ECONOMIC VALUATION OF FOREST ECOSYSTEM SERVICES

Learning Outcomes

At the end of the presentation, participants should be able to:

1. Explain the concept of economic valuation
2. Discuss the need for economic valuation
3. Describe the difference between consumer and producer surplus
4. Explain the types of economic values and its assessment approach
5. Describe three approaches of economic valuation

Outline

- The situation
- Reasons for forest degradation
- The context of economic valuation
- Meaning of economic valuation
- Why is economic valuation needed
- Concept of economic value and categories of economic value
- Assessment approach
- Approaches of economic valuation

The Situation

• Pricing for most market goods and services (which are privately owned) is determined in the *market place*, or by governmental authorities for controlled goods

• Environmental resources are considered as economic goods and services.

•For most environmental goods and services, they have no “price tags.” Such goods and services are known as *non-market commodities*

• Environmental benefits, therefore, tend to be *understated* over market or private benefits

The Situation……

•Support for environmental regulation is widespread in recent years. This is so because environmental degradation can lead to:

- •social *disharmony*
- •*unequal* income distribution
- •*inefficient* resource allocation
- •*unsustainable* development
- •*injustice* international trade

•The challenge to economists is to assign "*correct*" monetary values of environmental service flows.

• If these values are priced "correctly," long term social benefits will be *sustained*

The Situation…..

• Economic development and growth is a main goal to achieve country's long term socio-economic objective.

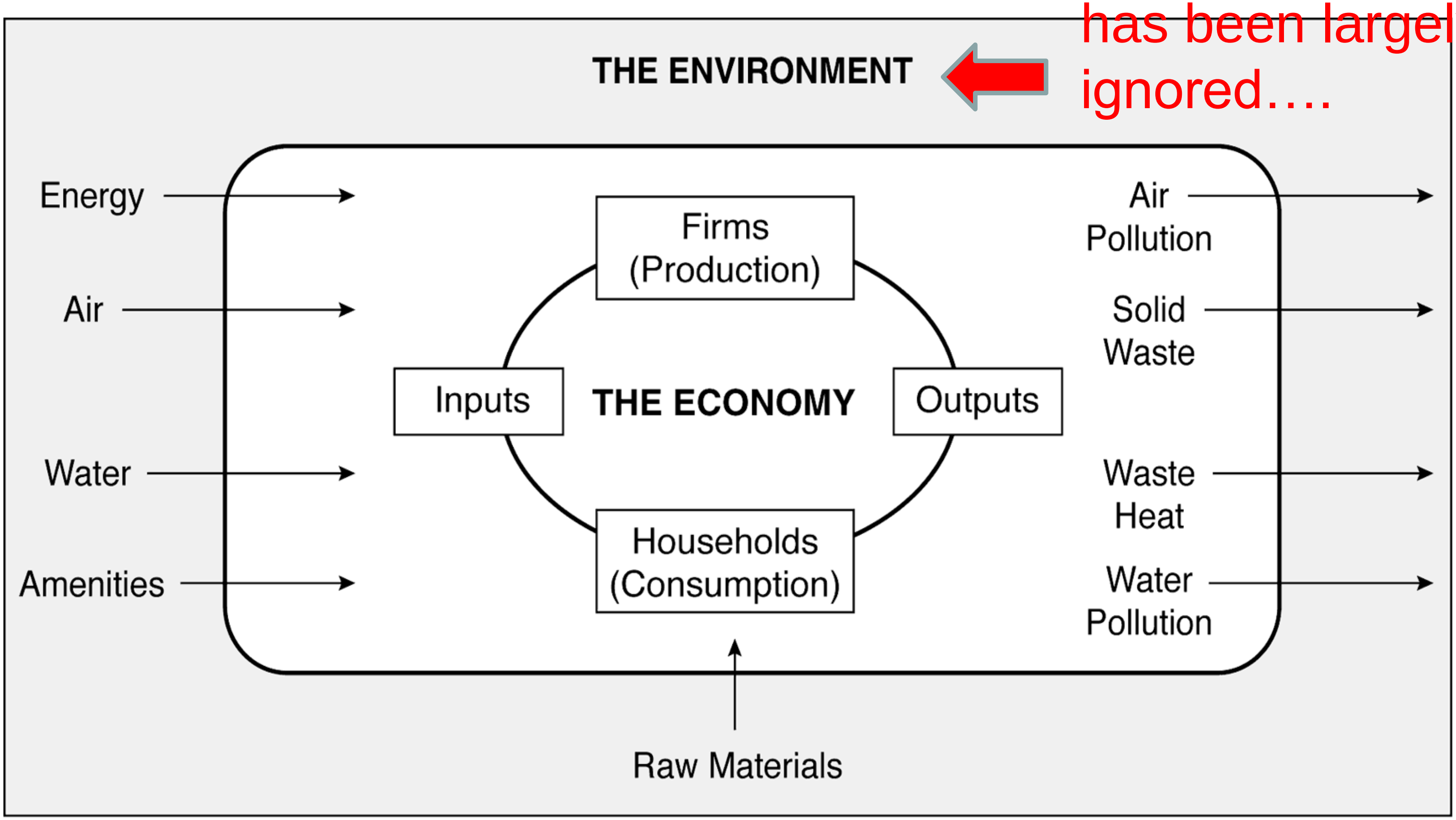
• Development projects are thus needed e.g. agriculture, forestry, fishery; manufacturing, transport, health, education, mining, services, etc……

• Projects are carried out by the government or private companies.

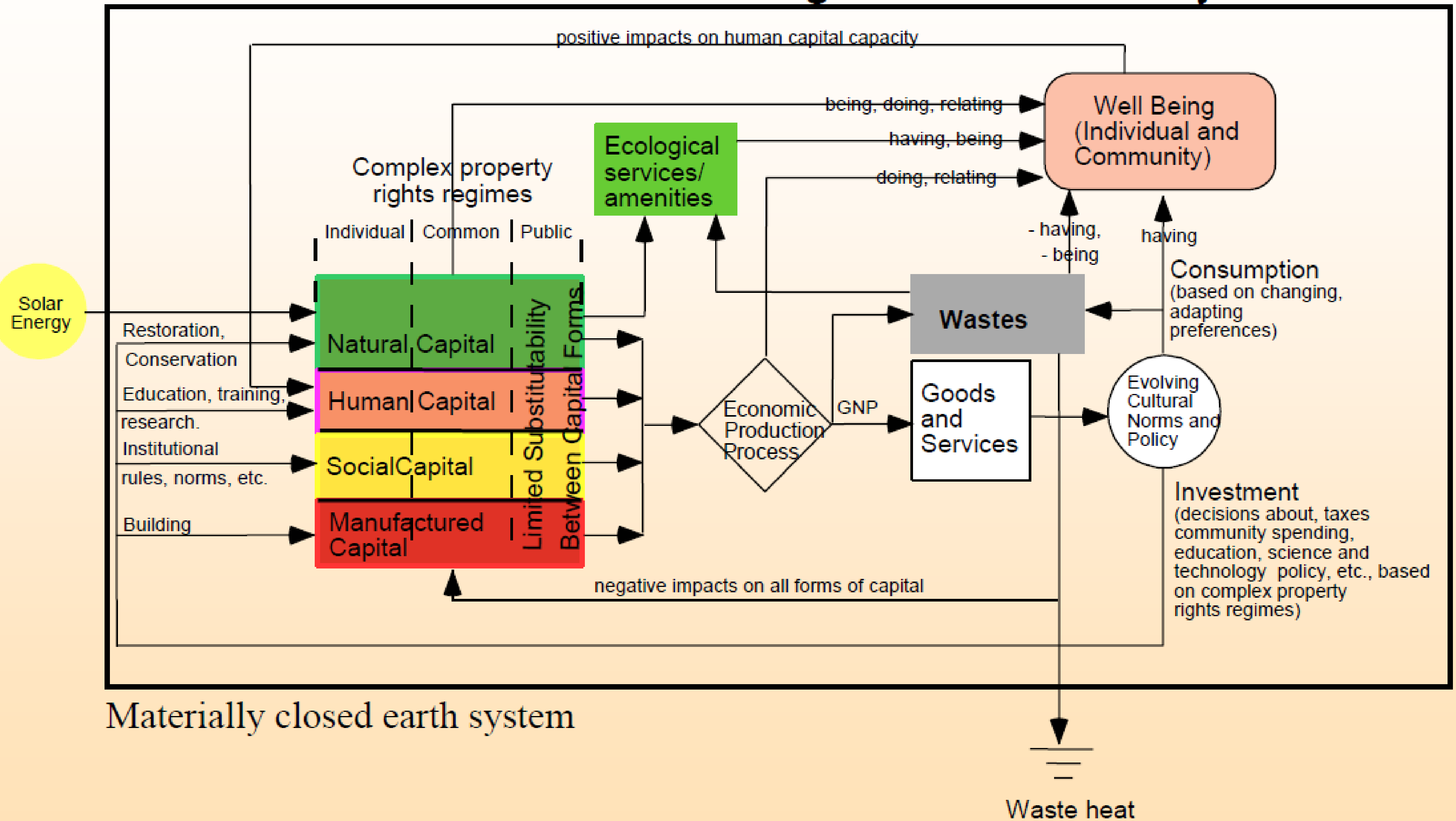
• Development projects involve the use of resources – land, labour, capital, entrepreneurship skills, and environmental resources

A Simple Linkage between Economic System and The Environment (Tietenberg, 2010)

has been largely ignored….



“Full World” Model of the Ecological Economic System



From: Costanza, R., J. C. Cumberland, H. E. Daly, R. Goodland, and R. Norgaard. 1997. An Introduction to Ecological Economics. St. Lucie Press, Boca Raton, 275 pp.

Costanza (2008)

The Situation…..

- These environmental resources have been largely ignored in project planning.
- Some questions with regards to management of environmental resources
  - ✓ Who own these resources? (air quality, aesthetic value, sedimentation, …)
  - ✓ What is the price of these resources?
  - ✓ Is there any law to govern the use of these resources?
  - ✓ What is the transaction cost in enforcing the law?
  - ✓ How to assess these resources and its impact on ecosystem or ecology of an environment?
  - ✓ Who will be affected if these resources are degraded?
  - ✓ Who will pay the cost of environmental damage?
  - ✓ Are people would be willing to pay to avoid this damage?
  - ✓ Are people would be willing to accept the compensation due to the environmental degradation?
- We have problem with resource depletion, resource degradation, deforestation, unsustainable management, climate change, loss of biodiversity, etc
- What are the reasons?

Reasons for Degradation
Policy failure

- Unbalanced policy - encourages the development of agriculture activities
- Inefficient taxation system
  -

Reasons for Degradation

Institutional failure

- No clear institutional arrangement - property rights structure or market-based instruments
- High transaction cost - legal dispute, policing and getting complete information (inventory, survey, damage assessment, lawyer fees, etc)

Reasons for Degradation

Market failure

- Cost of externalities (e.g. sedimentation) are not included in pricing
- Property rights are not well defined (e.g. no ownership rights on the loss of biodiversity, ecotourism areas, carbon, etc).
- Most of the ecosystem services are considered as public goods – not priced and tend to understate the potential resource rent/value
- Unpriced ecosystem services result in undervaluation/ underpricing

Reasons for Degradation

Social failure

- “Free riders” behaviour
- Lack of environmental education and awareness – “free gifts”
- “Rent seeking” behaviour

The context of economic valuation

- Resources are limited, but human wants are unlimited.
- Limited resources warrant optimal allocation in order to satisfy human wants
- Individuals are willing to pay to consume the resources that satisfy his or her well being.
- The willingness to pay (WTP) reflects individuals' preference for the good and service in question
- So, economic valuation of goods and services (or resources) is '*measuring the preferences*' held by people.

Economic Valuation

- For instance, in the context of environmental resources, economic valuation measures the preference of people for environmental good or against an environmental bad.
- Valuation is therefore of preference held by people.
- Valuation process is *anthropomorphic*
- The result is monetary terms: estimate the willingness to pay, or inferring their WTP through other means (asking people directly (stated preference), or calculate the economic value through revealed preference).

Economic Valuation

- Economic valuation is a misleading term: it does not mean the ‘valuing the environment’ or ‘pricing the environment’.
- What is being valued is not the ‘the environment’, but *people preference for changes in the of environment*, and *their preferences for changes in the level of risk*.
- We find that: *people are willing to pay to prevent or secure change*; such as donations to conservation or people are willing entrance fees to enjoy amenity value of a recreational forest

Economic Valuation

What is Economic Valuation?

- Economic valuation is the *process of determining the or discovering the demand curve for a particular good and service*. The use of *money* as measuring rod is a convenience: it happens to be one of limited number of ways in which *people express preferences* .i.e. through their willingness to pay.

Economic Valuation

- For environmental assets, there are **two types of values**:

- *Economic value*: the *value of preferences* of people beings place on the environment. This value can be measured.
- *Intrinsic value*: the *value that 'intrinsically resides* 'in' environmental assets. This value cannot be measured.

Economic Valuation

- If two values exist, which values should inform and guide the process of making decision?
- Both are ‘legitimate’, and both are relevant to decision-making
- If decision makers do not feel for quantified both values (assessment of costs and benefits) the lack of quantification is not an obstacle to decision making.
- Otherwise, it will difficult to make choices between competing projects or alternative policies with differing environmental impacts.

Economic Valuation

- Problems with economic valuation: there is *no apparent markets or very perfect markets*. But this is done either through stated or revealed preference.
- Part of the value is intrinsic value. This is partly valuing 'on behalf' of the environment as an entity in itself.
- Economic value is a two part process:

  - demonstrate and measure economic value of environmental assets-demonstration process

  - find ways to capture the value- 'the appropriation process'

The Need for Valuation – Why?

We need economic valuation to apply in the following areas:

- Changing the National Accounting System – obtain Net National Product (GDP – Env. Cost = NNP)
- Correcting prices – shadow price
- Project Appraisal and Planning – benefit cost analysis
- Setting national and sectoral priorities (prioritize the projects/programmes)

Economic Concept of Value

Economic Concept of Value

- In economic terms value ≠ price.
- Price is the "*willingness to pay*" to obtain the rights to use the resources, rights to own, etc. (factor ownership)
- This is the "*marginal utility*"
- In economic terms value refers to '*preference held by people*'
- Values can be measured in terms of *consumer surplus or producer surplus*

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- Economic value is one of many possible ways to define and measure value. It is useful to consider when making economic choices – choices that involve tradeoffs in allocating forest resources.
- Measures of economic value are based on what people want: their preferences.
- People express their preferences through the choices and tradeoffs that they make, given certain constraints (e.g. income or available time)
- The economic value of a particular item, or good is measured by the maximum amount of other things that a person is willing to give up to have consume other good.
- Assuming an individual has two goods to choose from, A and B, the value of good A would be measured by the most A that the person is willing to give up to have one more of B.

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- Economic value: is measured by the most someone is willing to give up in other goods and services in order to obtain a good, service, or state of the world.
- Willingness to pay: the amount that at a person is willing to pay for a good or service or tells us how much of all other goods and services a person is willing to give up to get that item.
- Economic value is one of many possible ways to define and measure value. It is useful to consider when making economic choices – choices that involve tradeoffs in allocating forest resources.
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- Economic value: is measured by the most someone is willing to give up in other goods and services in order to obtain a good, service, or state of the world.
- In a market economy, dollars (or some other currency) are a universally accepted measure of economic value, because the number of dollars that a person is willing to pay for something tells how much of all other goods and services they are willing to give up to get that item. This is often referred to as "willingness to pay."

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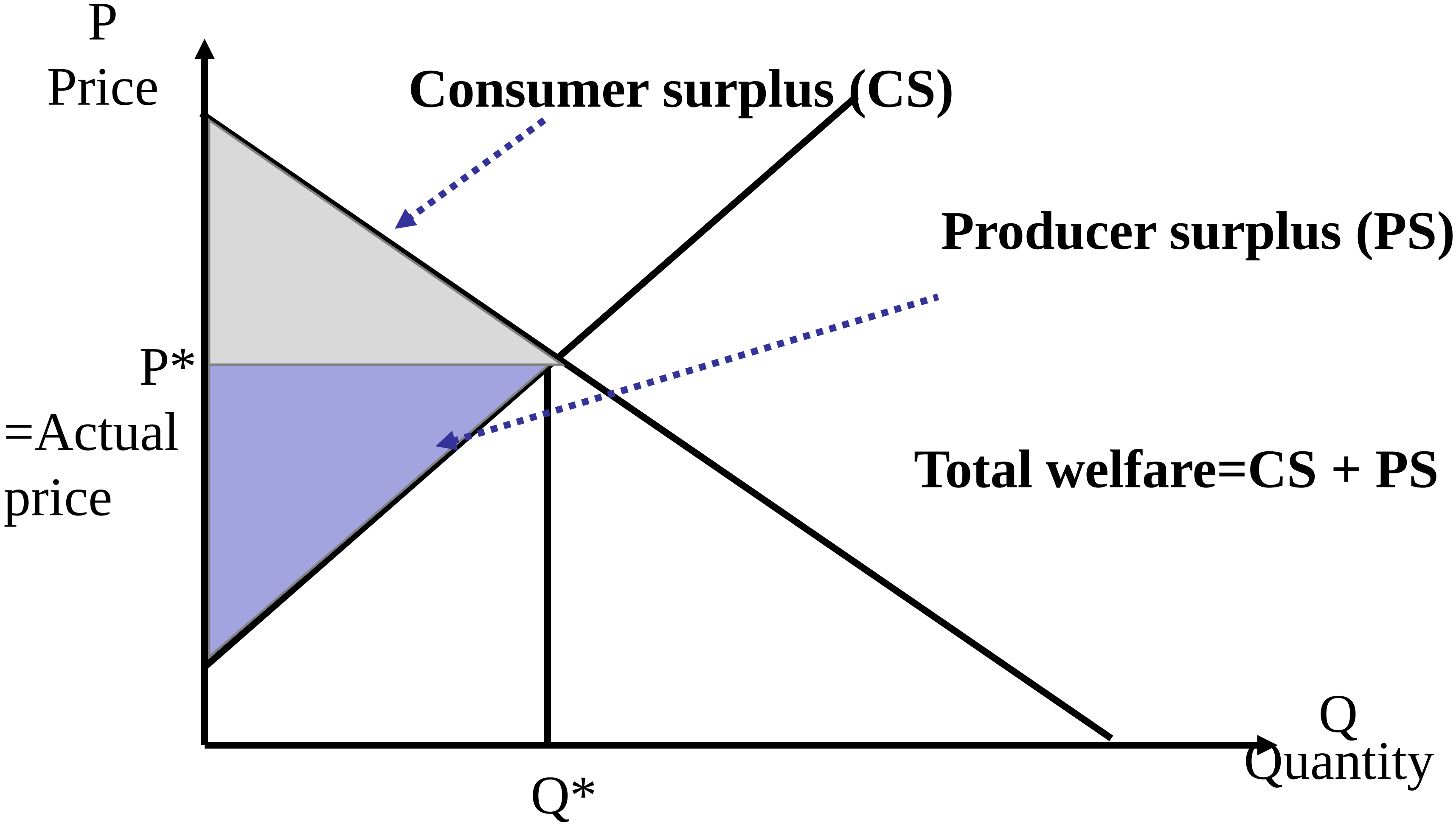
- In general, when the price of a good increases, people will purchase less of that good.
- This is referred to as the law of demand—people demand less of something when it is more expensive (assuming prices of other goods and peoples’ incomes have not changed).
- By relating the quantity demanded and the price of a good, we can estimate the *demand function* for that good.
- From this, we can draw the demand curve, the graphical representation of the demand function.

- The economic benefit to individuals, or consumer surplus, received from a good will change if its price or quality changes.
- For example, if the price of a good increases, but people’s willingness to pay remains the same, the benefit received (maximum willingness to pay minus price) will be less than before.
- If the quality of a good increases, but price remains the same, people’s willingness to pay may increase and thus the benefit received will also increase.
- The economic value is represented by consumer and producer surplus. This is the welfare measure of economic well-being.

Producer and consumer surplus



Taxonomy of Economic value

Four types of economic values

1. **Direct Use Values** (DUV) - Benefits derived from the actual use of resources

- *Direct consumptive use values - consumption of wood products, medicinal plants, animal products and fisheries from wetlands*

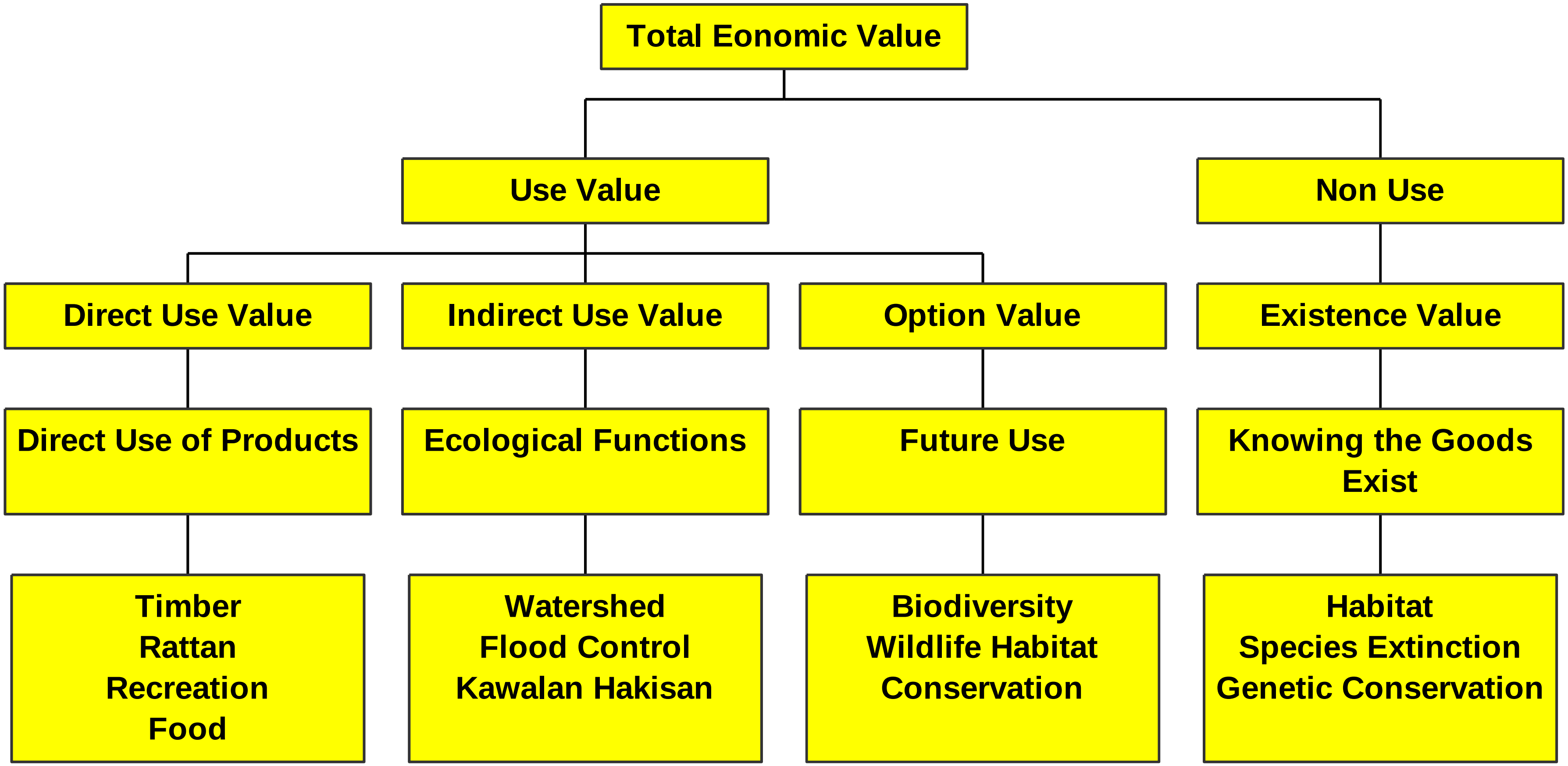
- Direct non-consumptive use values - personal uses of services that can be observed such as recreation and scientific information

2. Indirect Use Values (IUV) - Essentially the ecological services/functions of wetlands/forest area, such as flood protection, coastal stabilization, and biodiversity

3. Option Value (OV) - Values derived by an individual for having the option of using the resources sometime in the future

4. Existence or Passive Value (EV) - Values placed by individuals regardless of use. It consists of knowledge that a particular resource is in existence naturally. It includes the notion of bequesting an environmental resource for the use of future generations.

Total Economic Value (TEV)



$$TEV = DUV + IUV + OV + EV$$

The components of TEV, however, must not be mutually exclusive

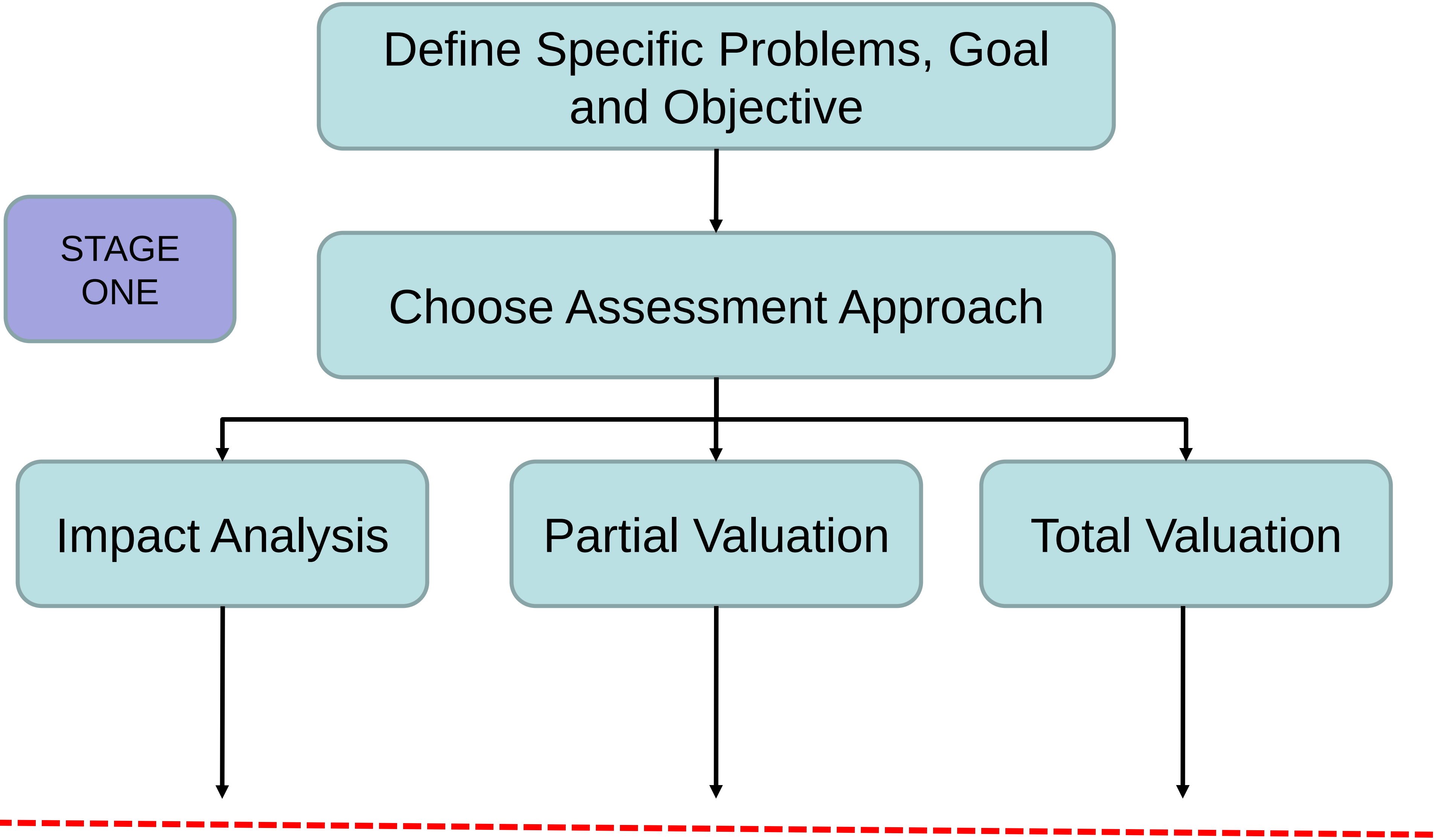
Table B6.1 Total Economic Value of a Tropical Forest

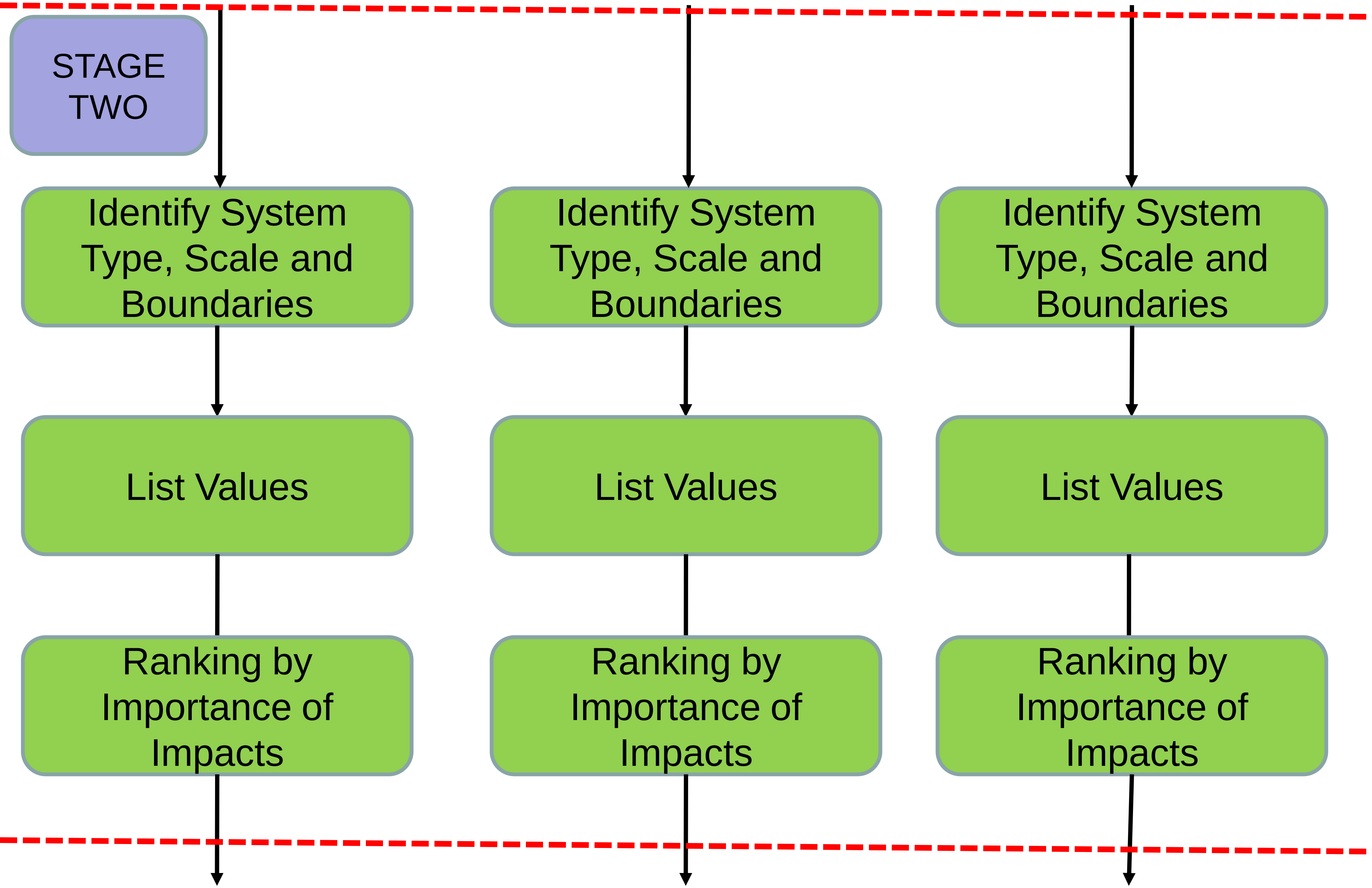
Use Values			Non Use Values
(1) Direct Value	(2) Indirect Value	(3) Option Value	
Sustainable timber	Watershed protection	Future use as per (1) and (2)	Existence value
Non timber forest products	Nutrient cycling		Cultural heritage
Recreation and tourism	Air pollution reduction		Biodiversity
Medicine	Micro climatic functions		
Plant genetics	Carbon store		
Education	Biodiversity		
Human habitat			

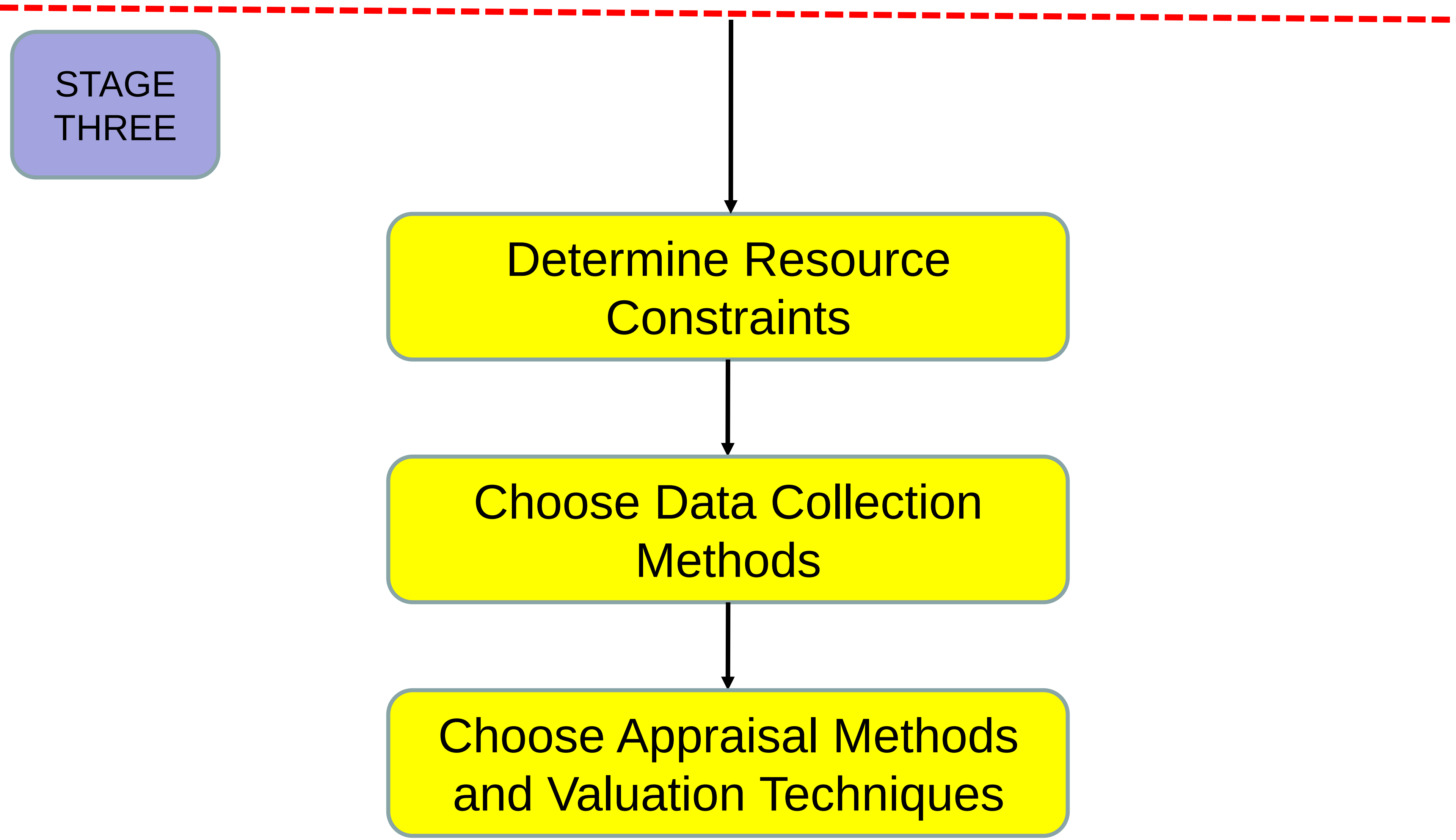
Assessment framework

Refer to the diagram in the next slides
(involves three stages)

Assessment Framework for Economic Valuation of Forest Goods and Services




STAGE TWO
Identify System Type, Scale and Boundaries
Identify System Type, Scale and Boundaries
Identify System Type, Scale and Boundaries
List Values
List Values
List Values
Ranking by Importance of Impacts
Ranking by Importance of Impacts
Ranking by Importance of Impacts


STAGE THREE
Determine Resource Constraints
Choose Data Collection Methods
Choose Appraisal Methods and Valuation Techniques

The overall assessment framework economic evaluation involves three levels/stages:

- **Level 1**: Problem Definition and selection of appropriate assessment approach
- **Level 2**: Define the scope and limits of analysis and Information needs
- **Level 3**: Define data collection methods and valuation techniques required for the economic appraisal, including distributional impact analysis

Level 1

Defining the problem and assessment approach

- The first stage in the evaluation process is to define the problem of forest ecosystem services assessment. This is because the problem will determine the approach of the assessment. There are basically three types of approach:
- **Impact Analysis**: Assessment of the external damages arising from specific economic activities
- **Comparative valuation**: Assessment of two or more alternative economic activities
- **Total valuation**: assessment of the total economic contribution or net benefit of a particular economic activity.

Impact Analysis

- It is carried out in situations where a particular economic activity results in specific environmental impacts. For example, logging activities will result in:
  - Increased run-off and sedimentation
  - Reduction in fish production
  - Affecting agriculture and water quality downstream
  - Economic activities from logging activities produce externalities (positive--external economy, or negative--external diseconomy). These externalities are costs (if negative), and thus they reduce economic values (losses in value). Therefore, downstream or off-site effect of the economic need to be evaluated and weight against the net production benefits. In this situation the net benefit is obtained as follows:

$NB^D = B^D - C^D$

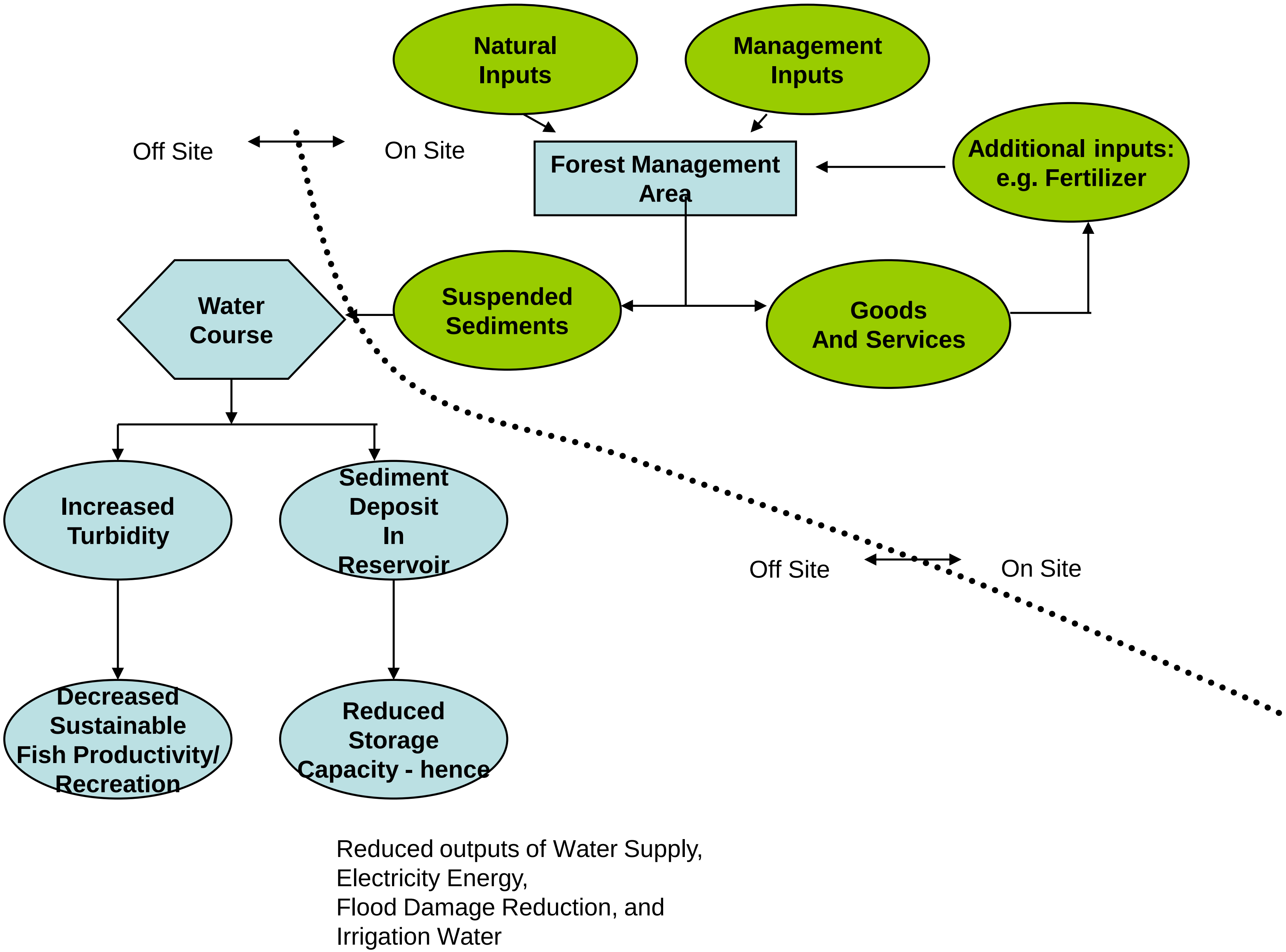
where:

NB^D = Direct net benefit

B^D = Direct benefit

C^D = Direct cost

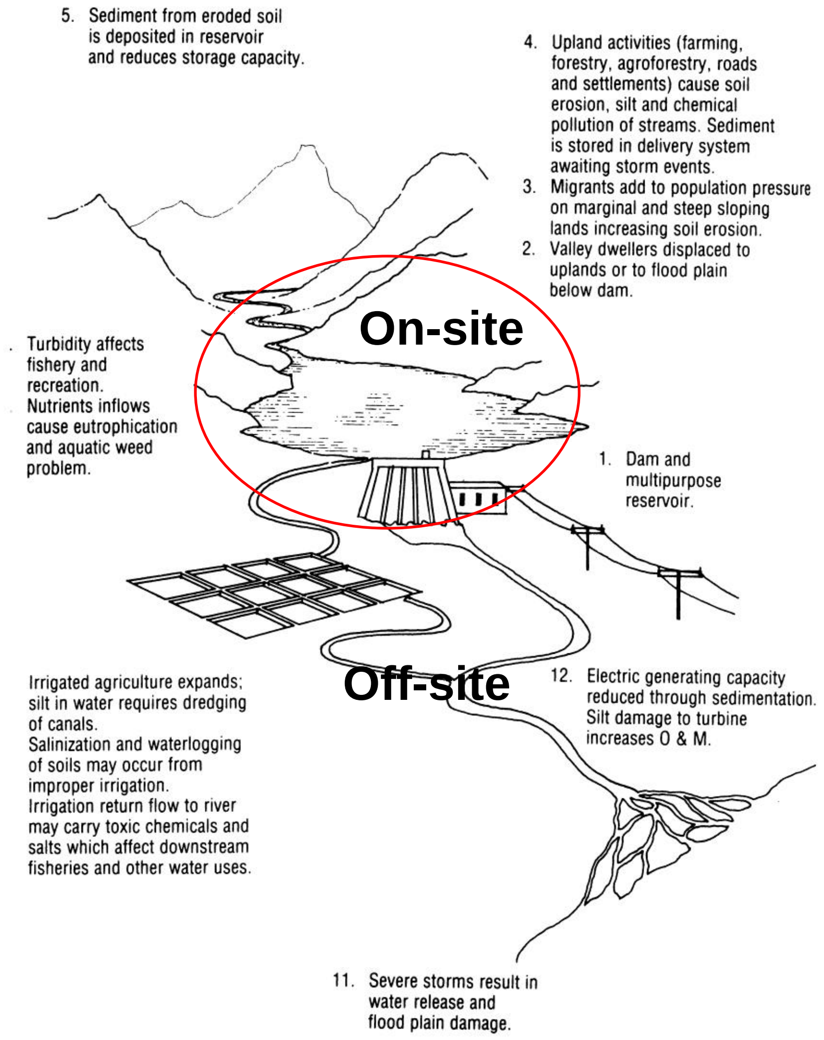
- We also need to consider 'Indirect Effects': indirect costs, C^I
- The project is worthwhile if: $NB^D > C^I$
- Problems using this criteria:
- Distributional allocation (who gets what and who pays the costs)
- Efficient use of resource (allocation of resources)
- Implications for Policy Makers
- Equity: who gains (gets benefits) and loses (pay costs) of downstream effects
- Efficiency: can gainers compensate losers
- Sustainability: continuous flow of benefits over time
- Impact analysis requires information on the physical impacts, for example, the effect of logging on non-timber forest products, environmental services or fish productivity. All these effects are evaluated over a number of years (or within one cutting cycle or rotation)



Natural Inputs
Management Inputs
Off Site
On Site
Forest Management Area
Additional inputs: e.g. Fertilizer
Water Course
Suspended Sediments
Goods And Services
Increased Turbidity
Sediment Deposit In Reservoir
Off Site
On Site
Decreased Sustainable Fish Productivity/ Recreation
Reduced Storage Capacity - hence
Reduced outputs of Water Supply,
Electricity Energy,
Flood Damage Reduction, and
Irrigation Water

On-site and Off-site Effects:

Conceptual View



Comparative valuation

- Principle: Compare any pair of economic activities
- Use benefit cost analysis approach (with and without project)
- Concept: Opportunity cost of choosing option A is forgoing the net benefits of B. It is not sufficient for the net benefits of A to be positive. The net benefits of A must exceed the forgone net benefits of B if A is preferred to B.

  $NB^{A} - NB^{B} > 0$
- For example, we want to evaluate two policy options: timber production vs. watershed protection. In this analysis, we should include both direct and indirect benefits of each option or situation. This calculation of 'Incremental Net Benefit (INB)' is:
- $INB = (NB^{DA} + NB^{IA}) - (NB^{DB} + NB^{IB}) > 0$

Total Valuation

- Principle: Full accounting of the costs and benefits associated with particular economic activity (land use option). For example, we want to measure the economic contribution of a particular forest land use to the welfare of a society.
- Objective: to value as many as possible the net production and environmental benefits

$$NB = NB_1 + NB_2 + NB_3 + \ldots\ldots\ldots\ldots\ldots\ldots + NB_n$$

- Problem: Ignore environmental impacts, which are non-marketed. ‘User cost’ is not accounted for.

- In this analysis, normally use ‘Total Economic Valuation (TEV)’ framework:

$TEV = NB^{D} + NB^{It} - C^{U} > 0$

NB^{D} = Net direct benefit

NB^{It} = Net external environmental impacts (+ or -)

C^{U} = User cost (due to resource depletion)

- Data requirement s are very extensive
- Data problem: difficult to estimate reasonable monetary values of non-marketed goods and services

Level 2
Defining the Analysis and Information Needs

- Identify the area under consideration, the scale, geographic analytical boundaries of the systems
- Identify the economic values to be assessed:
  - **Direct Use Values**
  - **Indirect Use Values**
  - **Option value**
  - **Existence value**
- Rank these values. Ranking is based on value judgment or subjective ranking.
- For impact analysis: The use resources can be based on functions and attributes affecting the impacts that are being assessed.
- For comparative valuation: Identify the relative importance of different values and determine the ‘cost effectiveness’ of acquiring and assessing the data
- For total valuation: The criteria will be similar . Try to measure as many values as possible.

Example: Hypothetical Ranking of Tropical Forest Ecosystem Services

Value	Low	Medium	High
Direct Use Values			
Timber resources			√
Forage resources	√		
Fuelwood		√	
Medicine		√	
Genetic material		√	
Utensils	√		
Recreation/tourism		√	
Human habitat	√		
Cultural/recreational use	√		

Source: IIED (1994)

Example: Hypothetical Ranking of Tropical Forest Ecosystem Services

Value	Low	Medium	High
Indirect Use Values			
Air pollution and protection	√		
Watershed protection			√
Micro-climate regulation		√	
Nutrient retention			√
Carbon store	√		
Biological diversity		√	
Non-use Values			
Uniqueness to cultural/ heritage	√		
Intrinsic worth	√		

Source: IIED (1994)

Level 3

Defining Data Collection needs and Valuation Techniques

- Carry out actual assessment
- Give priorities to assessing the values with the highest ranking
- Identify constraints--time, financial, skills
- Technique used varies for different types and values

Choice of Valuation Method

- Broadly speaking, the choice of which valuation methods to be used in determining the economic value of forest ecosystem service should be based on the followings:
    - Which types of values are most prominent in a given forest area
    - What information is available and feasible to collect
    - The resources available to the analyses
- It is important to determine that the chosen method for conducting the study is acceptable to a chosen forest resource or service in question.
- This is so because there are many arguments about the acceptability of the values obtained from valuation exercise.
- The chosen method is consistent with the needs of the users or policy makers.

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- Collecting data for the various valuation techniques has different costs and collection difficulties.
- Consideration should be given to the type and amount of data and information that is available and the cost of collecting it.
- The availability of resources to conduct a valuation exercise using appropriate method is also important. In the long term research, a more complex valuation technique could be applied compared to short term and less demanding valuation exercise.

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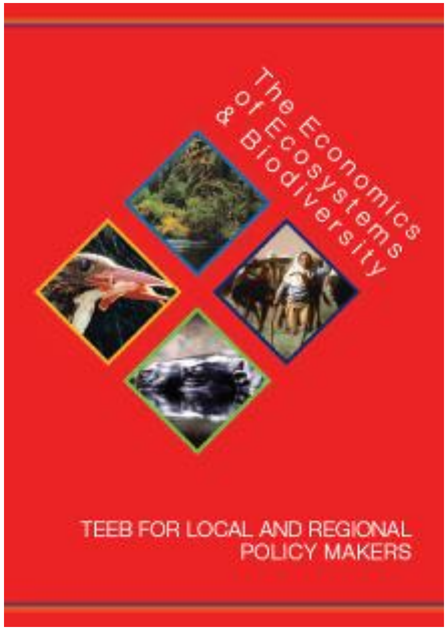
- When valuing each type of forest ecosystem service, a first checklist on the valuation estimates is to consider whether valuation results comply with the way they are going to be used in the economic analysis. Care must be taken in transferring values that are relevant because in general these values may not be methodological comparable due to the following factors:
  - Type of forest
  - Annual per hectare values versus net present value
  - Type of products considered
  - Gross versus net values
  - Actual versus potential values
  - Stock versus flows
  - Marginal or average values
  - Actual or potential values
  - Spatial variations

A Framework for integrated assessment and valuation of ecosystem services according to TEEB (The Economics of Ecosystems and Biodiversity) (UNEP)

Another approach of economic valuation has been developed by TEEB

There are six steps for effectively appraising ecosystem services

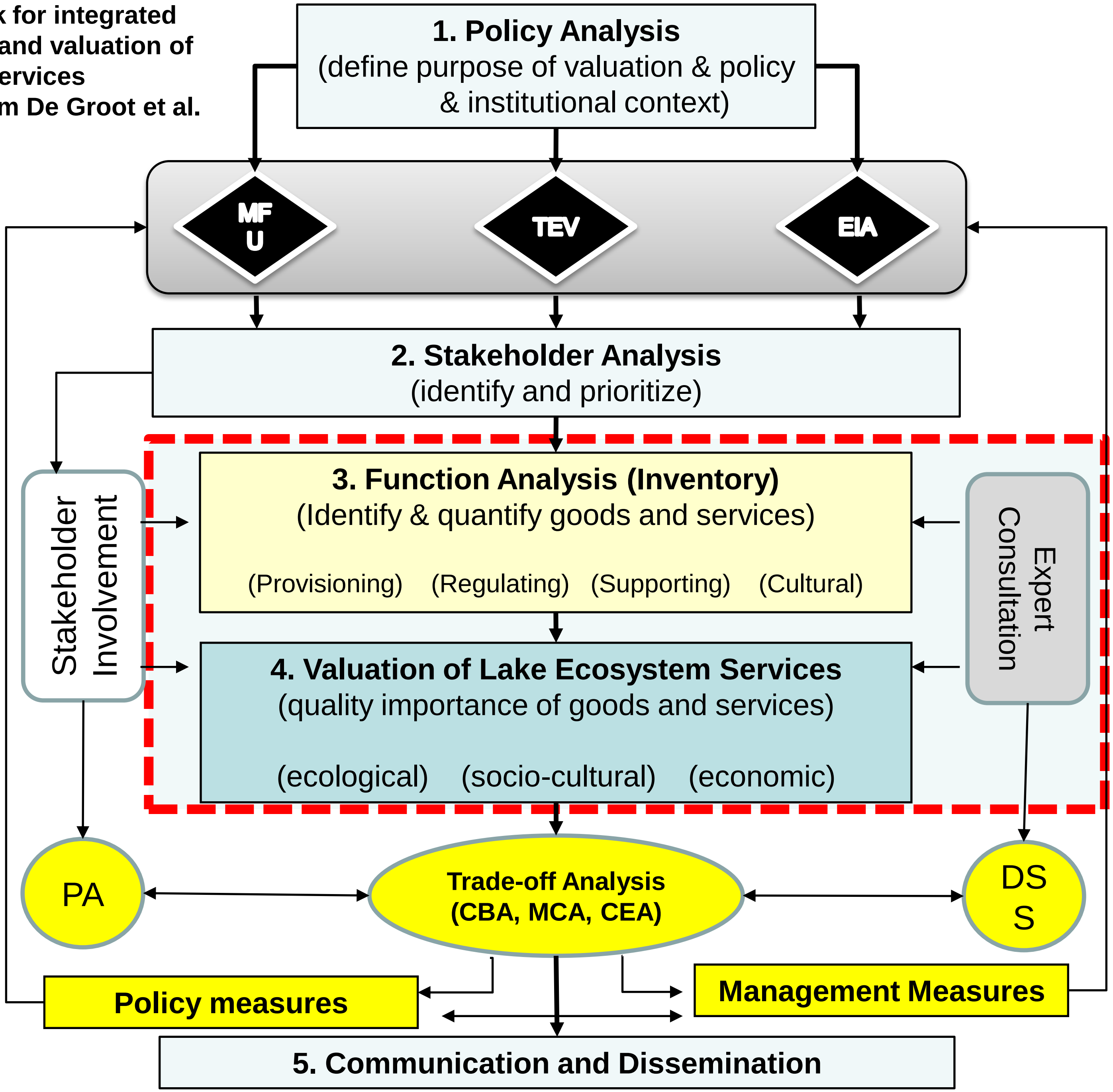
- This is not a fixed recipe but guidance for policy makers in designing their own processes:



1. Specify and agree on the policy issue with stakeholders.
2. Identify the most relevant ecosystem services.
3. Define the information needs and select appropriate methods.
4. Assess ecosystem services.
5. Identify and appraise policy options.
6. Assess distributional impacts of policy options.

Details explanation can be refferd to: TEEB 2010 – Quick Guide to TEEB for Local and Regional Policy Makers

A Framework for integrated assessment and valuation of ecosystem services (Adapted from De Groot et al. (2006)



Approach of Economic Valuation

3 Approaches Valuation:

- Market-based Approach
- Revealed Preference Approach (Surrogate Market)
- Stated Preference Approach

(*These approaches are applied for a particular type of economic value*)

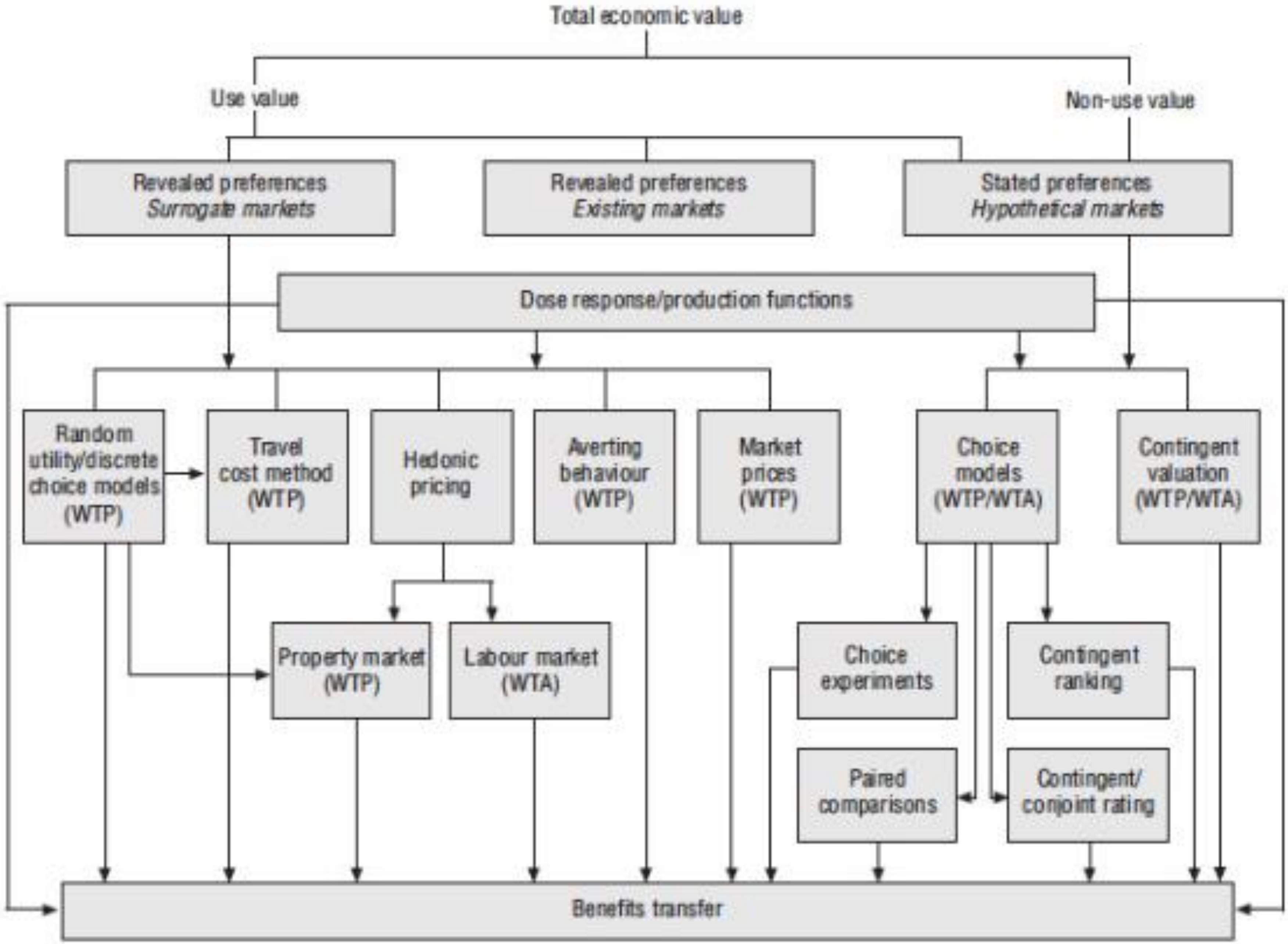


Figure 2.4: Total Economic Value: valuation approaches

Market-Based Approach

Market-based Approach

Classification based on IIED (International Institute for Environment and Development, 1994)

Price-based

- **Market-prices**
- **Efficiency or shadow price**

Cost-based

- **Indirect opportunity cost**
- **Restoration cost**
- **Replacement cost**
- **Relocation cost**
- **Preventive/Defensive Expenditure**
- **Damage Costs Avoided**

Market-based Approach

Classification based on Australia (1995)

- Change-in-productivity technique
- Change-in-income technique
- The replacement-cost technique
- The preventive-expenditure technique
- The relocation-cost technique

Principles of Market-based Approach

- Use market price to value forest resources
- Use market prices with and without alterations.
- If market exists: use *market price*
- If market is distorted (due to market failure, externalities, etc.) *shadow prices* have to be estimated and calculated.
- Value a benefit as *an increase in revenue or as a decrease in monetary outlay*
- Value a cost as *an increase in monetary outlay or as reduction in revenue*

Market-based Approach

Some techniques

- Production function (changes in production or change in producer surplus)
- Market prices
- Replacement Cost Technique
- Preventive expenditure
- Human capital (change in income technique)
- Relocation cost technique

Revealed Preference Approach

Basic Concepts

This approach is based on the assumption that the non-marketed good or service affect preferences expressed by consumers

- Preference of consumers are expressed in terms of expenditure of marketed good and service (*travel expenditure*), or in the level of productivity by certain market activities (*wage rate* or *house price*)

- The purpose is to identify the relationship between environmental change and the affected prices of marketed goods and services

Basic Concepts…..

- How this is done?
- Through applications of some techniques based on household production function
- Consumers are willing to pay for a good or service because they want to maximize utility (satisfaction)
- This utility is reflected in the expenditure that the consumers spend in obtaining this good or service

Techniques

- **Travel cost method (TCM)**
  - **Individual Travel Cost Method (ITCM)**
  - **Regional Travel Cost Method (RTCM)**

- **Hedonic price method (HPM)**
  - **Housing price method**
  - **Wage differential approach**

Stated Preference Approach

- Elicit WTP from respondents
- Use questionnaire
- Dependent variable – “latent” (0/1) – YES/NO
- Contingent Valuation Method
- Choice Experiment / Model
  - Choice Model
  - Contingent Ranking
  - Contingent Rating
  - Paired Comparisions