on other. Information feedback systems are essentially closed systems and they are self-regulating. However, exogenous inputs are included as independently generated variables and serves as excitation of the internal system responses. In obtaining explicit mathematical solutions, linear models are much simpler than nonlinear. However, such explicit solutions are generally unable to deal effectively with highly complex nonlinear socio-economic systems. Simulation methods that gives only a particular solution to a specified set circumstances can deal as readily with nonlinear as with linear systems. Thus, system dynamics provide a framework of philosophy and procedures that is particularly suited for studying the utilization of natural resources.

Basic Causal Feedback Loops: Causal feedback provides the basic structure of system dynamics models. A causal feedback loop consists of two or more variables. The relationship between a causal feedback loop variables can be either positive or negative. A positive variable relationship means that a change in one variable causes the other variable to change in the same direction. A negative relationship means that the affected variable reacts in a direction opposite of the initiating variable action. A set of interrelated variables forming a closed path represent a causal feedback loop. Such loops can also be designated as either positive or negative. In a positive feedback loop, if any variable changes, then the loop causes that variable to change further in the same direction. In other words, positive feedback loops generates self-reinforcing changes. However, if a variable in a negative feedback loop is changed, then the loop causes that variable to- adjust in the opposite direction. Thus, negative feedback loops produce self-regulating changes.

Examples of Feedback Loops: In modeling the utilization of natural resources system, several feedback loops can be constructed.Figure1showsan example of a negative feedback loop. The loop shows that resources production rate and supply levels are positively related. However, resources supply/demand variable is positively influenced by the resources supply level and negatively influence the resources production rate. The loop is self-regulating since a change in any of its variables in a given direction would causes it to change again in an opposite direction. An example of a positive feedback loop is shown in Figure 2. Since the loop is positive, a change in one of its variables would results in a similar change of all of the other variables in the loop.

Recommendations for further research: A system dynamics model can be constructed to simulate the working of a specific national system that integrates the sectors of resources, technology, infrastructure facilities, trade, manufacturing and other economic sectors. Reda (1985 & 1986) presents a prototype simulation model which can be employed to guide the development of a resources based national model. Such system model would address resources utilization concerns and questions such as exportation versus indigenous manufacturing or processing, and the selection of which manufacturing or down-stream processing industries.

REFERENCES

Cody, J.,H. Hughes, D. Wall, editors, 1980. Policies for Industrial Progress in Developing Countries, Oxford University Press, Washington D.C.

Dorner, P., M. el-shafie, editors, 1980. Resources and Development, The University of Wisconsin Press, Madison, Wisconsin.

Badiru, Adedeji B. 2018. "The many languages of sustainability: IE's should push for better resource utilization across all fields." Industrial Engineer, Nov. 2010, p. 30+. Academic OneFile.

Dustin Chambers, Jang-Ting Guo, 2009. "Natural Resources and Economic Growth: Some Theory andEvidence". ANNALS OF ECONOMICS AND FINANCE 10-2, 367–389.

Prasenjit Mondal, Ajay Dalai, 2017. "Sustainable Utilization of Natural Resources". CRC Press.

Forester, J., 1961. Industrial Dynamics, MIT Press, Cambridge. Mass.

Reda, Hussein, T. Green, 1986. A Prototype Simulation Model for the Study of socio-Economic Development Systems, Proceedings of the 1986 Summer Computer Simulation Conference, SCS, Reno, Nevada.

Reda, Hussein, 1985. A Theory for National Industrial Development Presented in a System Dynamics Model. A Ph.D. Dissertation, Virginia Tech, Blacksburg, Virginia.

****