

แบบจำลองการจัดการที่มีวัตถุประสงค์หลากหลายของระบบนิเวศป่าเขตร้อน  
: กรณีศึกษาอุทยานแห่งชาติแก่งกระจาน ประเทศไทย

นางสาวเพ็ญศรี ศรีกัญหา

วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาวิทยาศาสตรดุษฎีบัณฑิต

สาขาวิชาวิทยาศาสตร์ชีวภาพ

คณะวิทยาศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย

ปีการศึกษา 2547

ISBN 974-17-3407-7

ลิขสิทธิ์ของจุฬาลงกรณ์มหาวิทยาลัย

MULTI-OBJECTIVE MANAGEMENT MODEL OF TROPICAL FOREST ECOSYSTEM  
: A CASE STUDY IN KAENG KRACHAN NATIONAL PARK, THAILAND

Miss Pensri Srikanha

A Dissertation Submitted in Partial Fulfillment of the Requirements  
for the Degree of Doctor of Philosophy in Biological Sciences

Faculty of Science

Chulalongkorn University

Academic Year 2004

ISBN 974-17-3407-7

Thesis Title            Multi-objective Management Model of Tropical Forest  
                                 Ecosystem: A Case Study in Kaeng Krachan National Park,  
                                 Thailand

By                            Miss Pensri Srikanha

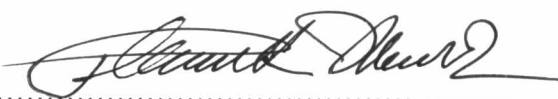
Field of Study            Biological Sciences

Thesis Advisor         Associate Professor Jiragorn Gaj aseni, Ph.D.

Thesis Co-advisor     Dr. Robert I. Muetzelfeldt

---

Accepted by the Faculty of Science, Chulalongkorn University in Partial  
Fulfillment of the Requirements for the Doctor's degree.

  
..... Dean of Faculty of Science  
(Professor Piamsak Menasveta, Ph.D.)


THESIS COMMITTEE

  
..... Chairman  
(Professor Sirit Wongsiri, Ph.D.)

  
..... Thesis Advisor  
(Associate Professor Jiragorn Gaj aseni, Ph.D.)

  
..... Member  
(Associate Professor Nantana Gaj aseni, Ph.D.)

  
..... Member  
(Associate Professor Sitanon J esdapipat, Ph.D.)

  
..... Member  
(Dr. Theerapat Prayurasiddhi)

นางสาวเพ็ญศรี ศรีภักุหา: แบบจำลองการจัดการที่มีวัตถุประสงค์หลากหลายของระบบนิเวศป่าเขตร้อน: กรณีศึกษาอุทยานแห่งชาติแก่งกระจาน ประเทศไทย (MULTI-OBJECTIVE MANAGEMENT MODEL OF TROPICAL FOREST ECOSYSTEM: A CASE STUDY IN KAENG KRACHAN NATIONAL PARK, THAILAND) อาจารย์ที่ปรึกษา : รองศาสตราจารย์ ดร. จิราภรณ์ คชเสนี, อ.ที่ปรึกษาร่วม : Dr. Robert I. Muetzelfeldt จำนวน 230 หน้า. ISBN 974-17-3407-7.

แบบจำลองการจัดการระบบนิเวศที่มีวัตถุประสงค์หลากหลายนี้สร้างขึ้นเพื่อพัฒนาเป็นแบบจำลองต้นแบบของการจัดการระบบนิเวศป่าไม้ในเขตอุทยานแห่งชาติทางบกของประเทศไทย งานวิจัยนี้เลือกอุทยานแห่งชาติแก่งกระจานเป็นกรณีศึกษา แบบจำลองทั้งหมดที่สร้างขึ้นประกอบด้วยส่วยย่อย 3 ส่วน ส่วนที่หนึ่งแสดงรายละเอียดเกี่ยวกับการเปลี่ยนแปลงทรัพยากรระบบนิเวศป่าไม้ ส่วนที่สองอธิบายเกี่ยวกับระบบการใช้พื้นที่เพื่อการปลูกพืชเกษตรที่พบในเขตอุทยานแห่งชาติแก่งกระจาน ส่วนที่สามอธิบายเกี่ยวกับโครงสร้างระบบประชากรที่อาศัยอยู่ภายในบริเวณเขตอุทยานแห่งชาติ งานวิจัยนี้มีบางส่วนใช้การประเมินค่าทรัพยากรในเชิงเศรษฐศาสตร์เพื่อกำหนดชนิดของกิจกรรมนันทนาการที่อยากให้มีขึ้นในพื้นที่เพื่ออำนวยความสะดวกแก่นักท่องเที่ยวที่เข้าใช้บริการเป็นหลัก ผลของแบบจำลองแสดงให้เห็นว่าปัจจัยที่เกิดขึ้นและคาดว่าจะมีผลต่อการเปลี่ยนแปลงโครงสร้างระบบนิเวศป่าไม้เช่น จำนวนช้างป่า หรือประสิทธิภาพในการป้องกันทรัพยากรป่าไม้มีผลต่อการเปลี่ยนแปลงโครงสร้างโดยรวมของระบบนิเวศ รวมถึงลักษณะการใช้ที่ดิน และโครงสร้างของประชากรที่อาศัยในพื้นที่ การทำลายพื้นที่ป่าไม้เกิดขึ้นเพียงบางส่วนแม้ในระยะยาวก็ไม่มีการเปลี่ยนแปลงมากนัก ในเรื่องของการแนะนำการจัดการการท่องเที่ยวแบบใหม่โดยให้ชาวบ้านในพื้นที่มีส่วนร่วมในการแสดงความคิดเห็นและมีส่วนร่วมในการอนุรักษ์ทรัพยากรป่าไม้ พบว่าการแนะนำกิจกรรมเกี่ยวกับการให้บริการรถรับส่งตามจุดท่องเที่ยวสำคัญในเขตอุทยานมีความน่าจะเป็น ในการเกิดขึ้นและมีระดับความต้องการสูงสุด และกิจกรรมเหล่านี้ส่งผลรวมต่อระบบการจัดการอุทยานแห่งชาติแก่งกระจานคือ การเพิ่มอัตราการจ้างงานและการเพิ่มงบประมาณรายรับที่ทางอุทยานจัดหาได้ด้วยตนเอง และการจัดสรรงบประมาณเหล่านี้เพื่อระบบการจัดการอุทยานแห่งชาติที่ดีและมีประสิทธิภาพในอนาคต

สาขาวิชา วิทยาศาสตร์ชีวภาพ

ลายมือชื่อนิสิต เพ็ญศรี ศรีภักุหา

ปีการศึกษา 2547

ลายมือชื่ออาจารย์ที่ปรึกษา 

# # 4173815423: MAJOR BIOLOGICAL SCIENCES

KEY WORD: Multi-objective, Simulation model, Ecosystem, Kaeng Krachan National Park,  
Management, Policy.

PENSRI SRIKANHA: MULTI-OBJECTIVE MANAGEMENT MODEL OF TROPICAL FOREST  
ECOSYSTEM: A CASE STUDY IN KAENG KRACHAN NATIONAL PARK, THAILAND. THESIS  
ADVISOR: ASSOCIATE PROFESSOR DR. JIRAGORN GAJASENI, THESIS COADVISOR: DR.  
ROBERT I. MUETZELFELDT, 230 pp. ISBN 974-17-3407-7.

The purpose of this study was to construct a prototype management model for protected area management. This study selected Kaeng Krachan national park, the biggest terrestrial national park in Thailand to be a research site. This model composed of three working sub-models: forest, agriculture and community sub-models. Forest sub-model indicated vegetative patterns and changes of forest pattern due to natural and human-changed influencing factors. Agriculture sub-model explored situation of crop cultivation system and effect of chemical and fertilizer applications due to crop production in Kaeng Krachan. Community sub-model explained demography and community and population characteristics of local residents. This study also explored current tourism in Kaeng Krachan national park. Suggestion on new recreational services was made up in this research. Selected methods for data collection input into the model encompassed forest assessment, land-use surveys, questionnaire interviews, and model development and analysis. Contingent Valuation Method and Travel Cost Method were used to evaluate recreational services and the value of Kaeng Krachan site. The results of the model indicated that at existing condition, forest ecosystems in Kaeng Krachan were not extremely disturbed and destroyed by wild elephants although elephant population supposed to maximize at 300 individuals. When capability of forest protection and conservation were maximized by increasing numbers of forest staffs to 300 persons, forests and land uses were extremely protected. At that condition, tree density was maximized, forest area was partially disturbed and converted into agricultural land and settlement area. Community and people structure were partly changed due to effects of contamination of organic matters from fertilization. For tourism management, local people were suggested to cooperate when new management programs were induced. These results are to be useful to forest managers when new management procedures are developed in future.

Field of study Biological Sciences Student's signature Pensri Srikanha  
Academic year 2004 Advisor's signature [Signature]

## ACKNOWLEDGEMENT

I would like to express my gratitude to my dissertation supervisor, Associate Professor Dr. Jiragorn Gajaseni, for his useful advices and suggestions since the beginning of this research. I am also truly grateful to Associate Professor Dr. Nantana Gajaseni, without her encouragement and her supports, my life and my Ph.D. work will really disappeared and drifted out in the air with no direction. I really appreciate and thank to my co-supervisor Dr. Robert I. Muetzelfeldt, from Institute of Ecology and Resources Management, the University of Edinburgh, United Kingdoms. Six months with him and Simile ecological software provided me more unfamiliar experiences and worth my life with most useful experiences. Also, thanks to Dr. Muetzelfeldt for his licensed copy of Simile software for my extended works. I sincerely grateful to Professor Dr. Siriwat Wongsiri and lecturers in Ph.D. in Biological Sciences Program for their encouragements all the times while I am studying at Faculty of Science, Chulalongkorn University. I am truly grateful to all of the thesis committee for their valuable suggestions in production of this work in future.

I would like to acknowledge Biological Science Program for all supports encouraging to this work. I gratefully thank to the Royal Golden Jubilee Program (RGJ), under the umbrella of Thailand Research Fund (TRF) for providing me a scholarship and financial supports as well as a chance to extend my experience in the Institute of Ecology and Resources Management University of Edinburgh, Scotland.

Special thanks to Mr. Manot Rakkanpanakngan and Kaeng Krachan' forest officers at Kaeng Krachan National Park and Mr. Satit from Petchaburi Statistical Division. Without data and information supported from those people, this work would not have been accomplished. This work was actually spirited by colleagues of Tropical Ecology Laboratory, Faculty of Science, Chulalongkorn University, other government units, and the Biological Sciences Program. Very special thanks to Miss Chatnaree, Miss Puangpaka, Mr. Bhuvadol, Mr. Pongchai, Mr. Ing, Mr. Kobchai, Miss Jiranan and other lab 104 members who come later for their encouragements and entertainments during developing this thesis.

## Table of Contents

	Page
Thai Abstract .....	iv
English Abstract .....	v
Acknowledgement .....	vi
Table of Contents .....	vii
List of Tables .....	x
List of Figures .....	xii
Acronyms .....	xv
Glossary .....	xvi
Chapter I: Introduction .....	1
1.1 Overview of the study .....	1
1.2 Objectives of the study .....	5
1.3 Hypothesis of the study .....	6
1.4 Organization of the thesis .....	7
Chapter II: Reviews of the research .....	10
2.1 Research framework .....	10
2.2 Protected area: A review of national system .....	12
2.2.1 Legal framework: Policy and legislation .....	13
2.2.2 Administration and management .....	15
2.2.3 Natural resource management in Kaeng Krachan .....	18
2.3 Introduction to system thinking and model .....	21
2.3.1 Systems theory .....	22
2.3.1.1 Systems and systems approach .....	23
2.3.1.2 Emergent property .....	25
2.3.1.3 System hierarchy .....	28
2.3.2 Defining model and simulation .....	29

## Table of Contents (continued)

2.3.2.1	Model and simulation .....	29
2.3.2.2	Modeling process .....	30
2.3.2.3	Ecological modeling software .....	35
2.4	Ecosystem valuation .....	37
2.4.1	Economic value .....	37
2.4.2	Valuation of ecosystem benefits .....	40
2.5	Reviews of literatures .....	48
2.5.1	Modeling natural resources and environment .....	48
2.5.2	Valuation of ecosystem benefits and techniques .....	56
Chapter III: Research Methodology .....		61
3.1	Study site .....	61
3.1.1	Overview of KKCNP .....	62
3.1.1.1	Land uses .....	63
3.1.1.2	Vegetation .....	64
3.1.1.3	Community and people .....	65
3.1.1.4	Tourism and recreation .....	66
3.2	Model development .....	68
3.2.1	Model construction .....	68
3.2.2	Sub-model development .....	72
3.2.2.1	Forest sub-model .....	72
3.2.2.2	Agriculture sub-model .....	76
3.2.2.3	Community sub-model .....	79
3.3	Data collection and analysis .....	81
3.3.1	Forest assessment .....	81
3.3.2	Land use survey .....	82
3.3.3	Community and demography assessment .....	83
3.4	Valuation of ecosystem benefits .....	83



## Table of Contents (continued)

3.4.1	Site selection .....	83
3.4.2	Determining recreation fees: CVM analysis .....	85
3.4.3	Valuation of Kaeng Krachan site value: TCM analysis .....	90
Chapter IV: Results and Discussion .....		95
4.1	Data input and model analysis .....	95
4.1.1	Land uses .....	95
4.1.2	Forest and tree distribution .....	96
4.1.3	Reforestation .....	101
4.1.4	Illegal logging .....	103
4.1.5	Wild elephants .....	105
4.1.6	Environmental condition .....	107
4.2	KMP Model analysis .....	113
4.3	Predication and scenario analysis .....	117
4.3.1	Existing forest ecosystem and its condition .....	117
4.3.2	Elephant population change .....	123
4.3.3	Increasing capability of forest protection .....	125
4.4	Valuation of ecosystem benefits .....	133
4.4.1	Tourism and recreation .....	133
4.4.2	CVM analysis .....	136
4.4.3	Kaeng Krachan site valuation: TCM analysis .....	143
Chapter V: Conclusions and recommendation .....		155
References .....		162
Appendices .....		182
Biography		

## Lists of Tables

Table		Page
Table 2.1	General steps of modeling-building process in SIMILE. ....	36
Table 2.2	Types of implicit non-use benefits of environmental amenities.....	42
Table 2.3	Types of data used and techniques for valuation:.....	43
Table 2.4	Types of data used and techniques for valuation of non-market benefits. ....	44
Table 3.1	General characteristics of vegetation community in KKCNP observed in 1993. ....	64
Table 3.2	Components and general steps of model construction And descriptions General characteristics of vegetation community in KKCNP. ....	70
Table 3.3	Types of Trip generating Function (TGF). ....	94
Table 4.1	Details of land uses in KKCNP, classified as disturbed and undisturbed sites in Kaeng Krachan National Park. ....	96
Table 4.2	Details of park area and sampling plot size. ....	98
Table 4.3	Total tree density classified by DBH size. ....	99
Table 4.4	Survival and mortality rates of sampling trees in five size-classes. ....	10
Table 4.5	Calculation of aboveground biomass of trees in five size-classes. ....	101
Table 4.6	Average numbers and sizes of stumps per unit area. ....	104
Table 4.7	Details of elephants in Kaeng Krachan national park:.....	107
Table 4.8	Population characteristics in KKCNP. ....	109
Table 4.9	Summary results of 22 scenarios. ....	119
Table 4.10	Summary results of 9 scenarios. ....	120
Table 4.11	Estimated visitors' increasing rate. ....	136
Table 4.12	Logarithmic and Linear equations and $R^2$ values for prediction of number of visitors. ....	137
Table 4.13	Response rates for surveys of three sampling areas in KKCNP. ....	138
Table 4.14	Responses for WTP of new recreational services in KKCNP. ....	138

### Lists of Tables (continued)

Table 4.15	Related variables were grouped and extracted by PCA.....	139
Table 4.16	Selected variables for Factor Analysis.....	140
Table 4.17	Loading factor of components of new factor extracted.....	141
Table 4.18	Response of WTP for Bus service.....	142
Table 4.19	Logit Model test for Goodness of Fit.....	142
Table 4.20	Comparison of WTP responses before and after analyzed with Logistic Regression Analysis (LRA). .....	144
Table 4.21	WTP for Bus service by lump sum charging system. ....	144
Table 4.22	WTP for Bus service by real charge charging system. ....	144
Table 4.23	Response of WTP for Home stay service. ....	145
Table 4.24	Logit Model test for Goodness of Fit. ....	145
Table 4.25	Comparison of WTP responses before and after analyzed with Logistic Regression Analysis (LRA).....	146
Table 4.26	WTP for Home stay service by lump sum charge system. ....	147
Table 4.26	Response of WTP for Forest ranger service. ....	147
Table 4.27	Logit Model test for Goodness of Fit. ....	149
Table 4.29	Comparison of WTP responses before and after analyzed with Logistic Regression Analysis (LRA).....	149
Table 4.30	WTP for Forest ranger service by lump sum charge system.....	149
Table 4.31	Calculation of demands of each service type.....	150
Table 4.32	Calculation of visits per one thousand visitors ( $V_i/1000$ ) of each concentric ring zones. ....	151
Table 4.33	Complete travel cost from each zone following assumption. ....	151
Table 4.34	Run regression to establish functional relationship between visitation rate and travel cost.....	152
Table 4.35	Summary output for Semi-log (dependent) model. ....	153

## Lists of Figures

Figure		Page
Figure 2.1	Conceptual framework of the research study. ....	10
Figure 2.2	Structure of the organisation of the Ministry of Natural Resources and Environment. ....	17
Figure 2.3	Institutional framework and responsibilities to natural resource management in Kaeng Krachan (a); important components of KKCNP (b); and sources of problems in Kaeng Krachan (c). ....	20
Figure 2.4	A system in interaction with its environment. ....	24
Figure 2.5	Common steps of model-building process. ....	32
Figure 2.6	Demand curve and consumer surplus. ....	39
Figure 2.7	Supply curve and producer surplus. ....	39
Figure 2.8	Total Economic Valuation (TEV) of environmental resources. ....	41
Figure 2.9	Total Economic Valuation (TEV) and valuation techniques. ....	45
Figure 3.1	Kaeng Krachan National Park established in April 1983. KKCNP ranges approximately 21,500 hectares in the southwestern part of Thailand. ....	61
Figure 3.2	Conceptual framework of multi-objective management model of Kaeng Krachan National Park. ....	72
Figure 3.3	Conceptual framework of forest sub-model composes of both natural and human-induced factors which can influence changes of land use in KKCNP. In forest sub-model, state of the forest, tree density and forest size are main structures that are observed. ....	73
Figure 3.4	Conceptual framework of agriculture sub-model. Three main components including vegetation growth process, crop harvesting and selling process are indicated. ....	79

## Lists of Figures (continued)

Figure 3.5	Conceptual framework of community sub-model. Three components including people and community structure and socio-economy are indicated. ....	80
Figure 3.6	Sampling sites for questionnaire survey: KKCNP headquarter (A); Panoen Thung and Ban Krang campsites (B); and Paala aau Waterfall (C). ....	84
Figure 3.7	Statistical analysis for determining of WTP probability, charge value systems, and recreation use fees for new recreational activities. ....	88
Figure 3.8	Statistical analysis for ZTCM. ....	89
Figure 4.1	Average annual rainfall levels in Kang Krachan national park. The data was averaged from the year 1952 to 1999. ....	108
Figure 4.2	Kaeng Krachan Management Model (KMP Model) in forms of compartment-flow model diagram development. ....	114
Figure 4.3	Forest compartment-flow sub-model diagram. ....	115
Figure 4.4	Agriculture compartment flow sub-model diagram. ....	116
Figure 4.5	Community compartment flow sub-model diagram. ....	117
Figure 4.6	Panels A-F depict changes of 6 different model components (average tree density, state of the forest, land encroachment, forest size, disturbed size and estimated numbers of logged trees in size-class 6). ....	122
Figure 4.7	Panels A-F depict changes of 6 different model components when number of wild elephants increased (average tree density, state of the forest, land encroachment, disturbed size, forest size, intensity of logging). ....	125

## Lists of Figures (continued)

Figure 4.8	Panels A-F depict changes of 6 different model components (average tree density, state of the forest, forest biomass, disturbed size , forest size, and land encroachment). .....	127
Figure 4.9	Estimated crop production values when 1250 kilograms and 2500 kilograms/ha/yr were applied. ....	129
Figure 4.10	Total estimated crop production value keeping for sell.....	130
Figure 4.11	Predicted total number of local villagers in KKCNP by end of year 2050. ....	132
Figure 4.13	People' quality of life in Kaeng Krachan national park. ....	132
Figure 4.14	Number of visitors in KKCNP in each month. ....	135
Figure 4.15	Predicted number of tourists in Kaeng Krachan National Park in 2010. With 44.49% increasing rate, employing Logarithmic equation ( $R^2 = 0.772$ ), number of tourists was estimated by 250000 persons. ....	136
Figure 4.16	TGF demand function compared between linear and Semi-log (dependent) forms.....	152
Figure 4.17	Demand curve for trip to site. ....	154

## Acronyms

CVM	Contingent Valuation Method
DMWP	Department of National Park Wildlife and Conservation
EM	Ecosystem Management
EMOD	Ecological Model
EV	Ecosystem Valuation
FA	Factor Analysis
FPU	Forest Protection Unit
GOT	The Government of Thailand
ITCM	Individual Travel Cost Method
KKCNP	Kaeng Krachan National Park
KMP	Kaeng Krachan Management Model
LRA	Logistic Regression Analysis
MOMM	Multi-objective Management Model
PAs	Protected Areas
PCA	Principle Component Analysis
RFD	Royal Forest Department of Thailand
TCM	Travel Cost Method
TNPM	Terrestrial National Park Management Model
ZTCM	Zonal Travel Cost Method
WTA	Willingness To Accept
WTP	Willingness To Pay

## Glossary

Common Factor	A factor on which two or more variables loaded.
Communality	the proportion of a variable's variance explained by a factor structure. A variable's communality must be estimated prior to performing a factor analysis. A communality does not have to be estimated prior to performing a principal component analysis. A communality is denoted by $h^2$ .
Conceptual Model	A graphical model describing the system services in general terms as how they are related, their focus and entities
Demand curve	The graphical representation of the demand function. The demand function relates price and quantity demanded. It tells how many units of a good will be purchased at different prices. In general, at higher prices, less will be purchased, so demand curves slope downward. The market demand function is calculated by adding up all of the individual consumers' demand functions.
Demand Function	The mathematical function that relates price and quantity demanded for goods or services. It tells how many units of a good will be purchased at different prices. The market demand function is calculated by adding together all of the individual consumers' demand functions.
Eigenvalue	The variance in a set of variables explained by a factor or component, and denoted by $ \lambda$ (lambda). An eigenvalue is the sum of squared values in the column of a factor matrix.
Externalities	Uncompensated side effects of human actions. For example, if a stream is polluted by runoff from agricultural land, the people downstream experience a negative externality.
Factor loading	A term used to refer to factor pattern coefficients or structure coefficients.



## Glossary (continued)

Factor scores	Linear combinations of variables, which are used to estimate the cases' scores on the factors or components. Least squares estimates of factor scores are the most commonly used.
Hierarchy	(1) A form of organization resembling a pyramid. Each level is subordinate to the one above it., (2) An organization whose components are arranged in levels from a top level down to a bottom level., (3) A partially-ordered structure of entities in which every entity but one is successor to at least one other entity; and every entity except the basic entities is a predecessor to at least one other entity, (4) Narrowly, a group arranged in order of rank or class; we interpret it to denote a rank arrangement in which the nature of function at each higher level becomes more broadly embracing than at the lower level.
Interface	Originally, the connections between two pieces of electrical equipment. Now, the telecommunication equipment, information carriers, input-output devices and computer networks mediating between people, computers and production processes.
Monoculture	The cultivation of a single crop, usually on a large area of land and on a commercial trading basis.
Net economic benefit	The net economic benefit is the total economic benefit received from a change in the state of a good or service, measured by the sum of consumer surplus plus producer surplus, less any costs associated with the change.
Non-use values	Value that are not associated with actual use, or even the option to use a good or service.
Opportunity Cost	The value of the best alternative to a given choice, or the value of resources in their next best use. In regard to time, the opportunity

## Glossary (continued)

Quality of life	<p>cost of time spent on one activity is the value of the best alternative activity that the person might engage in at that time.</p> <p>An indicator mainly focuses on economic vitality of a community or of a system, and is designed to support decision-making, planning, and policy-setting that ultimately determine the quality of life and sustainability of the community. Better quality of life can help state and local officials build better communities by providing information, resources, tools and suggestions for state and local policies.</p>
System	<p>1) a set of variables selected by an observer; 2) Usually three distinctions are made: An observed object, A perception of an observed object., and A model or representation of a perceived object., and 3) A set or arrangement of entities so related or connected so as to form a unity or organic whole. 4) Any definable set of components. Usually the term "system" is used to refer to either 1 or 2. Model usually refers to 3.</p>
Use value	<p>Value derived from actual use of a good or service. Uses may include indirect uses. For example, enjoying a television show about whales provides an indirect use value for the whales.</p>
Willingness To Accept	<p>The amount of compensation an individual is willing to take in exchange for giving up some good or service. This may be elicited from stated or revealed preference approaches.</p>
Willingness To Pay	<p>The amount an individual is willing to pay to acquire some good or service. This may be elicited from stated or revealed preference approaches. The amount—measured in goods, services, or dollars—that a person is willing to give up to get a particular good or service.</p>