SWIM and Horizon 2020 Support Mechanism

Working for a Sustainable Mediterranean, Caring for our Future

SWIM-H2020 SM Regional Activities

Training on Cost of Environmental Degradation

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Air pollution in Jordan

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Content of the presentation

- Background
- Emissions
- Validation / calculations
- Identifying pollution
- Estimating population exposed
- Establish dose-response coefficients
- DALYs
- Total cost for air pollution in Jordan

Background

- Although Government has adapted policy measures, air pollution remains an environmental challenge due to the growth of the vehicle park and increase of industry
- Hot spots are Amman, Zarqa and Irbid, where (too high) concenrtations of particles have been measured.
- Mining is by far the most polluting industry, use of fuel oil for power generation and domestic heating is another important source, next to transport.
- Air pollution however does not occur in centers of tourism such as the Dead Sea, Jerash, Petra, the desert.
- In the hot spots where it occurs, air pollution likely affects health significantly, through airborne diseases, and the environment, through reduced visibility and aesthetic value of landscape.
- This chapter estimates the cost of environmental degradation carried out within the Jordan Country Environmental Analysis in 2008.

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Emissions

Table 3.1 Pollutant Emissions from Transportation and Industry Sources, 2004

Source of emissions	NO_x	SO_2	*TSP*
Road transportation (%)	79[a]	20[b]	39
Other diesel (%)	0	0	1
Air transport (%)	2	1	14
Industry (%)	7	30	18
Electricity production (%)	11	48	28
Total (tons)	**72,900**	**123,000**	**6,500**

Please note that Total suspended particles in PM10, PM 2.5 is (was) not measured 10 years ago

Valuation /Calculation

Valuation steps. Valuation is based on four steps:

1. Identifying pollutants and measuring concentration

2. Estimating the population exposed

3. Establishing the dose-response coefficients

4. Estimating the health effects.

Identifying pollution

Table 3.2 Estimated PM_{10} Concentration and Exposed Population in Selected Urban Areas

Location	*Estimated average PM_{10} concentration ($\mu g/m^3$)*	*Exposed population (millions)*
GAM	67[a]	1.40
Zarqa	95[b]	0.54
Fuheis	58[c]	0.01
Rashadeia	54[d]	0.01

The average PM10 concentration in the GAM is calculated on the basis of the PM10 concentration and the population density in each of its districts.

The weighted average concentration for the GAM as a whole is estimated at 67 micrograms per cubic meter.

Estimating the population exposed

- For each GAM district, the exposed population is estimated by multiplying the total resident population by a coefficient of exposure.
- The latter reflects the proportion of the total population that spends most of the time in the district where they reside, based on expert local opinion
- For Amman it is estimated that 1.96 million people are exposed to too high concentrations

Establish dose-response coefficients 1

For mortality related to short-term exposure of children under 5 years of age:

$RR = \exp [\beta (x - x0)]$, (3.1)

where β ranges between 0.0006 and 0.0010,

x = current annual mean concentration of PM10 (µg per cubic meter),

x0 = baseline concentration of PM10 (µg per cubic meter).

Establish dose-response coefficients 1

WHO:

For mortality related to short-term exposure of children under 5 years of age:

RR (Relative Risk) = exp [β (x – x0)]

where β ranges between 0.0006 and 0.0010,

x = current annual mean concentration of PM10 (µg per cubic meter),

x0 = baseline concentration of PM10 (µg per cubic meter).

Establish dose-response coefficients 2

WHO:

For cardiopulmonary mortality related to long-term exposure of adults over 30 years of age:

$RR = [(x + 1)/(x0 + 1)]\beta$, (3.2)

where β ranges between 0.0562 and 0.2541,

x = current annual mean concentration of PM2.5 (µg per cubic meter),

x0 = baseline concentration of PM2.5 (µg per cubic meter).

Establish dose-response coefficients 3

WHO:

For lung cancer mortality related to long-term exposure of adults over 30 years of age (Pope and others 2002):

$RR = [(x + 1)/(x0 + 1)]\beta$, (3.3)

where β ranges between 0.08563 and 0.37873,

x = current annual mean concentration of PM2.5 (µg per cubic meter),

x0 = baseline concentration of PM2.5 (µg per cubic meter)

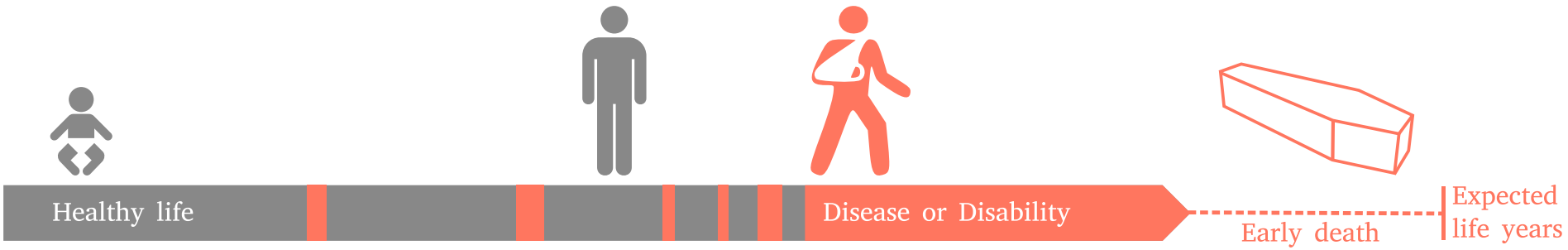
DALYs

- Disability-adjusted life year (DALY), a measure of disease burden in economic terms
- Becoming more and more common in health impact assessment
- DALYS from literature
- Multiply by GDP/head of population or by willingness to pay for not getting ill.

DALY

Disability Adjusted Life Year is a measure of overall disease burden, expressed as the cumulative number of years lost due to ill-health, disability or early death

= YLD Years Lived with Disability + YLL Years of Life Lost



DALYs for air pollution in Jordan

Using the GDP or WTP approaches, total DALYs were calculated

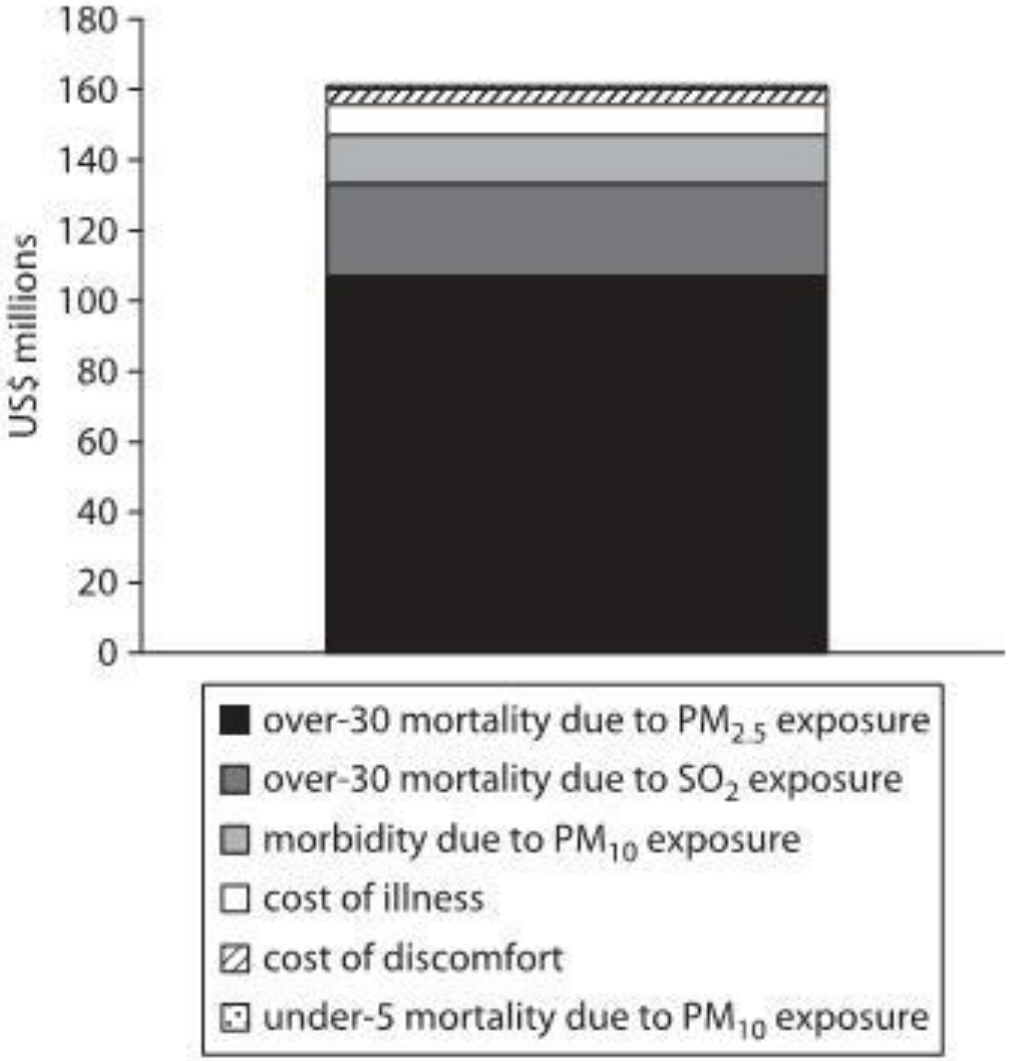
Health effect	DALYS per 10,000 cases	GDP	WTP
Mortality PM10 children < 5	80,000	100	880
Mortality PM25 adults > 30	80,000	2,860	11,280
Mortality SO2 exposure	80,000	2,480	2,480
Chronic bronchitis (adults)	22,000	1,890	1,890
Restricted activities days	3	1,650	1,650
Respiratory symptoms	.75	1,310	1,310
Total		**11,070**	**20,270**

Total costs for air pollution in Jordan 1

- Total costs for health impact equals 156.5 million USD (2006)
- Cost of discomfort (data from Morocco: 13-15 USD per household per month). Adjusting for GDP differences and considering 300,000 households in Amman, costs are estimated at approximately 4.5 million USD per year
- Hence total costs are 161 million USD, equal to 1.15 percent of GDP in 2006

Total costs for air pollution in Jordan 2

Figure 3.1 Estimated Damages from Air Pollution



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Thank you for your attention.

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