SWIM and Horizon 2020 Support Mechanism

Working for a Sustainable Mediterranean, Caring for our Future

Estimating the Cost of Environmental Degradation in Lebanon

(EFH-LB-3)

4-5 February 2019, Beirut, Lebanon

Hosted by

Republic of Lebanon
Ministry of Environment

This Project is funded by the European Union

SWIM and Horizon 2020 Support Mechanism

Working for a Sustainable Mediterranean, Caring for our Future

SESSION 1: BASIS OF THE COSTS OF ENVIRONMENTAL DEGRADATION ESTIMATION

Anil Markandya

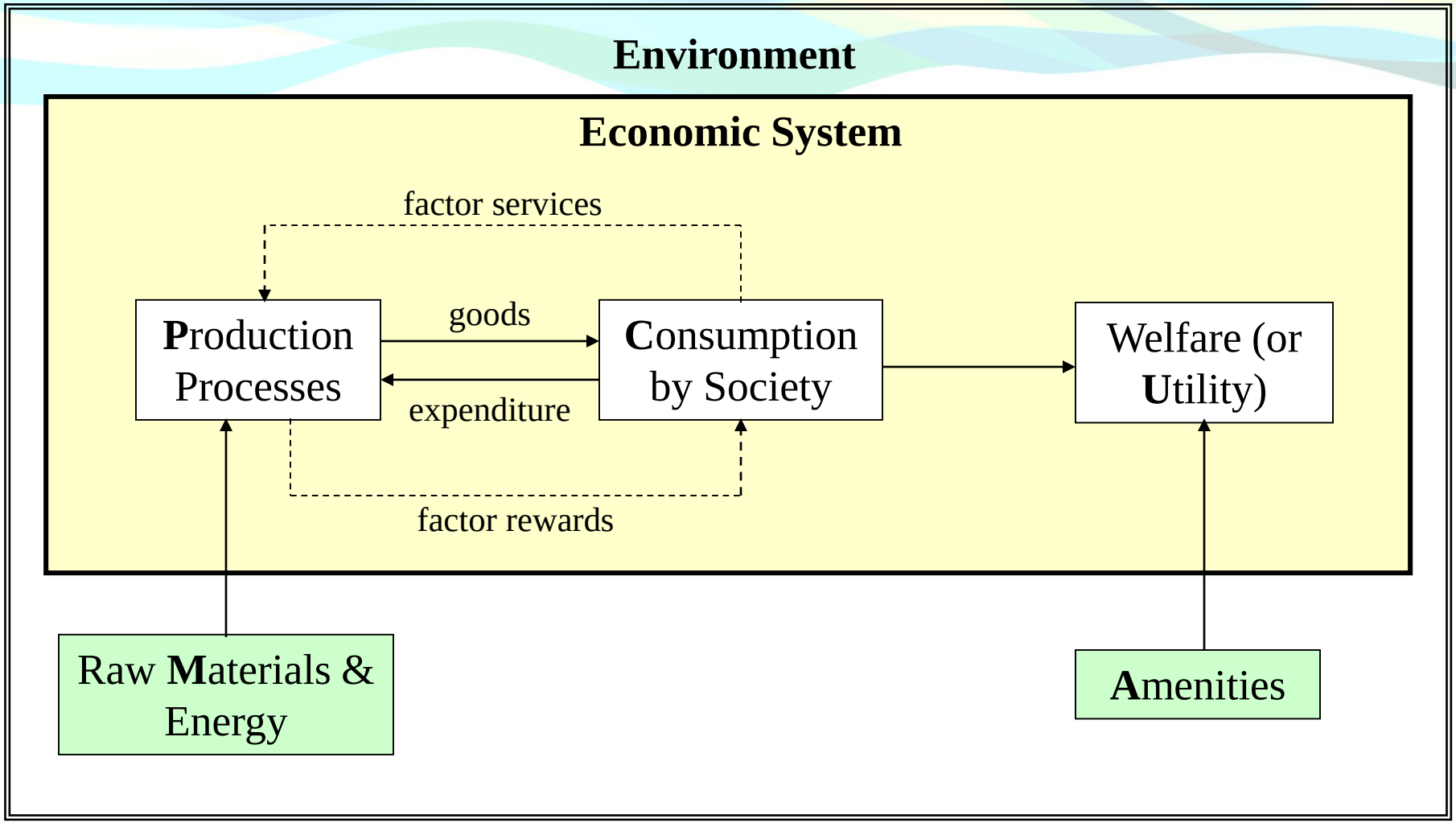
This Project is funded by the European Union

WHY DE WE WANT TO ESTIMATE THE COSTS OF ENVIRONMENTAL DEGRADATION?

- **The economic accounts of a country do not include many of the damages done to the environment.**
- **Production and consumption activities reduce the natural resources and damage the environment to dispose of the waste.**
- **These losses affect current welfare and the welfare of future generations.**
- **If we do not take them into account we will not be doing the best for both the present and future generations.**

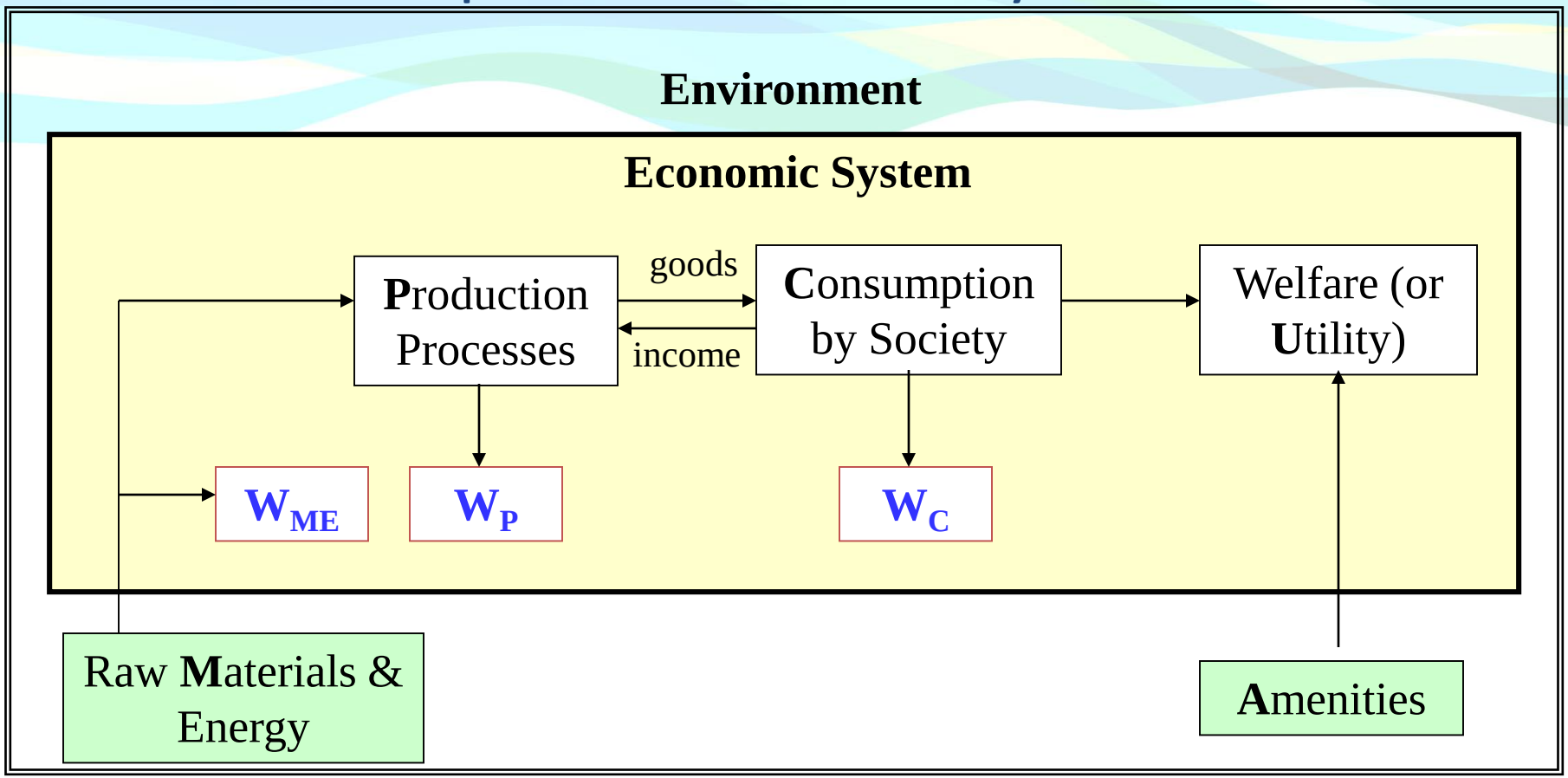
LDK CONSULTANTS

Economy Viewed as a Simple Linear System



The above picture is incomplete – What elements of this economic system are missing?

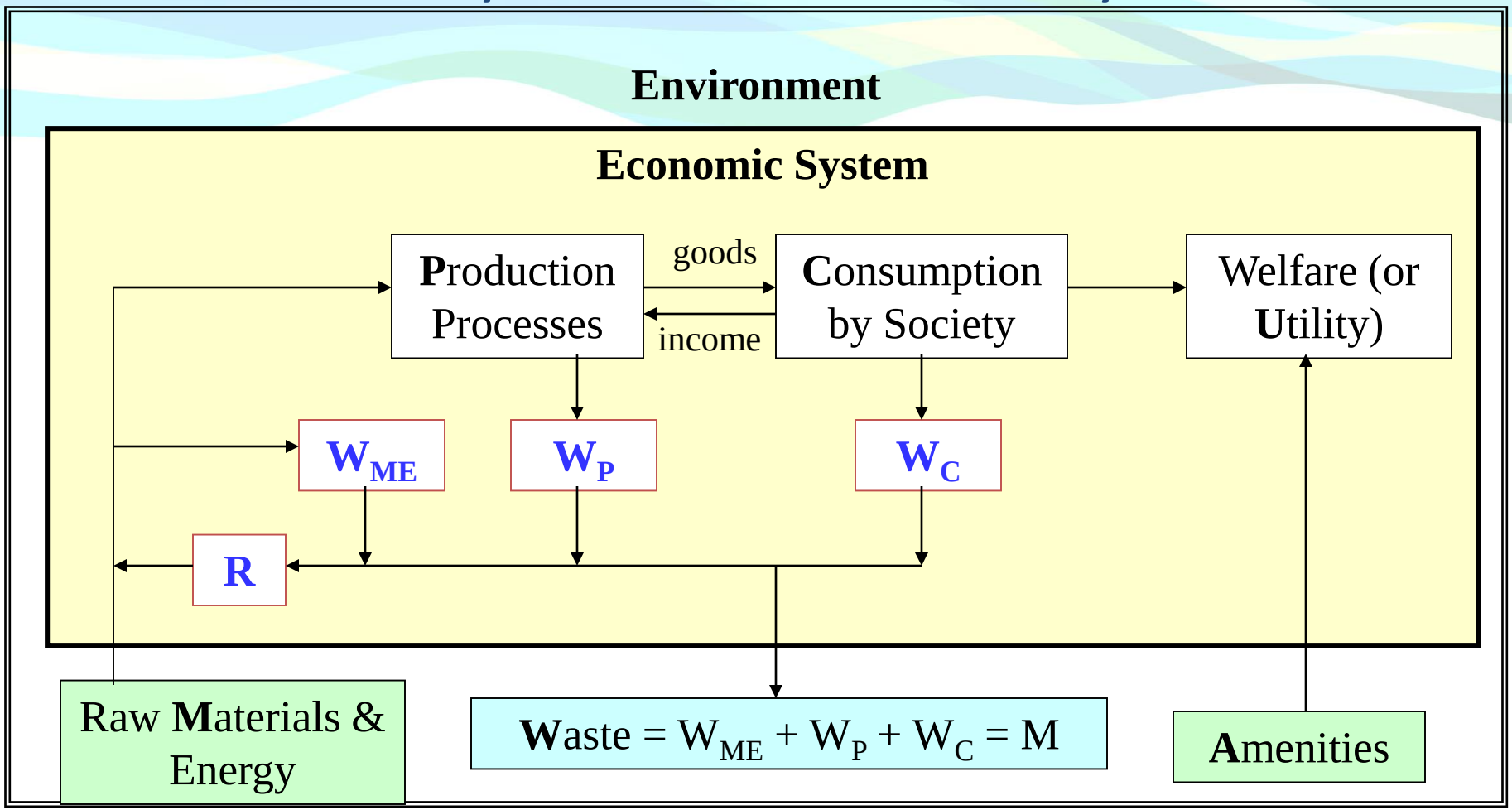
Expanded Economic System



First law of thermodynamics/law of conservation of mass – energy and materials are always conserved – they cannot be created nor destroyed, only converted from one state or form to another.

What are the implications of these laws for the above system?

Economy Viewed as a Circular System



The mass of material flowing into the economic system eventually must equal the mass of material flowing out to the environment – **materials balance model**

Earth is a **closed system** – **what are the implications of the "entropy" law?**

Bio-physical Constraints on the Economy

Entropy law – as applied to energy process, states that no conversion from one form of energy to another is completely efficient, and that the consumption of energy is an irreversible process.

- in the absence of any new energy inputs, any closed system (the Earth) will eventually use up its supply of energy available to perform work.

As a consequence of consumption and degradation resulting from waste disposal, the economy is faced with a bio-physical constraint – i.e. the environment's ability to supply **Materials** and **Amenities** is <u>limited</u>.

Economic expansion is not limited completely – it can temporarily be supported by:

- **Draw-down** of terrestrial stocks of **Materials**
- **Take-over** of habitats

Why might society object to draw-down and/or take-over?

Garbage piled up in Lebanon. Waste collection and sewage treatment operations have struggled to keep up with development.

Lebanon Crises Pollutes the Mediterranean

HOW TO ESTIMATE ENVIRONMENTAL DEGRADATION?

- Methods have been developed to estimate the cost of environmental degradation.
- These methods combine physical data on losses with methods for valuing the physical losses.
- They have been applied in many countries and for many types of degradation: air pollution, water quality, soil and land degradation, fishery, forest, etc. Also for loss of biodiversity and amenity, such as beaches, parks, coral etc.

LDK CONSULTANTS

Taxonomy of Valuation Techniques

PHYSICAL LINKAGES	BEHAVIOURAL LINKAGES	
	Revealed Preference	**Stated Preference**
Change in Inputs/Outputs Cost-of-illness Replacement Cost	Hedonic analysis Travel Costs Averting Expenditure	Contingent Valuation

INDIRECT METHODS	DIRECT METHODS	
Dose-response	**Revealed Preference**	**Stated Preference**
Change in Inputs/Outputs Cost-of-illness Replacement Cost	Hedonic analysis Travel Costs Averting Expenditure	Contingent Valuation

CONVENTIONAL MARKETS	IMPLICIT MARKETS	CONSTRUCTED MARKETS
Change in Inputs/Outputs Cost-of-illness Replacement Cost Averting Expenditure	Hedonic analysis Travel Costs	Contingent Valuation

Valuation Techniques Based on Physical Linkages

These techniques use physical linkage between change in the state of the environment and change in a good/service traded in a market (has an observable price).

- STEP ONE: The physical linkage is described by cause-effect (or dose-response) function

  Example - links the level of water pollution (cause) to a change in fish harvest rates (effect).

- STEP TWO: Expected change in the quantity fish harvested are converted to money using price.

They are also called collectively known as damage function methods. Main methods include:

- change in the output (or input) of marketable goods;
- cost of illness/human capital; and
- replacement cost.

Replacement Cost Technique

When benefits of an environmental function cannot be measured directly, cost data can yield valuable information. Estimates of value can be obtained by using:

- the cost of replacing the services provided by the affected environmental resource <u>after</u> the impact has occurred (RC); or
- the cost of reducing or avoiding the impact <u>before</u> it occurs (AE or PE).

Deterioration in environmental quality (e.g. from air or water pollution) could damage durable assets, requiring the owner to:

- undertake additional cleaning over and above that which would be required in the absence of the pollution (soiling from PM);
- undertake accelerated replacement following degradation of the asset (sandstone, rubber, plastic).

Cost-of-illness & Human Capital

Health impacts of pollution are divided into sickness (or morbidity), and premature deaths (or mortality). Once the physical health impacts have been estimated, a monetary value needs to be placed on them, to give the economic benefits of a reduction (or increase) in pollution.

Two main approaches economists use to value health outcomes:

- Individual preferences (WTP or WTA compensation) - preferred measure of economic value.
  - Derived through averting expenditure, wage-risk or contingent valuation studies.
- Resource or opportunity costs.
  - More 'direct' measures are commonly used - the cost of illness approach for morbidity, and the human capital approach for mortality.

Techniques Based on Behavioural Linkages: Revealed Preference

Valuation techniques under this heading work by:

1: Observing individual expenditures of money or time to obtain goods /services, or avoid their loss, and

2: Inferring WTP values for environmental goods/services from these expenditures.

3. Revealed preference approaches, include:

- hedonic analysis (property and wage-risk);
- travel cost;
- averting expenditures

Hedonic Property Analysis

- In addition to the physical characteristics of your home (e.g. total floor area, number of bedrooms, size of gardens, presence of garage, etc.) what other factors do you think influence the its rental value, or selling price?
- The quality of the environment will affect the value of the property.
- The hedonic method values the additional gain to the value of a property due to the environment
- It does this by using statistical methods of regression analysis, with all variables that affect the value included as explanatory variables, including environmental and non-environmental ones.

Hedonic analysis: advantages:

- uses observed data
- versatile - applicable to several environmental issues

Disadvantages:

- Results sensitive statistical assumptions
- Assumptions necessary restrictive and often unrealistic; and
- Full hedonic studies require much data – therefore often difficult and expensive

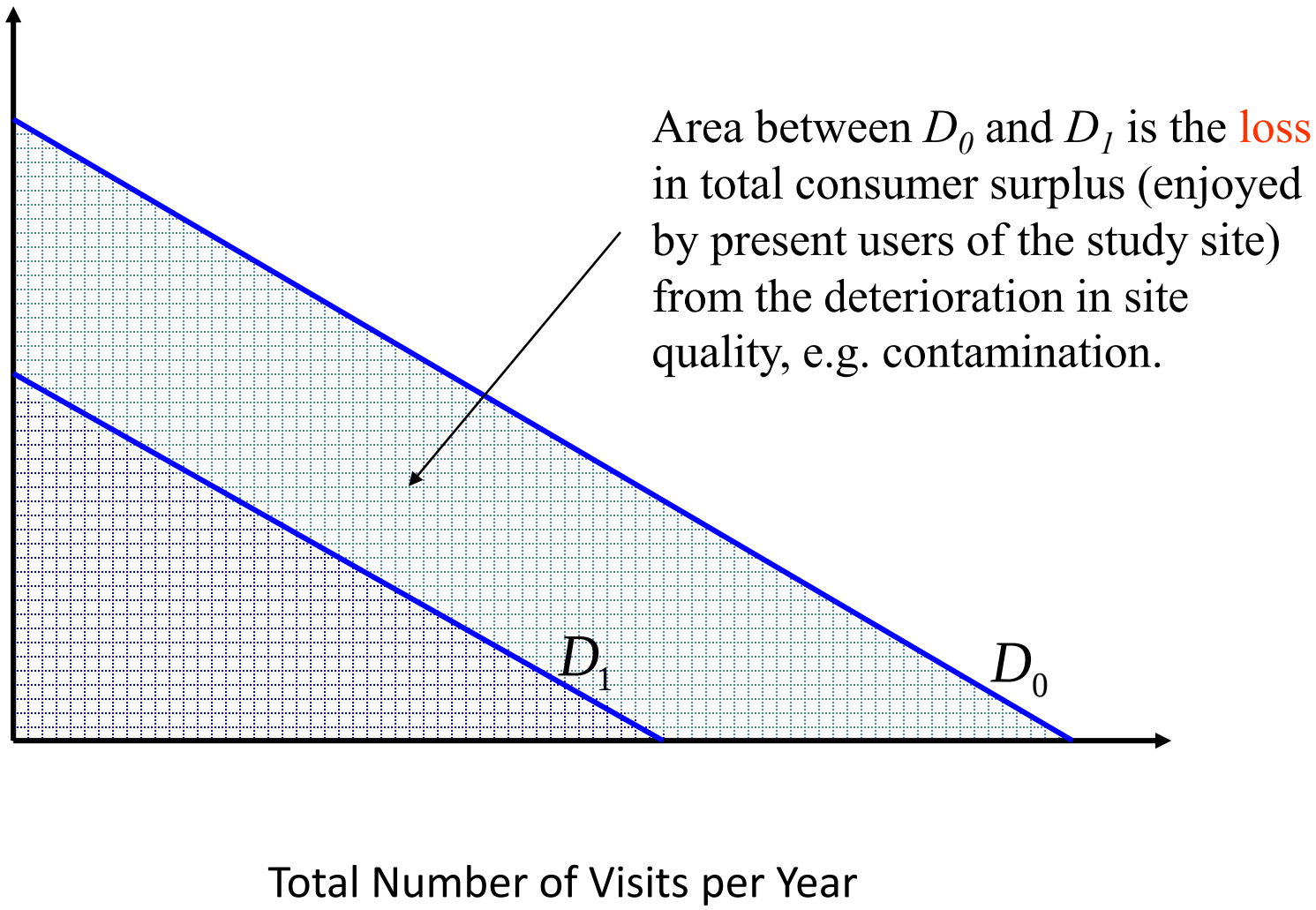
Travel Costs

The travel cost model is the most commonly used approach to valuing site-specific levels of environmental resource provision.

Basic approach - information on visitors' total expenditure to visit a site is used to derive their demand curve for the services provided by the site (beach – bathing).

Basic premise – if a consumer wants to use the services of a site they have to visit it. The TC to reach the site is considered as the implicit or the surrogate price of the visit, and changes in the TC will cause a variation in the quantity of visits.

Added Trip Cost – Travel cost plus admission fee



Some problems with the TCM

- only measures the benefits to current users, not to society as a whole; it does not account for option or existence values, i.e. benefits associated with non-use.
- it sometimes ignores users who travel on bicycle or foot.
- ‘standard’ TC does not account for the quality of the experience, i.e. it does not account for the affect that crowding or congestion will have on the estimates.
- some trips are multi-purpose. Since the method is only concerned with the one site, travel costs should be divided between the different sites.

Averting or Preventive Expenditures

These approaches assess the value of non-marketed goods such as clean water or air, through the amounts households/producers are WTP for market goods:

- to prevent the environmental impact, or
- to prevent a utility loss from environmental degradation, or
- to change their behaviour to acquire greater environmental quality.

The preventative or averting expenditures are intended to eliminate or mitigate the environmental impact of the pollution before it occurs.

Assuming your water supply is sourced from a groundwater well - if the groundwater were to become polluted, what actions might you take to avoid potential adverse health impacts?

You could avoid the potential adverse impacts of groundwater pollution in any one of three ways:

- buying durable goods (e.g. point-of-use treatment systems);
- buying non-durable goods (e.g. bottled water); and
- changing daily routines to avoid exposure (e.g. boiling water for cooking and drinking

The implicit value of the groundwater pollution is revealed in your willingness to incur these preventative expenditures.

AE or PE rarely eliminate pollution impacts <u>completely</u>.

- where AE or PE are considered a reasonable measure of the pollution costs avoided, the total costs of pollution are the <u>sum</u> of AE or PE and residual pollution costs.

Techniques Based on Behavioural Linkages: Stated Preference

Seeks to measure consumer preferences for environmental goods by asking individuals to directly state their preferences:

ONE: The value of an environmental <u>improvement</u> can be measured either by:

- The individual's maximum WTP to obtain the improvement; or
- The individual's minimum WTA compensation to forgo the improvement.

TWO: The value of environmental <u>damage</u> can be measured either by:

- The individual's maximum WTP to avoid the damage; or
- The individual's minimum WTA compensation to consent the damage.

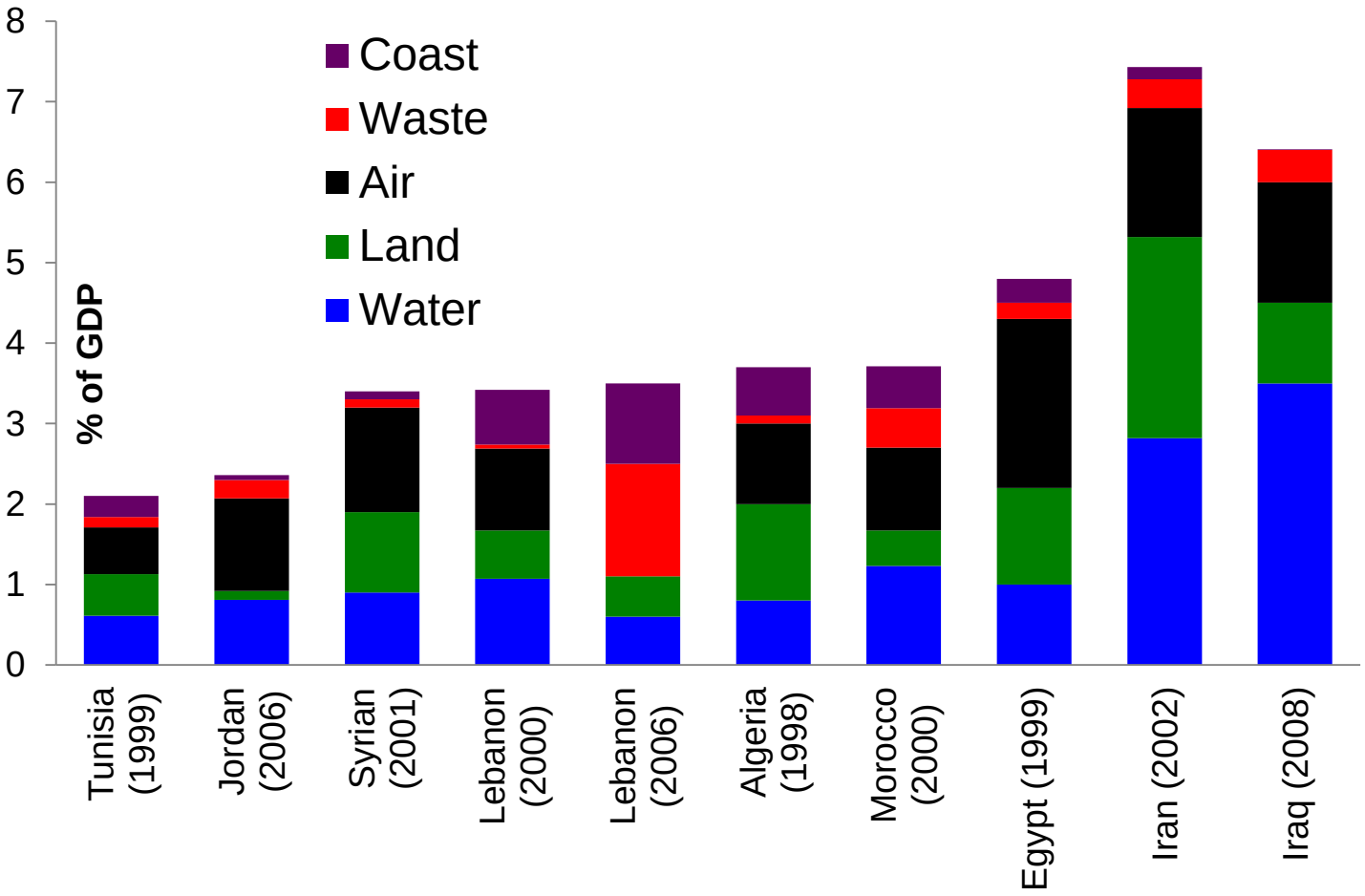
The main type of stated preference approach is the contingent valuation method.

Cautions regarding CV:

- The hypothetical nature of the method means numerous possible biases
  - strategic bias;
  - design bias (starting point bias, instrument bias, information bias
  - hypothetical bias (operational bias)
- survey-based research is expensive and time-consuming - valid benefit estimates require properly designed sampling and enumeration procedures

But now we have a lot of experience in using these methods and with the right protocols we can get reliable results in most cases.

RESULTS OF APPLYING METHODS TO ESTIMATE COED



What has been the impact so far? (1)

Raised awareness about the importance of the environment

- Results of the study have been quoted in various newspaper/media in Lebanon, Algeria and Egypt

Increased budgetary allocations for environmental protection by US$1 billion:

- **Algeria**: the first country that used the COED as a tool for priority setting in its National Environmental Action Plan for Environment and Sustainable Development. As part of the country's first Economic Recovery Program, the government committed **US$450 million** for the 2001–04 period to implement **institutional reforms and pilot investments** in the environment sector. The first investment was geared toward the National Program for Integrated Municipal Waste Management.

What has been the impact so far? (2)

Egypt: the COED study highlighted the high damage costs resulting from air pollution, particularly health costs. It played an important role in the design of the Second Pollution Abatement Project, the largest environmental project ever co-financed in Egypt (US$198.4 million).

Jordan: the COED study emphasized the environmental damage associated with the Amman landfill => the Government prepared the Amman Solid Waste Management Project (US$40 million) to strengthen the Greater Amman Municipality's capacity to manage its solid waste, improve the existing landfill and put in place a CDM project consisting of a landfill gas recovery system.

What has been the impact so far? (3)

Morocco: The COED study assessed the cost of water degradation at 1.23% of the GDP and that of inappropriate waste management at 0.5% of GDP => the Government used these results to prepare:

- the National Wastewater Program and the National Municipal Solid Waste Program (2007)
- First Water Sector DPL (US$100 million)
- Solid Waste Sector DPL (US$132 million)

Experience from the EU and the USA

EU: Studies on COED

Studies carried out to estimate COEDfor a number of countries. Green Accounting Program. Major EC 2007 Report.

Estimates include COED but also other reasons why GDP is not a good measure of wellbeing.

Beyond GDP

Measuring progress, true wealth, and the well-being of nations

LDK CONSULTANTS

EU STUDIES ON COED

Input to cost benefit analysis for major public investments such as railways, roads, airports.

Input to setting of technology standards for plats. BAT has been changed to BATNEEC!

Input to design regulations on emissions and setting of other standards. EU regulations now require a full Regulatory Impact Analysis(RIA) for each new standard or fiscal instrument. This requires an evaluation of the environmental costs and benefits as well as other factors – employment, risk etc.

LDK CONSULTANTS

Examples of Environmental Data in Regulation in the EU

1. Economic evaluation of the draft directive on Non-hazardous waste Incineration (1997)
2. Regulatory appraisal of the NO2 and PM10 air quality objectives. (1997)
3. Regulatory appraisal of the SO2 air quality objectives. (1997).
4. Cost and benefits of the Multi-pollutant, Multi-effect protocol. (1998)
5. Economic evaluation of the costs and benefits of acidification and ground level ozone. (1998)
6. Non-health benefits of the National Air Quality Strategy (1998)
7. Cost-effectiveness analysis of health impacts. (1998)
8. Comparative Risk Assessment of Electric Power Technologies. (1998)
9. Economic evaluation of costs and benefits for the Emission Ceilings Directive. (1998)
10. Comparison of the external costs of renewable energy technologies versus conventional sources. (1998)
11. Cost-benefit analysis of proposals under the UNECE Multi-pollutant, Multi-effect protocol. (1999)

LDK CONSULTANTS

Examples of Environmental Data in Regulation in the EU

13. Quantification and valuation of the health effects of fine particles. (1999)
14. The environmental costs of lorries: a study to incorporate environmental costs in vehicle excise duty rates. (1999)
15. Economic evaluation of diverting PVC from incineration to landfill and recycling (1999)
16. Surface transport costs. A study of the comparative environmental costs of road and rail in the UK. (2000)
17. A comparison of the external costs of very large lorries and rail freight in the UK.
18. Guidance on Reducing the Environmental Impacts of Urban Energy-Use in Developing Countries. (2000)
19. A Regulatory and Environmental Impact Assessment (REIA) on the Second Daughter Directive Concerning Air Quality Limits for CO and Benzene. (2000)

LDK CONSULTANTS

In the USA a similar benefit cost assessment is required by federal law. Applications include:

- Phase out of lead used data on environmental benefits.
- Emissions limits for air pollutants from stationary sources (e.g. SO2 cap and trade)
- Emissions limits for air pollutants from mobile sources (NOx and PM standards for vehicles)
- Technology standards for pulp and paper plants.

شكرا جزيلا

THANK YOU

LDK CONSULTANTS