SMIA
Genève | 2005

Draft # 04

Meso Environment-Economic Analyses

Methodology and Main Results – Industry and Urban Communities in Arab Countries

by
Gonzague PILLET*, David MARADAN**, Karen MAYOR***,
Eric STEPHANI°, and Karim ZEIN°°

Mailing Address: Prof. Dr. Gonzague PILLET, pillet@ecosys.com
Ecosys Inc., 27, rue de la Filature, CH 1227 Carouge (Switzerland)

JEL: Q5 Environmental Economics, Q51, Q53 and Q24, Q25, Q26
Keywords: meso & macro environmental economics, damage and remediation costs, benefit/cost ratios

Abstract

Macro-economic studies related to the cost of environmental degradation in the Middle East and North Africa region have been performed by the World Bank. *Meso-economic* analyses of industrial sectors in Arab countries are based on economic appraisals of the environmental costs and benefits of industrial production (cement, electricity) and urban communities in Mashreq and Maghreb countries. Ecosys and SBA have carried out such studies under the auspices of the Arab Union for Cement and Building Materials (AUCBM) and the Swiss Agency for Development and Cooperation (SDC).

Estimated *macro-economic* damage costs and resource inefficiencies in Mashreq and Maghreb countries remain substantial and range between 4 and 6% of GDP (Gross National Product). As a benchmark, damages to the environment in Switzerland were approximately 5% of GDP in the mid-eighties.

Estimated *meso-economic* damage costs and resource inefficiencies in industrial sectors and urban communities in Arab countries can reach 20% of VA (value added), resource inefficiencies constituting somewhat more than half of that total cost.

This paper presents the methodological framework for meso environment-economic analyses together with main cross-compared results related to industry and urban communities in different Arab countries.

Introduction

The costs of environmental damages and resource inefficiencies are considered to be benefits if remedial action is undertaken. Therefore, a comparison of these potential benefits and the costs of remediation allows the pinpointing of the environmental categories for which benefits are likely to substantially exceed the cost of remedial action. Ratios of damage costs and resource inefficiencies to remediation costs for cement sectors in Arab countries are estimated to range between 1.5 and 3.5. The overall ratio for inefficiencies (as an economic category) is estimated at about 3, i.e. estimated benefits are more than three times higher than remediation costs. This ratio shows that first dealing with inefficiencies can remediate to a large extent environmental damages.

---

* Professor, Department of Economics and Department of Biology, University of Fribourg; Lecturer, Center for Human Ecology and Environmental Sciences, University of Geneva; President, Ecosys Inc., Geneva – pillet@ecosys.com

** PhD, Department of Economics, University of Geneva, Switzerland; Associate, Ecosys Inc., Geneva, Switzerland – david.maradan@ecopo.unige.ch

*** Trinity College, Dublin; Associate, Ecosys Inc., Geneva, Switzerland – www.ecosys.com

° MA in Economics and Social Sciences; Associate, Ecosys Inc., Geneva, Switzerland – eric.stephani@ecosys.com

°° MBA; President of SBA-Sustainable Business Associates, Lausanne, Switzerland – sba@planet.ch

Yet, individual countries differ, individual industrial sectors differ, single production plants differ just as urban communities also do. How do we analyze such various conditions? What is the methodology at hand? Then, how do we cross-compare industrial sector performances (alternatively, urban community performances) of different countries with each other? And how do we relate environment-economic performances at a sectoral or urban level with performances at a national level? Methodology as well as such cross-country results (benchmarking) are the two purposes of this paper.

1 Context and Objectives

The interest in taking into consideration the economic sides of environmental degradation can be traced back to the works of A. C. Pigou (1920), T. Scitovsky (1954) and J. E. Meade (1973). These studies established the theory of externalities. By an externality, economists refer to a non-market consequence (or an unanticipated consequence, which leads to the same result) on the well-being of individuals or the performance of firms, such as an increase or a decrease in the quality or the availability of an environmental good or service-provided that this effect has not been compensated in one way or the other (through payment, agreement, etc.). An external cost is a negative externality while an external benefit is a positive externality.

Thus, it is not the environment *per se* which is taken into account by individuals or firms but rather the environmental consequences of the various activities of the latter. The object of the evaluation is not «Nature» but the decrease in its quality (polluted air and water; endangered public health, etc.) or its capacity to provide environmental services (degraded soil, diminished carrying capacity, etc.). These «new» economic goods and services appeared with the emergence of new environmental values (clean air and water, safe surroundings, restored carrying capacities, etc.; Pillet 1976). In short, restoring a degraded environment is «producing» benefits having an economic value in terms of their contribution to general well being.

In Switzerland, the first evaluations of the costs of environmental degradation were undertaken in the seventies for air pollution (EPFL 1977, Ciba-Geigy 1978, Börlin 1981), then in the eighties in a more comprehensive manner (Ledergerber 1984, Frey 1986, Pillet 1988, Walther 1990). In the mid-eighties, the cost of environmental degradation in Switzerland was close to 10 billion USD/year; that is approximately 5% of the GDP at the time (Pillet, 1991).

At the international level, studies on the cost of environmental degradation have been undertaken since the seventies mainly by the OECD (OECD, 1975, 1989), the World Bank (1991) as well as certain universities. Two trends have been developed in parallel: one being the environmental evaluation in its economic dimension (Markandya, 1991; Pillet 1993) and the other being the integration of environmental degradation and the value of natural heritage in national accounting (Eurostat, 1990; Pillet, 1992; Franz and Stahmer, 1993).

In the Arab Mediterranean countries (as well as in other regions in the world), the question of the economic cost of environmental degradation was raised with the development of National Environmental Action Plans (NEAP). In 1995 in particular, the World Bank published its « Environmental strategy for the Middle East and North Africa (MENA) ». It presented, based on 1990 data, the first estimates in order of magnitude of the costs of environmental degradation in the region, particularly those related to the impacts on human headline associated with a lack of safe drinking water and appropriate sanitary measures and those on the degradation of natural resources (mainly erosion and soil salinity). Subsequently, many specific studies were accomplished under the auspices of the German GTZ, the World

Bank-METAP program, UNDP, USAID, and other organizations, namely in Algeria, Egypt, Iran, Jordan, Lebanon, Morocco, Syria and Tunisia (e.g., Algerian NEAP 2002; Larsen, Sarraf, Pillet 2002).

In parallel to these macro-economic evaluations, others, of a meso-economic level, were undertaken for the cement sectors in Algeria, Tunisia, Morocco, Libya and Syria (Pillet and Zein 2003; Pillet, Zein et al. 2004, 2005), for urban communities in Morocco and Jordan (Pillet, Zein et al. 2004), and for fossil-fuelled electricity generation in Morocco (Pillet, Zein et al. 2005). The purpose is to evaluate, in economic terms, the environmental costs and benefits of economic sectors and regions while allowing them to better situate themselves with respect to macro-economic evaluations that are hard to grasp at their scale due to their highly aggregated level.

Indeed, a city, just like an industrial sector, needs a territory, consumes a number of resources (water, energy, primary products, etc.) and transforms them into goods and services whilst generating a number of discharges (solid, liquid and gas), thus putting pressure on the ecosystems it depends on. Such a representation of a city or an industry fixes the boundaries of the system analyzed, i.e. the flows of nature and the economy and their transformation—their metabolism—at the scale of an urban community or of an industrial sector.

The first objective of meso studies is to *seize the scale of these flows*, to *measure them along with their transformations* and to *appraise the impact of the latter on the environment*. This involves estimating the economic consequences of these actions, on the one hand in terms of the cost of environmental degradation and inefficiencies with respect to the use of resources and, on the other hand, in terms of the remediation costs existing to avoid these damages and inefficiencies. These costs are then valued as a share of the total value added of the various activities of the urban community (or industry) and the results are interpreted in terms of the economy and the environment. Finally, analyses on their *sensitivity* are produced and *recommendations* are proposed.

The interpretation of the meso results allows defining the priorities retained and to qualify and quantify their importance in the form of benefit/cost ratios. Sensitivity analyses allow us to answer questions of the type: « What would happen if the price of water increases? What economic incentives should be put in place? ». They thus serve to support decision-making or to orient discussions between different stakeholders.

Lastly, simulations are realized in order to support the recommendations linked to the environment-economic control of the community or industrial sector. In particular, they allow the analyzed structure to position itself *vis-à-vis* the national total costs and possibly *vis-à-vis* other agglomerations or industrial sectors of the same country or of different countries.

2 Methodological framework

The aim of this section is to explain the methodology necessary to understand the steps of the analysis and results presented hereafter. The analysis concentrates on the cost of environmental degradation (environmental damages), the cost of inefficiencies in the use of natural resources and the costs necessary to remediate environmental degradation and inefficiencies.

A. Definitions

These costs are expressed as shares of the value added of the industrial sector or of the community (which was calculated, in the latter case, as the sum of the VAs of the different economic sectors). The VA at meso level is equivalent to the GDP at macro level. Indeed, when studying at a macroeconomic scale, the GDP is the sum of the VAs produced by a country's companies, on its territory, over a one-year period.

An increase in the relative value of the costs of environmental degradation and inefficiencies over time suggests that the caused environmental damages and losses in efficiency are increasing at a higher rate than the generation of an economic value. Alternatively, this suggests that the environmental consequences of all economic activity are decreasing with respect to the created economic value. More precisely, once all damages and inefficiencies are avoided or remediated, the economic activities concerned produce, *de facto*, two values: the standard economic value added and the environmental value added.

Then, the comparisons between damage and inefficiency costs, on the one hand, and remediation costs on the other hand, allow the construction of benefits/costs ratios leading to the selection of priority actions.

Costs of environmental degradation (damage costs, or DC). The costs of environmental degradation are defined, from an economic point of view, as a loss of well being for a community or a country. Such a loss in well-being can result from (the list is not exhaustive), impacts on the health or welfare of a population (mortality and morbidity due to air or water pollution, an unhealthy environment or workplace, disamenities), lower gains (lower soil productivity, less heritage values due to pollution, reduction of other environmental qualities or capacities, etc.), or losses of environmental services (rivers, lakes, beaches, coastal zones or forests losing their recreational, tourist or simply amenity value). These different losses of well-being are evaluated according to what is materially affected as a result of a given type of pollution (lost number of years in the case of a premature death or lost days of work in the case of morbidity, lost yields in the case of lower soil fertility, etc.) or subjectively damaged (pollution or aesthetic damage to the environment, nuisance or disturbance). Unit values retained are local values or alternatively values recognised by the international community.

Inefficiency costs in the use of resources (IC). The cost of inefficiencies in the use of resources entails economic losses in the sense of a waste of resources. These losses vary from excessive leakages in the water distribution networks to the absence of energy-saving measures and avoidable losses of materials in production processes. They are evaluated at least at their local cost (cost of water, cost of electricity, etc.). Waste, although partially inevitable, belongs to the economic category of inefficiencies. It is evaluated at the cost of treatment not undergone.

Remediation costs (RC). Remediation costs represent the spending (given the current available knowledge and **data**) necessary to protect the environment by preventing or restoring its degradation. They also comprise the costs of process or management and necessary control for reducing or preventing wastage (inefficiencies). According to this principle, the remediation costs are at «the least cost» given the available technology. This condition is not always taken into consideration due to the lack of relevant applied technical-economic studies. With time, ad hoc studies should assist in refining remediation costs.

Benefits/Costs ratios. Ideally, remedial actions would lead to the elimination of damages and inefficiencies at the lowest possible cost. They would result both in benefits (elimination of damages and inefficiencies) and in costs (those relating to remedial action).

Expressing these benefits and costs in terms of a ratio:

$$\frac{\textit{Damage and inefficiency costs}}{\textit{Remediation costs}}$$

As more general explanation of the ratio:

$$\frac{Benefits}{Costs}$$

where “benefits” (B) are measured by the damage and inefficiency costs and the “costs” by the remediation costs (C). An efficient remedial action would then require that benefits override costs, that is:

$$\frac{Benefits}{Costs} > 1$$

Alternatively, it would be possible to prioritize the net economic benefits of a remedial action (keeping B - C rather than B/C) and setting as an efficiency factor:

$$Benefits > Costs$$

These two forms are useful. Nevertheless, the B/C ratio offers the advantage of a more visual representation («ordinal» value) of results.

B. ENVIRONMENTAL DOMAINS, ECONOMIC CATEGORIES

Evaluating the costs of environmental degradation consists in placing monetary values on the direct, known and clear consequences of the impacts of one or more economic activities on the environment. It is often carried out in two main steps: environmental diagnosis (quantitative) and economic valuation (monetary).

i. **The quantitative environmental diagnosis**. The quantitative environmental diagnosis of an urban community or industrial sector is undertaken in two phases. All inputs and outputs are assessed (production flows, natural resource flows, etc.). In addition, environmental impacts generated by the activities (air quality, noise level, soil degradation, waste storage, etc.) are noted. The diagnosis must show not just quantitative data (flows reported per year) but must also include all possible indications relating to known unitary costs or calculated costs in relation to inflows and outflows.

ii. **Monetary economic valuation**. Following the environmental diagnosis, the economic valuation of the costs of environmental degradation is carried out, also in two phases. The first phase consists in quantifying the direct consequences of degradations reported in the environmental diagnosis (number of illnesses and accidents due to environmental causes, the population affected by air pollution, alterations in environmental qualities and capacities - water, soil, and ecosystems - and impacts on agriculture, and various nuisances). This necessitates the collaboration of experts in disciplines other than environmental sciences and economic sciences (natural sciences, engineering, occupational medicine, epidemiology etc.). For the second phase, the economic valuation consists in expressing in «monetary» terms the environmental consequences thus established; that is, to estimate the value of lost workdays, lost agricultural production, and lost amenities (such as a less agreeable setting), and the economic consequences of uncontrolled waste dumping, etc. This evaluation is related to the domain of environmental economics.

The valuation of inefficiency costs. The valuation of inefficiency costs concentrates on the consequences of inefficiencies observed during the environmental diagnosis. These losses result from the consumption of water, and energy (petrol, diesel, and electricity). A "monetary" value is estimated for these losses at their equivalent cost in terms of material, labor, energy and spent capital.

The valuation of remediation costs. The remediation costs are estimated on a case-by-case basis depending on the damages and inefficiencies to be avoided, controlled or remedied. Generally speaking, remediation costs are more «technical» and «material» in the case of damages (investments); they are more «organizational» and «immaterial» in the case of inefficiencies (good housekeeping improvements, management, adjustments, etc.). As such, remediation costs are reported according to the local value of available technologies. International prices are quoted only when necessary (for example in the case of PCB treatment and contaminated soils).

Environmental domains. In order to organize the analysis in a structured manner and preserve the links with the results of the environmental diagnosis, traditional environmental domains are considered as follows:

i. Water
ii. Air
iii. Noise
iv. Agriculture and landscape
v. Waste
vi. Energy
vii. and Impacts on Global environment (CO_2 emissions)

Economic categories. In order to subsequently guide the economic analysis, each environmental domain is organized into one or more of the following three categories:

i. Health/Quality of life (effects on human health and surroundings);
ii. Natural capital (conservation of the natural heritage - environmental goods and services);
iii. Inefficiencies in the use of resources (economic losses, including losses in competitiveness).

For instance, for the environmental domain «water», we have the following economic categories:

i. Health/Quality of life: child morbidity due to water-borne illnesses (if applicable);
ii. Natural capital: contribution to the depletion of the water table (if this is the case);
iii. Inefficiencies in the use of resources: losses in the distribution network, taking into account a minimum threshold.

The presentation of damage and inefficiency costs and remediation costs according to these domains and categories allows the creation of typical environment-economic profiles.

C. CONSEQUENCES OF ENVIRONMENTAL DEGRADATION

Different methods are used in order to capture as much as possible the direct consequences of environmental degradation reported in the environmental diagnosis.

Estimating the consequences of environmental degradation on human health is a particular case that must be addressed. This case is a good illustration of the evolution of environmental degradation to a monetary valuation of the consequences previously identified.

The consequences of environmental degradation (air or water pollution) on health are expressed, on the international stage, as «DALY», an indicator adjusting, in terms of the number of years in a person's life, all consequences (from lost days to lost years) due to illnesses and premature death resulting from environmental degradation in a country per year. Accordingly, in a simplified manner, lost days due to bronchitis are added to lost years as a result of premature death due to air pollution in order to generate a number of DALYs; i.e. a total number of lost years for the country in question. One lost year due to bronchitis or to a premature death represents one DALY; subsequent years, if any, are discounted at a fixed rate.

This methodology was developed using the framework of the World Health Organization (WHO) and the World Bank Group (WB) with the collaboration of international experts in order to provide a harmonized measure of the impacts of air and water pollution on human health. Hence, DALYs lost in Jordan were estimated at 40,693 for air pollution, and at 20,000 for water as the average value of reduced DALYs lost each year due to poor water/sanitation.

The monetary valuation of the identified consequences is undertaken in a rather simple manner based on the fact that a lost year (one DALY) corresponds to the foregone contribution of an individual within a year to the national product, that is, to the GDP per capita (gross domestic product per inhabitant). The "value" of a DALY thus corresponds, in a simplified manner, to the GDP per capita of a given country. It should be worth noting that this value has nothing to do with the «value» of a life; life being excluded by definition from any measurement of an economic or temporal nature. The value of a DALY only aims to identify the part of the lost activity due to poor air quality in a given place. As an example, DALYs lost in the Greater Irbid, Jordan, have been estimated at USD 4.3 million for air, and USD 2.3 million for water/sanitation, using the Greater Irbid per capita value added.

Another method is to calculate all the economic consequences (lost days and years as well as healthcare costs) of illnesses and deaths reported, following a national study on health in relation to environmental degradation. The results of these surveys and calculations correspond, in order of magnitude, to the DALYs calculated by the WHO and the World Bank (Algerian NEAP, 2002). This alternative method is used at a local scale, for example in the case of water-borne diseases (WBD).

Another remark concerning this method of estimating the value of a lost year is that it does not account for the willingness to pay of individuals in order to reduce the risk of illness or death. Such applications in Europe and in the United States tend to show that it is significantly higher than the «value» of DALYs calculated on the basis of GDP per capita (Larsen, Sarraf, and Pillet 2002).

D. MONETARY EVALUATION OF THE CONSEQUENCES OF ENVIRONMENTAL DEGRADATION

The case of DALYs presented in the previous paragraphs clearly shows that monetary valuation does not depend on strict or narrow economic values. This is one of the conditions for the reliability of economic valuations of the consequences of environmental degradation. Neither Nature nor Life is evaluated. In a clear manner, the direct consequences, of an economic nature, of the impact on the environment of economic activities, are evaluated in monetary terms. No confusion in kind should hence be made.

Other valuation techniques were applied, particularly those putting emphasis on the willingness to pay (WTP) of households to improve their surroundings in case of nuisances. For example, a willingness to pay equal to 30 USD per household per year (for 50% of the households in the region) has been used as a proxi in the estimation of the degradation costs of the quality of life resulting from ambient air pollution, including non measured emissions (adapted from a survey conducted in Morocco). This does not imply that these households must pay this amount on a yearly basis (as the final the aim is to make air pollution disappear). This simply allows us to «account for» the consequences of air pollution on the surroundings in monetary terms.

In a number of other cases, the economic valuation relies, among others, on market prices, basic prices (market prices before taxes), production costs, least cost technologies, opportunity costs, or mid and long term marginal costs.

E. DAMAGE AND INEFFICIENCY COSTS VERSUS REMEDIATION COSTS

As indicated above, remedial actions should reduce as much as possible the cost of damages and inefficiencies. Ideally, the ratio

$$\frac{\textit{Damage and inefficiency costs (DIC)}}{\textit{Remediation costs (RC)}} > 1$$

should be higher than one:

$$\frac{Benefits\ (B)}{Costs\ (C)} > 1$$

where the «benefits» are generated by the elimination of damages and inefficiencies and the "costs" are the costs of remedial actions.

Nonetheless, taking into consideration available data, it is not possible to have remedial action "correspond" exactly to the damages and inefficiencies to be eliminated.

Alternatively, where margins of uncertainty or error are the same on both sides (damages and inefficiencies versus remediation), the ordinal arrangement of B/C ratios (the rankings taking precedence over the absolute values) becomes very interesting and valuable in the process of choosing priority actions.

Finally, an environment-economic analysis of the reality might stem from the idea that the link with applications will be accomplished with respect to optimal situations. As an example, an optimal situation is necessary to determine and measure the existence of distortions in the real world (CEMT, 2000 and 2002), such an optimal situation being the norm (Pillet 2001d).

Such complexities exist and prevail in a closed academic world; they however proved to be extremely inadequate in the real world «since the axiomatic environment required for their application does not exist in practice (…) the real world is constituted of inaccurate, wrong, insufficient, and incomplete data» (Beauzamy, 2002).

Applied meso environment-economic studies are confronted with the real world and in such circumstances optimal situations are often missing. As a consequence, the approach always bears a «heuristic» characteristic on top of its capacity to establish environmental and economic priorities.

3 BENCHMARKING MAIN RESULTS

As individual countries differ, so do individual industrial sectors, single production plants and urban communities; how do we analyze such diverse conditions? How do we cross-compare industrial sectors performances (alternatively, urban communities' performances) of different countries with each other? And how do we relate environment-economic performances at a sectoral or urban level with performances at a national level?

A. MACRO-LEVEL ENVIRONMENT-ECONOMIC PERFORMANCES IN MENA COUNTRIES

Environment-economic performances of various countries[1] are usually related to the Gross Domestic Product (GDP).

The gross output of an economy consists of two categories of goods and services – *intermediate* and *final*. Intermediate goods and services are those that are *used up* in the

[1] Re: METAP (Mediterranean Environmental Technical Assistance Program), Cost of Environmental Degradation in MENA countries, The World Bank, Beirut High Level Meeting, 2003.

production process. Final goods are all the other goods and services that are ultimately *consumed*[2].

By subtracting the value of intermediate goods and services from the value of the gross output of each producer, we obtain what the national accounts refer to as Value Added (VA). The most common way to calculate GDP *is then by adding up the value added of all producers*[3].

As an example, let's consider the definition of the Jordanian GDP 2002 as given by the national accounts (Tab. I).

GDP as given by the Jordanian National Accounts at basic prices (pre-tax prices) is obtained by subtracting intermediate consumption from the gross output at market prices.

Table I – GDP definition and value in current prices – Jordan, 2002

	Definitions	million JOD
1	Gross output at market prices	12'659.1
2	minus intermediate consumption	-5'960.3
3	GDP at basic prices [value added definition]	6'698.8

Source : *National Accounts in Jordan 1976-2002,* Dpt of Statistics, 2003

Environment-economic performances at the level of MENA countries have therefore been set as fractions of GDPs in order to place the cost of environmental degradation in perspective with the product of the nation and to further incorporate assessments of such costs into national policy making.

On average, annual costs of environmental degradation (damages only, not including inefficiencies in natural resource use) range between 2.1% of Tunisian GDP and 4.8% of Egyptian GDP.

Table II – Annual damage costs estimates as a % of GDP
(inefficiencies in the use of natural resources NOT included)

Country	Damage Costs (% of GDP)*
Algeria	3.6%
Egypt	4.8%
Jordan	2.8%
Lebanon	3.4%
Morocco	3.7%
Syria	3.5%
Tunisia	2.1%

* Mean estimates.
Source: adapted from METAP/The World Bank, Beirut Meeting, June 2003

In the pilot studies carried out by World Bank-METAP in order to set the methodology, inefficiencies in the use of natural resources as well as remediation costs were also tentatively calculated (Tab. III).

[2] Note that there is nothing inherent in the goods and services themselves that make them either final or intermediate. "A beef-steak bought by a household is final but if the same beef-steak were to be bought by a restaurant it would be intermediate". Quoted from ICP 2004 (International Comparisons Program – ICP Handbook Chapter 3, *GDP and the Main Expenditure Aggregates*.

[3] "Clearly, the value added of all producers must be equal to final expenditures because when intermediate expenditures have been subtracted from gross output all that is left is, by definition, final. It is also clear that another way to calculate GDP is to add up those final expenditures directly". The latter method of GDP calculations is the one elaborated by the aforementioned ICP 2004.

Table III – Annual damage, inefficiency and remediation cost estimates as a % of GDP (inefficiencies in natural resources included)

Country	Damage and Inefficiency Costs (% GDP)	Remediation Costs (% GDP)
Algeria	5.8%	2.8%
Egypt	6.0%	4.0%
Tunisia	3.4%	1.7%

Sources: adapted from PNAE-DD 2002 (Algeria), and Larsen, Sarraf, Pillet 2002 , METAP/The World Bank Cost of Environmental Degradation Draft Studies (Egypt, Tunisia)

At this stage of the macro level, everything is thus implicitly comparable. However, comparisons are not explicitly evident. Indeed, GDPs differ due to the following factors: current versus constant prices, international versus national prices, purchasing power parity versus constant dollars, etc., as illustrated by Table IV. Therefore, precaution is needed to compare different country environment-economic performance indicators with each other.

Table IV – PennWorld Table, PPP, and Atlas GDPs in USD per capita

Country	Year	GDPs at Constant Dollars	GDPs at International Prices	GDPs at Purchasing Power Parity (PPP)	Current GDPs (Atlas Method)
Algeria	2000	4,896	6,107	4,795	1,550
Egypt	2000	4,184	4,406	3,146	1,290
Jordan	2000	3,895	4,282	2,615	1,150
Morocco	2000	3,717	4,299	3,188	1,240
Oman	2000	–	–	13,000	7,830
Tunisia	2000	6,776	7,130	5,169	2,060
Syria	2000	4,094	4,338	2,702	1,020

Source: Alan Heston, Robert Summers and Bettina Aten, *Penn World Table Version 6.1,* Center for International Comparisons at the University of Pennsylvania (CICUP), October 2002. PPP and Atlas: *World Development Indicators*, The World Bank.

B. MESO-LEVEL ENVIRONMENT-ECONOMIC PERFORMANCES IN MENA CEMENT SECTORS

Thanks to the clear link made between GDPs at the macro level and VAs of production sectors (meso-level), meso environment-economic performances can be judged in reference to the VA of that sector, and then be put in perspective with both economic and environment-economic indicators at the country level.

The value added (VA) of an economic sector is the net output of the sector after summing all outputs and subtracting intermediate inputs.

As an example, we obtained the Syrian cement sector's VA by subtracting from the turnover the cost of all intermediate inputs (Table V). The cement sector in Syria being a public sector, the turnover had to be recalculated taking into consideration the "national" selling price to final consumers.

Table V – VA calculations for the Syrian cement sector

	Billion SYP
Turnover	18.5
./. cost of intermediate inputs	-11.4
= VA	7.10
VA to Turnover Ratio	39%

Source: *VA calculations for the Syrian Cement Sector – A Note,* Ecosys-SBA, 2004

Concerning meso environment-economic performances, environmental damage and inefficiency costs have been calculated for cement sectors in three MENA countries: Algeria, Syria, Tunisia, as well as for two urban communities: Irbid, Jordan, and Agadir, Morocco. Work is in progress for the Moroccan and Libyan cement sectors as well as the Moroccan fossil-fuelled electricity generation sector.

Meso environment-economic performances of cement sectors in MENA countries are shown in Table VI. VA to GDP ratios lie below 1% in each country, especially in Algeria (because of the importance of the oil sector in the national economy). In total, damage costs (DC) and inefficiency costs (IC) are proportionally higher at the cement sector level than at the country level (Table III and Table VI).

Table VI – Main meso indicators for cement sectors in three MENA countries

Country	VA/Turnover Ratios	DC/VA Ratios	IC/VA Ratios	VA/GDP Ratios (Meso | Macro)
Algeria	56%	7.6%	11.5%	0.4%
Syria	38%	10.9%	12.2%	0.8%
Tunisia	39%	8.0%	10.7%	0.6%

Acronyms: VA: value added; DC: damage costs; IC: inefficiency costs; GDP: gross domestic product

As an example, VA to GDP ratios for the industry and agriculture sectors are indicated on the figures below for Syria and Algeria with the plotting of related macro-economic environmental damages costs.

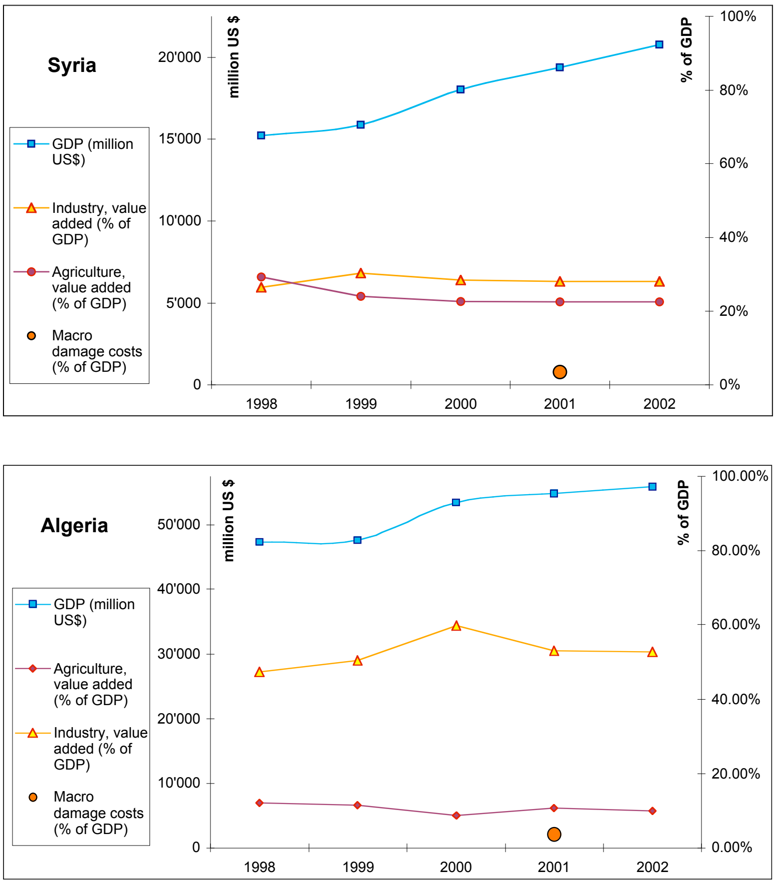

Figure 1: Syrian and Algerian GDPs, industry and agriculture VAs and macro damage costs (own graphs)

C. COMPARING ENVIRONMENT-ECONOMIC INDICATORS AT MESO AND MACRO LEVELS

In order to make comparisons at various levels, meso results need to be based on a common gauge; i.e., a common *VA/Turnover ratio*. As a result of a weighting process, a 45% VA to Turnover ratio has been set as the VA benchmarking in cement sectors in the MENA region (Table VII).

Accordingly, this changes damage and inefficiency figures, making inter-country meso results comparable on a somewhat better basis. As a main consequence, meso damages to VA ratios were recalculated for Algeria, Syria, and Tunisia. In addition, meso damages expressed as a fraction of macro damages are also expressed.

Table VII – Recalculating main performance ratios on a same VA/turnover basis

Country	VA/Turnover Meso set as 45% from:	Recalculated DIC/VA ratios	Recalculated VA to Atlas Country GDP	Macro Damage in % of Country GDP	Recalculated Meso Damage in % of Macro Damage
Algeria	56%	23.8%	0.4%	3.6%	0.9%
Syria	38%	19.5%	0.8%	3.5%	1.6%
Tunisia	39%	16.2%	0.6%	2.1%	1.9%

Environmental degradation costs are also, beyond industrial sectors, an issue for urban communities. In order to further compare urban communities from different countries with different industries, a specific benchmarking would be needed. Meso results show DIC/VA ratios of 16% for the Greater Agadir (Morocco), and of 12% for the Greater Irbid (Jordan).

In order to cross-compare cement production and urban communities, the position that a cement plant takes within an urban community is shown on Figure 2 by means of CO_2 emissions expressed in monetary value as a percentage of the urban community VA. On the left-hand side, CO_2 emissions associated with cement production are illustrated, whilst, on the right-hand side, are plotted CO_2 emissions associated with other urban activities.

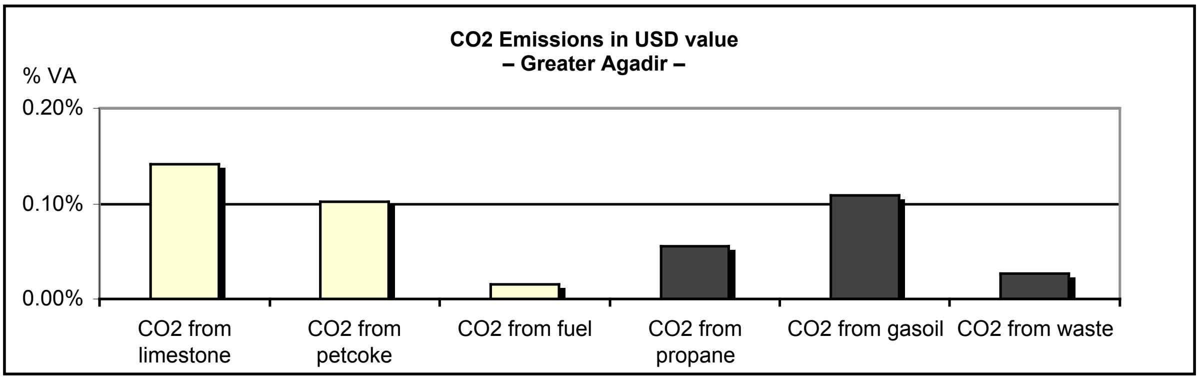

Figure 2: CO_2 emissions in monetary value, as percentages of the VA of the Greater Agadir, Morocco, with emissions from the cement plant on the left, and urban emissions on the right.
Source: Pillet, Zein *et al*. 2004.

Conclusions

Tracking macro and meso environment-economic performances over time.

Clearly, as suggested by Figure 1, macro and meso environment-economic performance indicators should be made available as time series.

Indeed, the issue is to make national and sectoral comparisons of economic and environment-economic performances available as time series. As shown by Table VI and Table VII, the VA of cement sectors contributes to less than 1.0% of the national product while it incurs up to 2.0% of national damages. This fact is further exacerbated in the case of urban communities (between 3 and 6% of the national product versus 8 to 20% of the national damages). It would thus seem likely that, either the national damages were underestimated (due to a less comprehensive assessment at the macro-level than at the meso-economic study level), or that the contribution to national damages is higher than to the national product. Still, it is impossible to judge such figures without time series showing how ratios behave over time (leveling, worsening or, on the contrary, improving).

This will take place through capacity building in countries of reference with the provision of a methodological framework that can be applied periodically to assess the cost of environmental degradation, and the benefits of its remediation.

Acknowledgements

The authors would like to thank the Swiss Agency for Development and Cooperation (SDC), Berne (Switzerland), and the Arab Union for Cement and Building Materials (AUCBM), Damascus (Syria), for the opportunity given to Ecosys and SBA to deal with meso environment-economic results relative to the meso program carried out in the MENA region. The conclusions and opinions drawn in this paper are, however, solely those of the authors and are not necessarily the views of any other institution.

Meso-economic Analyses

ECOSYS, 2000. Appraising Externalities of Swiss Agriculture. *Swiss Federal Department of Agriculture*, Berne, 179 pp., Appendices.

Maradan, D., G. Pillet and N. Zingg, 2001. Appraising Externalities of the Swiss Agriculture : A Comprehensive View. *Porto Venere Advances in Energy Studies,* S. Ulgiati, Ed., University of Siena (Italy), 16 pp.

Pillet, G., N. Zingg and D. Maradan, 2001. Appraising Externalities of the Swiss Agriculture – An Extended Cost-Benefit Analysis. *International Journal of Applied Economics and Econometrics,* Oct.-Nov., Vol. **9**, No. 4, pp. 425-449.

Pillet, G. and K. Zein, 2002a. *Tableau de bord méso-économique des coûts et bénéfices environnementaux de l'industrie du ciment en Algérie — Résultats et Guide méthodologique.* Ecosys-SBA | SGP-Industrie du ciment | Direction suisse du développement et de la coopération (DDC), Alger, Berne, 45 pp., CD-ROM.

Pillet, G. and K. Zein, 2002b. Meso-economic Indicators of Environmental Costs and Benefits for the Cement Sector in Arab Countries. *Proceedings of the 12th AUCBM International Cement Conference and Exhibition,* Marrakech; published by AUCBM, Damascus.

Pillet, G. and K. Zein, 2003. Meso-Economic Indicators of Environmental Costs and Benefits for the Cement Sector in Mashreq and Maghreb Countries. *AUCBM 13th International Conference and Exhibition on Environmental Protection in Cement Industries,* Abu Dhabi, Oct., Proceedings, 6 pp.

Pillet, G. and K. Zein, 2003. Meso-economic Indicators of Environmental Costs and Benefits for the Cement Sector in Mashreq and Maghreb Countries, *Cement & Building Materials Review,* **12**, pp. 46-49.

Pillet, G., K. Zein, D. Maradan et N. Benyahia, 2003. *Tableau de bord méso-économique des coûts et bénéfices environnementaux de l'industrie du ciment en Tunisie — Résultats et Guide méthodologique.* Ecosys-SBA | Chambre Nationale des Producteurs de Ciment | Direction suisse du développement et de la coopération (DDC), Tunis, Berne, 45 pp., CD-ROM.

Pillet, G., K. Zein, A. Carrara, and N. Benyahia, 2004. *Economic Analysis of the Environmental Costs and Benefits of the Cement Industry in Syria.* Ecosys-SBA | SDC and GOCBM, Damascus, 40 pp., CD-ROM.

Pillet, G., K. Zein, N. Benyahia, E. Stephani et T. Golliard, 2004. *Tableau de bord méso-économique des coûts et bénéfices environnementaux du Grand Agadir.* Ecosys-SBA | DDC et Royaume du Maroc, Secrétariat d'Etat à l'Environnement, Wilaya de la Région Souss Massa Drâa, Agadir, 38 pp., CD-ROM.

Pillet, G., K. Zein, K. Mayor, N. Benyahia, E. Stephani, A. Qaddoura, H. Hamad, and M. Hayek, 2004. *Meso-economic Assessment of Environmental Costs and Benefits in the Greater Irbid, Jordan.* Ecosys-SBA | SDC and Ministry of Municipal Affairs, Amman, 50 pp., CD-ROM.

Pillet, G., K. Zein, E. Stephani, and K. Mayor, 2004. Inter-meso Benchmarking Meso-economic Studies of Environmental Costs and Benefits for Cement Sectors in Arab Countries. *Proceedings of the AUCBM 13th International Cement Conference and Exhibition,* Muscat, Oman | 23-25 November.

Pillet, G., K. Zein, E. Stephani et T. Babaki, 2005. *Etude méso-économique des coûts et bénéfices environnementaux de la production d'électricité thermique au Maroc – Etat 2003 et prospective 2009.* Ecosys-SBA | DDC et Royaume du Maroc, Office National de l'Electricité, Casablanca, 35 pp., CD-ROM.

References

Algerian NEAP/PNAE-DD, 2002. *National Environmental Action Plan/Plan National d'Actions pour l'Environnement et le Développement Durable*. République Algérienne Démocratique et Populaire, Ministère de l'Aménagement du Territoire et de l'Environnement, Alger, 140 pp.

Beauzamy, B., 2002. Les mathématiques du réel. *La Jaune et la Rouge, Revue mensuelle de la Société amicable des anciens élèves de l'Ecole polytechnique*, **577**: 5-8.

Börlin, M., 1981. *Banken und Umweltschutz*. J. Vontobel & Co., Zurich.

CEMT/ECMT, 2000, 2002*, Taxation efficiente des transports – Efficient Transport Taxes and Charges.* OCDE-OECD*,* Paris.

CIBA-GEIGY, 1978. Umweltschutz – des einen Nutzen… des anderen Kosten ? *Das Ciba-Geigy Magazin,* **1**.

CNUCED/UNCTAD, 2002. *Classement des pays et des grandes entreprises multinationales suivant la valeur ajoutée (PIB pour les pays).* Agence de presse.

EPFL (Ecole Polytechnique fédérale de Lausanne), 1977. *Elaboration d'une fonction de dégradation – Application au cas du SO_2 en Suisse.* GEK/CGE, Berne.

EUROSTAT, 1990. *Système européen de rassemblement de l'information économique sur l'environnement – SERIEE,* projet de manuel. Office statistique des Communautés Européennes, Luxembourg.

Franz, A. and C. Stahmer (eds), 1993. *Approaches to Environmental Accounting.* Physica-Verlag/Springer, Berlin.

Frey, R., 1986. In : *Berner Zeitung.* 18. Januar.

Larsen, B., M. Sarraf and G. Pillet, 2002a. *Cost Assessment of Environmental Degradation in the Mashreq and Maghreb Countries—From Theory to Practice. Cost Assessment of Environmental Degradation in EGYPT.* The World Bank – METAP, Draft, 21 pp. + Appendices.

Larsen, B., M. Sarraf and G. Pillet, 2002b. *Cost Assessment of Environmental Degradation in the Mashreq and Maghreb Countries—From Theory to Practice. Evaluation du coût économique de la dégradation de l'environnement en TUNISIE.* The World Bank – METAP, Draft, 22 pp. + Annexes.

Ledergerber, E., 1984. Die Kosten der Luftverschmutzung in der Schweiz. *Neue Zürcher Zeitung,* **72**.

Markandya, A., 1991. *The Value of the Environment: A State of the Art Survey.* Conference Paper, Neuchâtel.

Meade, J.E., 1973. *The Theory of Economic Externalities.* IUHEI, Genève.

METAP-The World Bank, 2003. *High Level Meeting on Economic Tools for Environmental Sustainability.* 25-27 June, Beirut, Lebanon.

OCDE, 1975. *Méthodologie et Théorie Economique de l'environnement.* Paris.

OCDE, 1989. *L'évaluation monétaire des avantages des politiques de l'environnement.* Paris.

Pigou, A.C., 1920. *The Economics of Welfare,* Macmillan, London (4th ed., 1932).

Pillet, G., 1976. *Les déséconomies externes.* Thèse de doctorat, Faculté de Droit et des Sciences économiques et sociales, Université de Fribourg (Suisse).

Pillet, G., 1988. *Tentative de bilan des coûts économiques de la pollution*. SPE Société suisse pour la Protection de l'Environnement / Université de Genève, Genève.

Pillet, G., 1991. Coûts de la pollution de l'air en Suisse : avant et après le « Clean Air Act Concept ». *DISP* – Ecole Polytechnique fédérale de Zurich, **105** : 8-14.

Pillet, G., 1992. *Les comptes économiques de l'environnement / Ökonosmische Umweltkonten.* Office fédéral de la statistique, Berne.

Pillet, G., 1993. *Economie écologique.* Georg, Genève. *Economia Ecologica*. Instituto Piaget, Lisboa.

Pillet, G., 2001. *L'Efficace, le Juste et l'Ecologique.* Helbing & Lichtenhahn, Bâle, Munich, Genève.

Scitovsky, T., 1954. Two Concepts of External Economies. *Journal of Political Economy*, April.

Walther, A., 1990. *Die Folgekostenrechnung von Umweltschäder.* Dissertation, Hochschule St.Gallen, St.Gallen (Schweiz).

WORLD BANK, 1991. *Environmental Assessment Sourcebook.* World Bank Technical Paper Nb. **139**, 2 Vol.

WORLD BANK, 2003, 2004. *The Little Green Data Book – From the World Development Indicators*. 239 pp.