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Modeling Approaches in Social Sciences: Critical Reviewing on Selected Models and Their Application in Bangladesh Context

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Abstract: It is currently being hardly used modeling applications as a tool for social sciences research methods in worldwide. Although theory has been used in social science research in a long time. But the application and practices of modeling approaches in social science research is much less than that. In our country Bangladesh, although the theory is applied in different branches of social science research on a small scale but still applying modeling tools for developing original research design is so less. Several secondary data sources have been used for collecting data and information for this compressive review of this paper. This paper examinations the Scopus Google engines bibliographic search, possibly the biggest database of peer-reviewed research literature on theories, models and modelling approaches of social sciences domain. Especially, the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) methodology flow diagram showing screening of the 370 articles primarily, then 260 articles were evaluated and finally it has been selected 140 articles those were analyses the modeling approaches. Also, PRISMA flow diagram is designed for gathering literature review process for screening application and importance importance of modeling methods in social sciences research. The paper has successfully identified the most important modeling approaches i.e. 25 for geography and environment, 20 for urban and regional planning, 20 for economics, 20 for government and politics, 20 for anthropology, 20 for public administration, 20 for sociology and social welfare research respectively. The findings also recommend if the research are designed by those modeling ideas at the socio-environmental and political aspects of Bangladesh, then the field of research in social science would be valued more wide and unique. Through this research, it would be possible to develop several models by applying these identified theories and modeling approaches that can play a vital role for improving the social sciences research portfolio in Bangladesh as well as the other nations.

Keywords: Modeling; Social Phenomena; Innovation; Validation, Social Science

Introduction

The focus of fundamental and applied research is to analyze the interaction of human and the social environmental aspects around them and to plan for the future generation accordingly (Semtner, 1995; Rummukainen, 2010; Ganju, 2016; Parna et al., 2018; Pasquale et al., 2021). All the elements of the human environment are hidden in the various basic disciplines of the social sciences (Mershon and Shvetsova, 2019). And to know about these, of course, the need for fruitful research in various subjects of social sciences is immense. Social science research provides trustworthy information to the people that are systematically recognized so that end users can rely upon it (Nisio and Battista 2010; Hafsa, 2019; Babalola and Nwanzu, 2021). It is well-know that the social science research helps to explain the nature and behaviors of the society and the attitudes of people, how society works, discovering all from generates of economic growth and causes of redundancy to what makes people happy in their respective society (Mahmud, 2008; Rahman et al. 2015). The important information of social sciences are vital and can

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be used for developing many conceptual and theoretical models. Among other properties, it helps to shape managment strategies and government policies to ensure the future policy frameworks also (Weber, 2011; Albert and Neil 2010; Oliverio, 2020). Social science research supports the community or society in finding the solutions to different social problems and issues (Lave and March, 1975; Box, 1999; Bilaniuk, 2008).

Since 1960, many common but scientific research methods have been applied for social science as examples case studies, historical research, interviewing techniques, stakeholder participation, field observation, social network analysis, questionnaire survey research and statistical analysis etc. (Haq 2020; Babalola and Nwanzu, 2021). Through these traditional reseach methods, it would be possible to develope more sceintific reserach standardized set of techniques for building scientific knowledge or models (Cheng, 2001; Westland, 2010; McKie and Ryan, 2012). Other selective components in social science research are generally used in to achieve the research objectives, analysis and confirmation of results of the particular research, error analysis, self-correction and quality controls etc. However, the innovation, development and application of modeling in the social sciences is extremely limited and it lags far behind the Western or developed world. (Smith and Davis, 2016; Babalola and Nwanzu, 2021). But in the current scientific evidences show that many the researchers are highly encouraged to use models when they can assist in identifying significant variables in such a way that tests of hypotheses can be defined more sharply in their innovative social sciences research (Argyriades, 2006). In generally, the model is considered theoretical aspects of social and learning philosophies inform the social infrastructure and socio-environmental development. Figure-1 indicates that Input-Output System of modeling parameters for social science research, how to model building for predicting the social problems and issues.

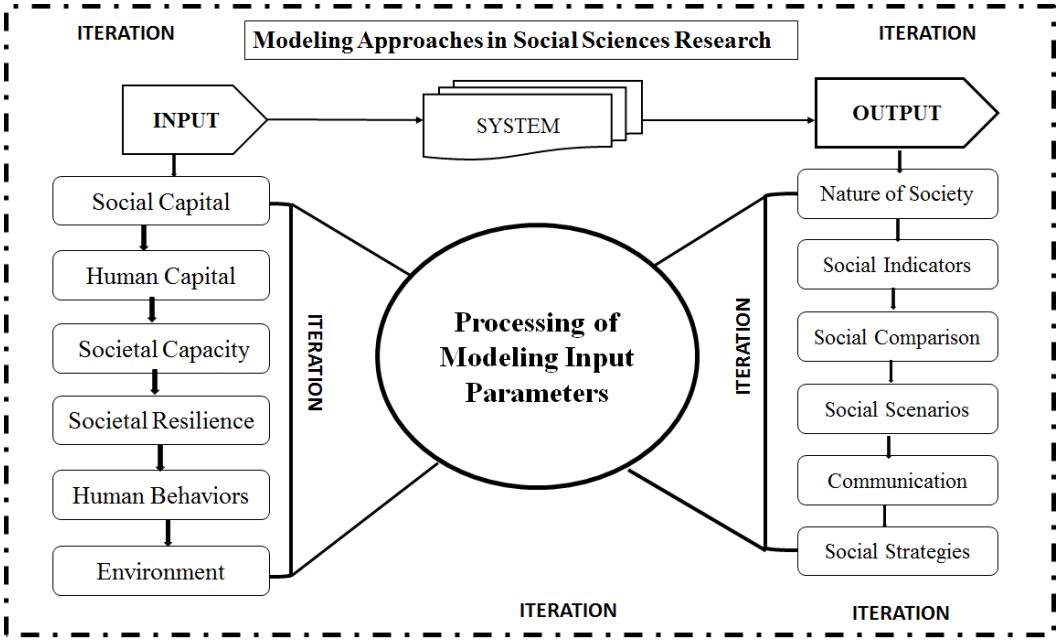

Figure 1: Input-Output System of modeling parameters for social science research, how to model building for predicting the social problems and issues.

Due to the skilled manpower and technological improvement in western world especially Europe, America and Asia pacific countries researchers developed many conceptual, theoretical and predictive models on social sciences research (Amy et al., 2003; Cumber and Githens, 2014; Xue et al., 2020; Allen, 2021). Problems were that all the social theories and models were developed in the above mentioned countries or regions especially on the basis of data collection from those areas (Lave and March, 1975; Box, 1999; Bilaniuk, 2008). But there is no doubt that models developed in social science research in Europe and America can be applied in practice and have the status of universal models. But the problem is that these models are modeled on the developed world, which is a real danger when applied in poor developing or underdeveloped countries (Mahmud, 2008; Rahman et al. 2015; Hafiz et al., 2020). Because in reality, these are not the models for the universal social system in the world. Therefore, understanding the structure, function, application and limitation of all these models, for a diverse society like Bangladesh, our sociologists or social sciences research should come forward for new model building and innovation (Hahl et al. 2016; Pasquale et al., 2021).

Significance of the Study

Now-a-days, many disciplines of the social sciences and its researchers are playing important role like the natural sciences, theoretical model building, hypothesis testing, and to make a comparative analysis (Amy et al., 2003; Hansen, 2003; Cumber and Githens, 2014; Xue et al., 2020; Allen, 2021). Apparently, the social scientists have acquired the inspiration for developing the modeling approaches in social sciences disciplines through the style of mathematical and econometrics modeling techniques used by the economists (Morton, 1999; Edling, 2002). In fact, in this age of information and technology, various aspects of the social sciences are in dire need of prediction, analysis, evolution and significant testing through modeling methods (Figure-2). The main goal of this study is to identify the source of the modeling method, to make a list of some models and to highlight the aspects of applying the models.

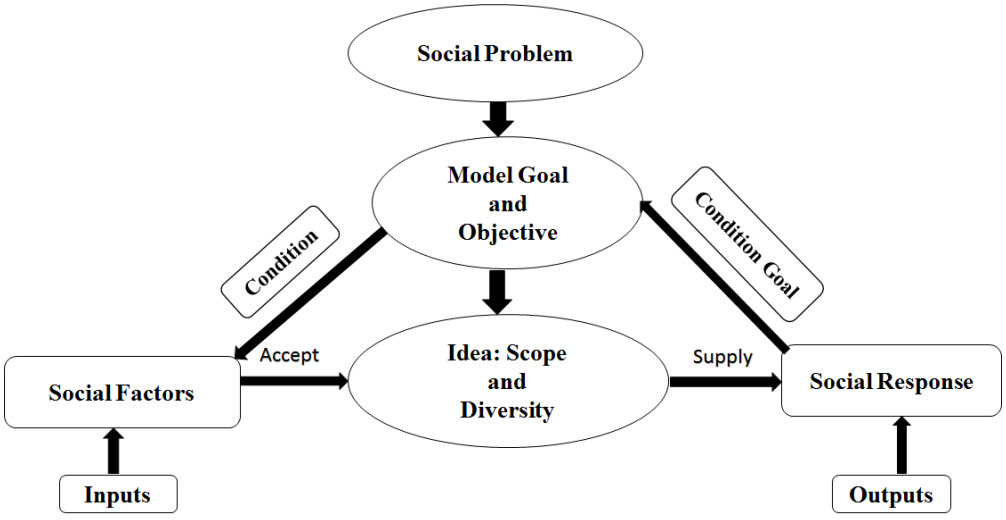

Figure 2: The rational-choice style of modeling in social problems from social factors to social response interacting the significance of model scope, goal and diversity.

In this review paper highlighted 145 social sciences related modeling approaches that could be the very helpful for doing social research and to prepare some models. Also, important research models have been presented in this paper so that the researchers in the social sciences can use their intelligence to create new research models with the help of numerical techniques, econometrics and machine-learning methods to develop social behavioral predictive models. (Edling, 2002; Kolkman et al., 2016; Haq 2020; Babalola and Nwanzu, 2021). If researchers can be able to do their fundamental and applied by applying modeling methods combining different types of theories in the social sciences, the stakeholders of the societal issues and problems will be to understand different elements of society, people and environment. Thus, modeling approaches in social science are very important because it provides an evidence-based foundation on which to build a more effective direction and consensus. Because these models help to understand the society structure and functions, and to know the societal behaviors. (Kolkman et al., 2016; Allen 2021).

Materials and Methods

In this study, a comprehensive review identify the Scopus Google engine's bibliographic search, possibly the major record of modeling related research literature on modeling approaches for social sciences research (Meraj et al., 2021). Systematically it has been searched for undertaking to appraisal all the works using a bibliographic Google/Google scholar search. The main criteria for selection has been included only modelling oriented paper published between 1960-2021 with the subsequent terms in the title, keywords, or abstract ("models" or "model application" or "social science" (Meraj et al., 2021). In this study, at first 370 papers have been selected that contained modelling approaches but carefully evaluation it has been selected for 2nd screen became more than 260 papers. Figure-3 mentioned that the indication of the literature review and study methods, design, information collection by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) methodology flow diagram showing screening of the 370 articles, 260 were evaluated and finally selected of 145 modeling approaches for future incorporating of social sciences research. The PRISMA is a screening oriented components or items for recording in methodical reviews and systems analysis (Moher et al. 2015; Shamseer et al. 2015). The PRISMA mainly attentions on the reportage of appraisals for assessing the effects of involvements, but can also be used as a basis for reporting the comprehensive reviews (Moher et al. 2015; Shamseer et al. 2015).

Research Context

In this study, a qualitative research design has been applied for collecting the data and other information. From the point of social science view, qualitative and quantitative research help to collect many evidences in the respective social attitudes, behaviours, and knowledge and human perceptions etc. Several content analysis and insensitive literature review follows the Scopus Google engine's bibliographic search has been applied for collecting, analysis and visualize data for this study. Also for collecting the baseline information like social capacity, social resilience, socio-economic, human attitudes and environmental status, it has also been studied books, many journals articles, periodic, blog and others secondary sources also.

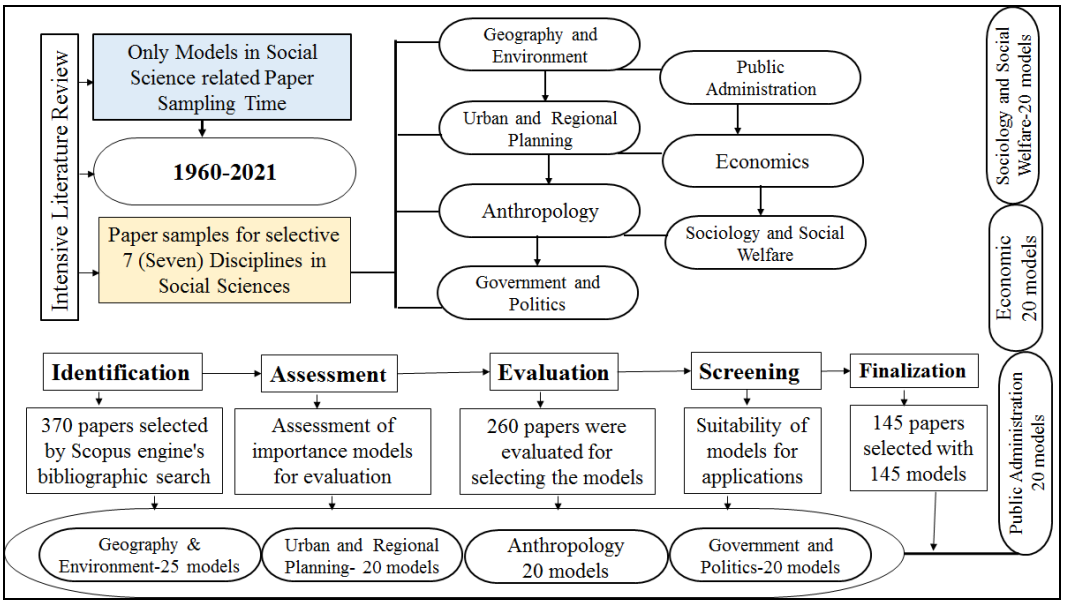

Figure 3: Indication of the literature review and study methods, design, information collection by PRISMA methodology flow chart showing screening of the 370 articles, 260 were evaluated and selected for 145 modeling approaches for future incorporating of social sciences research.

Aims and Objective of the Study

Various scientific research methods or techniques have been used for research in different branches of social sciences. But even if some theory or mathematical formulas are used in short range, but the application of modeling is very limited in social science research. Modeling is being used in basic research in various branches of science but the innovation, development and application of modeling in social sciences is very limited and it is far behind of the western or developed world. But in fact, the structure of the underdeveloped and developing countries social system, social environment, socioeconomic characteristics, human behavior and their customs, are very diverse. So if the researchers can combine the different theories and models of social science considering modern thinking and context, then it will be much easier to deal with human environment interactions in their respective society and other social problems and issues.

Models in any discipline enable the researcher to utilize a framework for understanding and solving a given problem in some contexts. In the case of social sciences in particular, there is a need to apply and develop modeling in research to create some scenarios of how difficult socioeconomic conditions change between people and the environment, and how complex social systems change over time, space and situation. There are some good quality research papers have been published in different branches of social sciences at the higher education level in Bangladesh. But most of the research works which have been performed using standard qualitative research methods and techniques. However, in some branches of social sciences, the researchers have successfully applied social theory and modeling approaches in the basic and applied research papers. The fact of the matter,

however, is that most of the research results demonstration that there is very little development or innovation of models in social science issues. And considering all these aspects, the aim and purpose of the present comprehensive review research paper has been fixed and summarized. Considering the above mentioned aims the specific objectives of the study are:

1) To identify the suitable models for selective disciplines in social science research,
2) To evaluate the implication of modeling approaches in the social science research;
3) To explain the challenges of model building constraints in the social science research.

Results and Discussion

Application of Modeling Approaches in Geography and Environment Research

Geography and environment is a dynamic subject of social sciences phenomena change in space and time. In many countries, including Bangladesh, Geography and Environment are taught in the Faculty of Social Sciences, Biological Sciences, Physical and Environmental Sciences. In some countries, Human Geography is also taught in the Faculty of Arts and Humanities. Therefore, in order to apply modeling to the subject of Geography and Environment, the researcher has to be proficient in Science, Biology and Social Sciences or Multidisciplinary approaches (Figure 4).

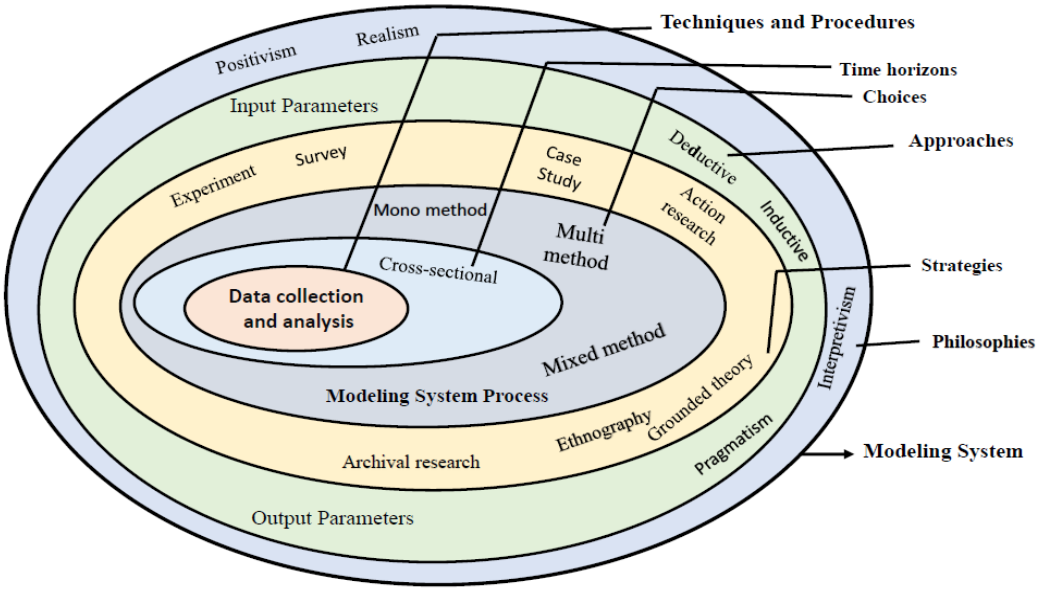

Figure 4: Implementation and interactions among the multidisciplinary social sciences research themes, philosophies, methodologies and evidence based modeling approaches Venn diagram (Fig. 4 credit goes to Saunders et al., 2007; after adopted, modified and adding modeling approaches).

But to overcome this complexity, the researcher has to decide on the application of modeling in the study by combining it with his or her dilemma. Modeling can be used

extensively at the research in geography and environment. The models identified and selected in our paper can be used for higher research, especially in the fields of physical geography, environmental geography and human geography (Table-1). The identified models can help the academicians and researchers to visualize, or picture in their mind, something that is difficult to see or understand. Environment related models help to inform both decisions and policies. Models improve the understanding of natural systems and how they react to changing conditions, such as exposure to hazardous substances and the temporal and dose effects from the exposure.

Table 1: List of selective modeling approaches in geography and environment research

S.L	Name Model	Suitability of Application	Sources/References
1	Physical System Model	Relevant properties of real world	Chorley and Haggett (1967)
2	Spatial modeling	Identify spatial features by GIS	Kirkby (1987)
3	Stochastic Models	Behavior of situation or process	Kirkby (1987)
4	Deterministic model	Assume that known average rates	Hahl and Kremling (2016)
5	3-D River Model	Labelled features of River basin	Parna et al. (2018)
6	Ocean Circulation Model	Predictability of ocean environment	Semtner (1995)
7	Hydrodynamic Coupled Model	Processes and interactions	Ganju (2016)
8	Regional Climate Models	Predict to regional climate	Rummukainen (2010)
9	Soil erosion model	Occurrence of soil erosion	Pasquale et al (2021)
10	Statistical Model	Prediction of statistical features	Saltelli (2019)
11	Mathematical Model	Prediction mathematical features	Saltelli (2019)
12	Cultural Diffusion model	Drivers of cultural transmission	Joaquim (2015)
13	Demographic Transition Model	Population dynamics & transition	Kirkby (1987)
14	Epidemiologic Transition Model	Risk factors for death or injury	Omran (2005)
15	Christaller and Losch Model	Hexagon of higher order centers	Britannica (2019)
16	Concentric Zone Model	Spatial urban arrangement	Kirkby (1987)
17	Rostowa´s Growth Model	Marginal utility of income	Rostow 1959; Minca 2009

S.L	Name Model	Suitability of Application	Sources/References
18	Von Thunen Theory/Model	Agriculture location and land use	Britannica (2014)
19	SWAT Model	Soil and Water Assessment Tool	Gassman (2007)
20	SWOT Model	Identifying their perceptions	Islam et al. (2015)
21	IMPACT Model	Mitigation Strategies of toxic algae	Islam et al. (2013)
22	Environmental-Societal Model	Dynamics of societal environment	Kirkby (1987)
23	DPSIR Model	Indicators structural organization	Tscherning et al. (2012)
24	The Butler Model	Tourism carrying capacity	Britannica (2019)
25	Spatial Exploration Model	Growth of the urban hierarchy	Sun et al. (2019)

Application of Modeling Approaches in Urban and Regional Planning Research

The use of models are very important for research in urban and regional panning. Through this study, 20 very important models have been provided in Table-02. If the researchers appreciate the content of these models and apply these models to the urban and regional planning research in Bangladesh, it will be easier to predict urban and regional problems and issues. Because these models help to understand us the wider purposes of urban citizens and their motive (Sharma et al., 2011; Mohsin and Anwar, 2015; Taubenböck et al., 2019).

As the concept of urbanization is gaining momentum in today's world, the importance and subject visions of the urban and regional planning has increased and its scope has multiplied day by day. In particular, scientific models of the planning process and of the urban system have been developed in depth, and many of these ideas have found their way into practice through the preparation of Structure Plans. But now there is need for a period of reflection and criticism so that these developments can be consolidated and interpreted in a broader perspective (Batty, 1976; Liu et al., 2018; Tusting et al., 2019).

In this study, 20 important models have been identified for applying urban and regional planning research in Bangladesh. Though many models are used in by the urban and regional planners but it is important to use the computer programing based simulations models for testing theories about spatial location and urban activities in Bangladesh (Herbert and Stevens, 1960; Zogas et al. 2005; Romain, 2008). The models obtained from this study can be used to make detailed scenarios and predictions about urban planning, urban growth, urban land use, urban environment, urbanization trends, urban culture and urban fringe etc.

Table 2: List of selective modeling approaches in urban and regional planning research

S.L	Name Model	Suitability of Application	Sources/References
1	Concentric Zone Model	Assumption on CBD center of city	Sharma et al. (2011)
2	Sector Model	Wedge-shaped patterns	Romain (2008)
3	Linear Urban Model	Belt or a buffer zone	Romain (2008)
4	Urban Ecological Model	Explain the spatial pattern	Schwirian (1983)
5	The CATS Model	Land use accounting purpose	Humburg and Sharkey (1961)
6	The UNC Model	Land use growth and succession	Chapin et al. (1964)
7	The EMPIRIC Model	Locational pattern analysis	Hill (1965)
8	The POLIMETRIC Model	Metropolitan development	Bolan. et al. (1963)
9	The Pittsburgh Model	Urban activity distribution	Lowry (1964)
10	The Penn Jersey Model	Market demand of urban land	Herbert and Stevens (1960)
11	The San Francisco Model	Community renewal market supply	Little (1966)
12	Eastern European Model	Cities with residential centers	Taubenböck et al. (2019)
13	Gravity Model	Interaction urban centers & distance	Almog et al. (2019)
14	Multiple Nuclei Model	Creation of different nuclei	Mohsin and Anwar (2015)
15	Western European Model	Cities with industrial centers	Taubenböck et al. (2019)
16	Galactic City Model	Mini edge cities by highways.	Liu et al. (2018)
17	Islamic City Model	Development of a city by mosque	Falahat (2014)
18	Sub-Saharan Africa Model	Natural resources and diversity	Tusting et al. (2019)
19	Southeast Asia Model	Squatter settlements and industry	McGee (2002)
20	Hoyt Model	Rents within a city	Zogas et al. 2005

Application of Modeling Approaches in Economics Research

Selection of economic models are not easy for developing nations for considering the socioeconomic aspects. In a sense, an economic model help to us regarding the reality of a simplified version of the abstract of real world features that allows us to perceive, recognize, and make predictions about economic activities, behavior and aspects (Yock et

al., 1986; Nakata, 2004; Donghan et al., 2014; León, 2019). In this study, it has been identified 20 important economic models that could be suitable for doing further research in Bangladesh. These selective models can be used as a fundamentals tools for descriptive the economic issues and problems in Bangladesh. Some economic models are introduced in the Table-3 which would be the suitable for developing the conceptual models or mathematical model (Nisio and Battista, 2010). Especially, macro-economic model, econometric model and binary response model offer a way to grow a comprehensive view or image of an economic condition and realize how economic aspects appropriate together (Nakata, 2004; Hansen, 2005; Donghan et al., 2014).

Table 3: List of selective modeling approaches in economics research

S.L	Name Model	Suitability of Application	Sources/References
1	General Equilibrium Model	Suppression as economic activities	Grossman (1991)
2	Econometric Model	Prediction of economic time series	Hansen (2005)
3	Benefit Financing Model	Consequences of unemployment	Wayne Vroman (2005)
4	Macro-economic model	Macro-economic systems analysis	Yock et al. (1986)
5	Cobb-Douglas Model	Deterministic profit maximization	Zellner et al. (1966)
6	Solow-Swan Model	Exogenous impact of population	Donghan et al. (2014)
7	Lucas Islands Model	Politics of monetary policy	Lohmann (1999)
8	Heckscher-Ohlin Model	Analysis of international trade	Khan (1980)
9	Black-Scholes Model	Option of economic price	Sovan (2012)
10	AD-AS Model	Aggregate demand and supply.	Pierre-Richard (2004)
11	DAD-SAS Model	Identification of susceptibility	Martinez et al. (2003)
12	Shock Therapy Model	Dramatic changes of economy	León (2019)
13	Russia's Economic Model	Command economy.	León (2019)
14	Binary Response Model	Estimation of loss and profit	Horowitz and Savin (2001)
15	Manpower forecasting Model	Human resource forecasting	Zhao et al. (2021)
16	Energy-economic model	Understand the energy systems	Nakata (2004)
17	Hedonic Pricing Model	Rent or house value	Malpezzi (2003)
18	Bio-economic Farm Model	Formulations describing farmers'	Janssen and Van (2007)
19	Monetary-Policy Model	Dynamics in the data to price	Fuhrer (2000)
20	Structural Equation Model	Assessing consumer satisfaction	Nisio and Battista (2010)

Application of Modeling Approaches in Government and Politics Research

In recent times, worldwide social government and politics relevant researchers have used some models but no realistic model of political science and policy formulation has been developed in Bangladesh (Carver, 2000; Kolkman et al., 2016; Xue et al., 2020). Integrating governance and policies are very significant issues because it is quite supporting the citizens to understand the functions and working strategies of political frameworks around the world (Schmitter, 2009; Cumber and Githens, 2014). In this aspects, it is found that there are many types of government and political schemes and framework worldwide according to the reliable, societal, cultural, ethnic, and social antiquity (Carver, 2000; Clarke et al., 2007). That's why it is quite difficult to build a model with comparative constructions of political association that has the bent to change preliminary with one nations then onto the next nations. Table-04 shows the list of selective modeling approaches in government and politics research.

Applying modeling approaches in government and politics research on examining empirical relationships, traditional corporate governance, and multi-theoretical perspective with developing casual thinking models are the demand of the time (Clarke et al., 2007; Uzonwanne, 2016). This is because modeling approaches can show of harmonizing the political aspects of a developing country with the principles of the components of governance considering the global situation. For developing any policy models, the researchers should be aware that the policies are a instrument for regulatory the performance of an society by leading the behavior of the inhabitants of the society (Clarke et al., 2007; Mullineux, 2010). In most cases the basic idea of the existing policies and the input parameters of the social model in the given situation are confirmed. But developing a governance a policy model selecting the input parameters or characteristics are very risky to balance the model validation.

Table 4: List of selective modeling approaches in government and politics research

S.L	Name Model	Suitability of Application	Sources/References
1	Delegate Model	Convey the views of others	Clarke et al. (2007)
2	Model of policymaking	Develop to describe policy	Kolkman et al. (2016)
3	Causal thinking Model	Examining empirical relationships	Clarke et al. (2007)
4	Pluralism of Model	Description and modeling task	Beck (2000)
5	REMM Model	Resourceful, Evaluating, Maximizing	Allen (2021)
6	Advisory Model	Multi-theoretical perspective	Cumber and Githens (2014)
7	Cooperative Model	Social program is the business	Xue et al. (2020)
8	Policy Board Model	Organizational effectiveness	Carver (2000)
9	The Anglo-US model	Corporate governance and capitalism	Mullineux (2010)
10	The German model	Traditional corporate governance	Mullineux (2010)
11	The Japanese model	Japan Revitalization Strategy	Passador (2016)

S.L	Name Model	Suitability of Application	Sources/References
12	Carver Board Model	Good personnel policies	Carver (2000)
13	Cortex Board Model	Operating a business/organization	Kolkman et al. (2016)
14	Consensus Board Model	Unambiguous leadership	Carver (2000)
15	Competency Board Model	Improve overall performance	Carver (2000)
16	Rational Policy Model	Model of decision making	Uzonwanne (2016)
17	The Traditional Model	Team members has leadership role	Amy et al. (2003)
18	The Team Spirit Model	Sharing of authority responsibility	Clarke et al. (2007)
19	The Cutting Edge Model	Group who manage themselves	Amy et al. (2003)
20	The Task Force Model	Group for specific time	Kolkman et al. (2016)

Application of Modeling Approaches in Anthropology Research

Anthropological models aim to solve the same fundamental problem about the relationships existing between reality, representation and imaginary (Whyte, 2002; Mahmud, 2008; Diah et al., 2014). So the anthropologist can also construct a sensory model of a society on the basis of the cultural body, as the senses are present in whatever aspect of knowledge (Table-5). The models that guide us through our everyday concerns may be termed folk models (Lave and March, 1975; Gatewood, 2012).

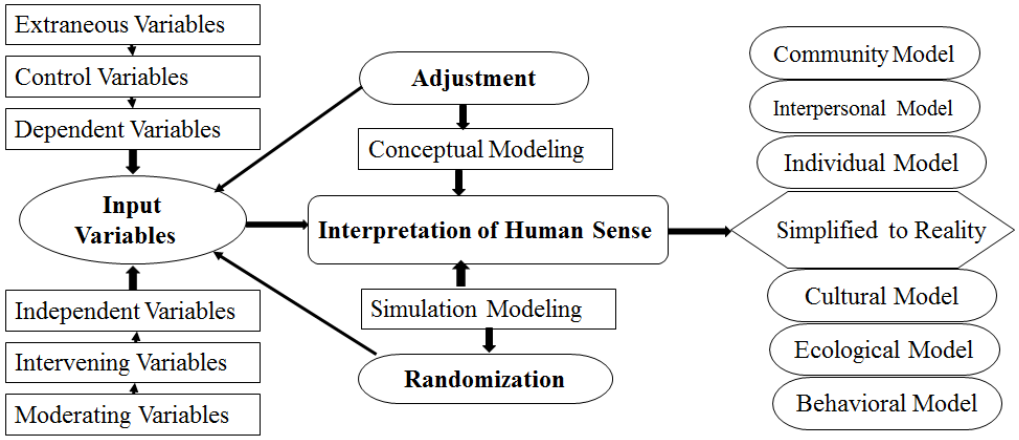

Figure 4: Schematic diagram of the major input variables, interpretation of human sense processing with adjustment and randomization condition for conceptual and simulation model for anthropological research.

In this study, 20 models have been selected from in different disciplines of anthropology which are related to human-environmental interaction. Although these models are not made in the context of Bangladesh, but anthropologists in Bangladesh will be able to create new models by following these models (Table -5).

Table 5: List of selective modeling approaches in anthropology research

S.L	Name Model	Themes and Concepts	Sources/References
1	Agent-based Model	Behavioral dynamics	Bonabeau (2002)
2	Cultural Model	Concerning the of psychology	Gatewood (2012)
3	Collaborative Model	Community collaboration	Lobban (2008)
4	Moral Model	Allocate reward and punishment	Andrade (1995)
5	Explanatory Model	Cross-cultural comparisons	Bollig and Finke (2014)
6	Charles Darwin Model	Process of gradual development	Freeman et al. (1974)
7	Anti-positivist Model	Individuality and diversity	Mahmud (2008)
8	Sapir-Whorf Model	Common frame of reference	Bilaniuk (2008)
9	Sociolinguistics Model	Language within cultural context	Miller (2011)
10	PCMH Model	Emphasize patient-centered	Diah et al. (2014)
11	Optimal Foraging Model	Predictor of foraging patterns	Hill et al. (1987)
12	Information Flow Model	Traditional anthropological problem	Zachary (1977)
13	EMIC Model	Clarifies the experience of illness	Weiss (1997)
14	Cybernetic Model	Interaction of human-environment	Viličić et al. (2007)
15	E-R Case Studies Model	The mapping constraints	Weiss (1997)
16	Mutual Exploitation Model	Behavior of the study informants	Zachary (1977)
17	Chinese Kinship Model	Aware of historical issues	Watson (1982)
18	Evaluative Model	Boundaries are quite arbitrary	Lobban (2008)
19	Knowledge-based Model	Understanding the world	Whyte (2002)
20	Dance Therapy Model	Aspect of human experience	Panagiotopoulou (2011)

Application of Modeling Approaches in Public Administration Research

This study examine that the several branches of public administration research are quite suitable for building a conceptual or mathematical model. The traditional theories of public administration like classical theory, management theory and postmodern theory are the strong scope for developing and applying the modeling approaches (Fox and Miller, 1995; Brian, 2003; Anyebe, 2017; Lampropoulou et al., 2018). Though some complexities could be raised to build a model using these three different perspectives of public administration theories. Developing a model for public administration research, it is important to learn about the below input parameters, its characteristics and their interrelationships (Stephen (2007; Tkach et al., 2019) (Table-6). Such as:

- Strengthening the functions of the government
- Authority fixation and ensuring flexibility
- Confirming performance, regulator and accountability
- Improvement the management of human resources
- Improving competition and optimal variables
- Enlightening the value of regulations
- Ensuring responsive services

Table 6: List of selective modeling approaches in public administration research

S.L	Name Model	Suitability of Application	Sources/References
1	Theoretical Model	Constructs and presents a framework	Lampropoulou et al. (2018)
2	Comparison Model	Common practice to estimate	Milne (1962)
3	Closed and Open Model	Study complex organizations	Brian (2003)
4	Institutional Model	Economic paradigm development	Tkach et al. (2019)
5	Elite-Mass Model	Policy output analysis,	Anyebe (2017)
6	Group Model	Group system dynamics.	Bérard (2010)
7	Systems Model	Introduce to the real systems	Hick et al. (2019)
8	Classical Theory-Model	Classical analysis of a concept	Woodrow Wilson (1887)
9	Public Management Model	To improve the efficiency	Stephen (2007)
10	Postmodern Theory-Model	The role of ideology of an issue	Fox and Miller (1995)
11	Entrepreneurial Model	Creation of a new business	Tkach et al. (2019)
12	Public Governance Model	Replace bureaucratic mechanisms	Anyebe (2017)
13	Structural Equation Model	Quality of policy formulation	Rathachatranon (2018)
14	East Asian Model	The separation of administration	Nakamura (2021)
15	Spatial Econometric Model	Spatial econometric methods	Hansen (2005)
16	Organic Model	Varieties of the mechanistic	Milne (1962)
17	Consensus-Building Model	Policy and Administrative Discretion	Hick et al. (2019)
18	Bureaucracy-Driven Model	Higher levels of cooperation	Vigoda-Gadot (2004)
19	Citizen-Driven Model	Citizen levels cooperation	Vigoda-Gadot (2004)
20	Political Accountability Model	The nature of government	Simms (1999)

Application of Modeling Approaches in Sociology and Social Welfare Research

The scientific evidences have shown that the most of sociologists are interested to study on social procedures, communications, shapes and forms etc. The sociology related academician and researchers have always tried to analyses societal problems, their sources and underlying causes. During this study it is observed that the most of the sociological theories pursue to elucidate social problems and their traditional solutions methods (Allan, 2006; Col, 2017). Of course these theories could be the main sources to build social models for predicting the future scenarios of sociology and social welfare (Allan, 2006).

Table 7: List of selective modeling approaches in sociology and social welfare research

S.L	Name Model	Suitability of Application	Sources/References
1	European Social Model	Promoting social protection	Albert & Neil (2010)
2	Cognitive Behavioral Model	Behavioral factors	Davis (2001)
3	Anglo-Saxon Model	Free-market economy	Boeri (2002)
4	Mediterranean Model	Distinct approaches to capitalism	Albert & Neil (2010)
5	Continental Model	Small financial markets	Christian et al., (2009)
6	Nordic Model	Combines features of capitalism	Albert and Neil (2010)
7	Problem-Solving Model	Generate possible solutions	Firend (2014)
8	Crisis Intervention Model	Emphasizing rapid assessment	Roberts & Ottens (2005)
9	Solution-Focused Therapy Model	Goal-oriented therapy	Ivesonn (2002)
10	Rational Choice Model	Optimization-based approach	Levin & Milgrom (2004)
11	Social Learning Model	Learning social media	Lowry et al. (2016)
12	Social Systems Model	traditional social structures	Brown & Stillman (2017)
13	Psychosocial Development Model	Cultural implication of development	Abbass et al. (2013)
14	Psychodynamic Model	Dynamics of behavior of a person	Abbass et al. (2013)
15	Social Exchange Model	Involves social exchanges	Cook et al. (2013)
16	Panel Model	Estimating causal parameters	Halaby (2004)
17	Black-Box Model	Network parameters affect	Davidson (2019)
18	Age-Period-Cohort Model	Measurements dependent quantity	Fienberg & Mason (1979)
19	Revolt Model	Sociological Systems Analysis	Chikafu (1993)
20	Nonrecursive Model	Simultaneous equation mode	Waite & Stolzenberg (1976)

Ivesonn, 2002 revealed in his study, in sociology, *"a few theories provide broad perspectives that help explain many different aspects of social life, and these are called model and paradigms".* Brown and Stillman, 2017 also stated that *"these model and paradigms are philosophical and theoretical frameworks used within the discipline to formulate theories, generalizations, and the experiments performed in support of them".* Table-07 shows the list of selective modeling approaches in sociology and social welfare research. Developing a sociology and social welfare related model it is important to learn the following phenomenon (Zongozzi et al, 2016). Such as:

- Select the suitable purpose and goals
- Identify and screening the concepts
- Regulate the social characteristics
- Finalize the model case and boundary condition
- Classify conflicting, designed, and prohibited cases
- Visualize the experiences and significances
- Communicate with realistic reference

Challenges of Model Building Constraints in the Social Science Research

The application of modeling techniques in the field of social sciences research greatly enhances the quality of research, no doubt (Waite & Stolzenberg, 1976; Fienberg and Mason, 1979). But the different disciplines of social sciences have some different thoughts, philosophy, wisdom and phenomena are arranged in different ways that's why so many challenges have to be faced while creating models in social science research. The main difficulties to develop a model for social science research no systematic theoretical approaches were not well defined (Waite and Stolzenberg, 1976; Fienberg & Mason, 1979; Halaby, 2004; Abbass et al. 2013; Retter, 2020).

To build a model, the main challenges of social sciences research are the various social systems components, different opinions and variations of behavioral approaches (Alsadey et al., 2021). As examples, i) challenges sampling from large samples, ii) lack of education and knowledge in the subject matters; iii) lacking of suitable theoretical frameworks, iv) lack of skilled manpower for preparing conceptual framework, v) Lack of statistical, mathematical and computer based programing skills (Omran, A, 2021; Alsadey et al., 2021). Executing a model applying in socials science is always complex job, experiencing thorough scheme and provisions, continuous responsibility, and robust governances are the key factors (Balanchine, 2018).

Challenges of parameters selection for model building

Any kind of modeling the most difficult steps of selecting the input parameters. It is important to understand that the input parameters dictate the models all the time. If the model input parameters are well-organized model could be the well-defined and more efficient and valid. But choosing the model input parameters are quite complex especially social sciences oriented research. The several challenges of parameters selection for model building in social sciences research are as below:

i) Complex human behavior and attitudes

ii) Multivariate culture, philosophy and wisdom

iii) Difficult to understand the interaction of societal impact the selected variables

iv) It is very difficult to separate the impact of hydrology, ecology, morphology, sociology, and anthropogenic impacts

v) Especially, selection of model parameters building a mathematical is more complex than the developing a conceptual or theoretical model

Challenges of systems domain to model process boundary

The system boundary is a conceptual line or domain. It divides the system many forms as example square, rectangle, leaner, non-leaner and smooth etc. The boundary conditions are the system's environment as being made up of those things that are not part of the model system, but can either affect the modeling process system or be affected the model parameters and output by it. Though a boundary condition is a discretionary graphic relief in the diagram; it does not add semantic value to the model theoretical or conceptual model. But it is mandatory to prepare boundary condition for mathematical or regional climate models ((Semtner, 1995; Rummukainen, 2010; Ganju, 2016; Parna et al., 2018; Pasquale et al., 2021). For example, if a researcher wants to make a numerical simulation model or computer based program model with a lake, river, estuaries, coast, sea or ocean pollution, he has to must give a boundary condition or system boundary. But building this boundary condition or systems boundary has become very challenging for researchers in many departments of social sciences.

Challenges of calibration and validation of the model

Model calibration is the procedure of modification of the model parameters by tuning or iteration and imposing within the boundary condition in the particular models. Also, resolving the errors and the uncertainties in model parameters it is necessary to calibrate model repeatedly (Semtner, 1995; Rummukainen, 2010; Ganju, 2016; Parna et al., 2018; Pasquale et al., 2021). Measurement uncertainty is reduced by ensuring accuracy in the model through calibration. Model calibration is performed until the measurement process is controlled by eliminating errors or measuring uncertainties at an acceptable level.

Validation is the process of verifying the accuracy of a model. The scenarios, results or cases obtained by the model are solved by comparing them with the actual system and its behaviors (Parna et al., 2018; Pasquale et al., 2021). It is very difficult to do model calibration and validation by proving statistically significant with qualitative data without creating mathematical model or computer programming based modeling in different branches of social science.

Conclusion

In developing countries including Bangladesh, it is very important to carry out fundamental and applied research in different departments of social sciences. Because social science research provides trustworthy evidence to the publics that are systematically recognized so that end users can rely upon it. But in the current scientific evidences show that many the researchers are highly encouraged to use models when they can assist in identifying significant variables in such a way that tests of hypotheses can be defined more sharply in their innovative social sciences research. However, in Bangladesh, various higher education institutions, public and private research

organizations use conventional qualitative and quantitative methods in social science research, but the number of researches using modeling techniques is insufficient.

And with this in mind, the current comprehensive review paper includes an introduction to 145 models published in various social science disciplines from 1960-2021. Researchers from different disciplines of social sciences in other countries of the world including Bangladesh will be able to get acquainted with 145 models through this article. They will also be able to learn more about the use and application of models using the Google search engine. In this way, researchers of different disciplines of social sciences may be interested in applying their research models and creating new models.

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