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Meso-economic Analysis of the Greater Irbid, Jordan

by
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Abstract.
This paper features a study that is part of a number of analyses conducted in Maghreb and Mashreq countries concentrating on the assessment of environmental damage costs and benefits at a Meso level. They are being carried out by Ecosys, Ltd. and SBA under the auspices of the Arab Union for Cement and Building Materials (AUCBM) and the patronage of the Swiss Agency for Development and Cooperation (SDC). They have been applied at the scale of industrial sectors (e.g. the cement industry in Algeria, Libya, Syria and Tunisia) and at the level of urban communities (e.g. Agadir in Morocco, and Irbid in Jordan).
Concerning the Greater Irbid community, a number of elements related to environmental degradation and to inefficiencies in the utilization of resources are obvious. What the analysis presented in this paper does, is quantify these damages and inefficiencies in economic terms through a combination of environmental and financial data as well as ratios to determine future decisions. It consequently gives a new perspective to the economic-environmental situation of the Greater Irbid.

Background.
The aim of the meso-economic approach is to appraise the environmental costs and benefits of an urban community with respect to its different economic and urbistic activities (industry, agriculture, services, energy and water supply, waste collection, etc.). This evaluation applied to an urban community outlines its environment-economic profile. The meso-economic profile is seized through the impacts of all inflows and outflows of this community, be they environmental or economic, through its metabolism.
This paper provides estimates of damage and inefficiency costs and their related remediation costs, i.e. the costs incurred when remedial action is taken to counter damages. These are calculated by environmental domains (water, air, land, waste…) and by economic categories (health/quality of life, natural resources, and economic inefficiencies). Damages to the global environment are also estimated. This paper situates these costs within the national damage costs to the environment and sets a number of environment-economic priorities for the community through the calculation of benefits/costs ratios. The estimates are set as shares of local value added and should be considered as orders of magnitude.

Presentation of the urban community of the Greater Irbid.
The Greater Irbid is situated in the Northern Region of the Hashemite Kingdom of Jordan, 70 km north of the capital city Amman. It lies in the centre of the main agricultural area of Jordan. The Greater Irbid has been recently set as a municipality out of 18 former small villages. It counts half a million inhabitants (Irbid Governorate: 1 million).
The region's main economic sectors are agriculture, real estate, transport and communication, electricity and water supply and public administration. The GDP of the Greater Irbid (or value added) has been estimated at 445 Million JOD, with a GDP per capita of 978 JOD in 2002 at current prices against 1240 JOD/cap for Jordan.
The environmental footprint of the Greater Irbid is characterised by 88 l/day of fresh water resources per person (Irbid Governorate) of which 70% is used by agriculture, 4% by industry and 26% by households. Excluding agricultural water consumption, much less than 50% of the water consumed goes through a sewage treatment. Waste generation per capita is estimated at 0.6 kg per day (Irbid Governorate level). Solid waste arriving at Akaider landfill from Greater Irbid is 300 tonnes per day as well as a good quantity of liquid waste. The seven hospitals in Irbid generate 960 kg per day of hospital waste. Major environmental related problems are indoor sanitation, industrial waste, hazardous materials transported by road and gas/chemical household products.

Nature and scope of the results obtained.
The notion of the cost of degradation to the environment. The environmental problems of Jordan have a direct negative impact not only on economic activity and efficiency but also on the health and quality of life of the population.
An economic (monetary) evaluation of the environment is in essence an evaluation of the economic consequences (costs) that environmental degradation incurs. No value is put on the natural environment itself, i.e. on Nature. Environmental degradation costs are thus linked to economic losses due to impacts on health, lower work productivity or losses of revenue due to soil erosion, air or water pollution. A value (either a benefit or an advantage) will then be linked to a better quality environment, to productivity gains and to a higher well-being of the inhabitants. These benefits or advantages will be the result of corrective measures (appraised by their related remediation costs) applied to the environmental degradation observed.
Hence, literally, an environmental cost will result from an increase in economic consequences due to a heavier environmental deterioration. Similarly, an economic benefit will be brought on by an improvement in well-being due to a better quality of the environment. These are then "marginal" values and costs. To make things easier, and due to the chosen scale (urban community or industrial sector), these definitions of marginality are left out in such a way that the evaluation of the cost of environmental degradation is reported to the "year" rather than to the "margin". The hypothesis of an increasing impact remains, but the economic analysis is undertaken in terms of annual costs of environmental degradation. These degradation costs are opposed to the costs of "remediation". Their comparison results in an order of magnitude of the economic advantages or benefits ensuing from adopted actions.
The estimates of the costs of environmental degradation (the costs of damages and inefficiencies) and of the remediation costs destined to protect the environment and restore its quality must be considered as orders of magnitude. The numbers are neither complete (basic data might be insufficient) nor final (the process of evaluation is continuous). Nevertheless, estimates provided allow the representation of the level of gravity of environmental degradation (quantitatively) and the deduction of an economic rationale in order to improve production

management in its relationship with the environment, identify priority actions and carry out relevant simulations involving these actions.
An economic analysis of the reality stems from the idea that the link with applications will be accomplished with respect to optimal situations. As an example, an optimal situation is necessary for determining and measuring the existence of distortions in the real world (CEMT, 2000 and 2002) – such an optimal situation is the norm (Pillet 2001d). Such complexities exist and prevail in a closed academic world, but they 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-economic studies are confronted with the real world and in such circumstances optimal situations are often missing.
A heuristic approach. The approach used for the Greater Irbid has a “heuristic” characteristic on top of its capacity to establish economic and environmental priorities. It is indeed destined to serve as a base for complementary analyses, as for instance, with the elaboration of the value added of the Greater Irbid which was missing at the beginning of the study.

Results.
The evaluation of damage and inefficiency costs and their remediation costs underlines a damage rate of about 9% of the value added of the Greater Irbid, as well as an important level of inefficiency costs (ca. 3% VA). Damages to the environment are mostly situated in the water domain. The inefficiencies are present in the waste, water and energy domains.
Together, damage and inefficiency costs represent approximately 12% of the value added of the Greater Irbid community (Table I).

Table I - Damage and inefficiency costs as shares of the value added of the Greater Irbid, by environmental domains (except global environment)

Environmental domains	%VA
Water	7.18
Air, Noise	1.30
Agriculture	0.95
Waste	2.46
Energy	0.23
Total	12.13

The remediation costs destined to avoid these damages and inefficiencies were then estimated at just over 9% of the VA of the Greater Irbid. They are mainly related to water, waste and air (Table II).

Table II - Remediation costs of the Greater Irbid, by environmental domains (except global environment)

Environmental Domains	%VA
Water	5.07
Air, noise	1.07
Agriculture	0.64
Waste	2.11
Energy	0.15
Total	9.04

The benefits/costs ratios (B/C) are constructed by relating, on the one hand, damages and inefficiencies (which once avoided are transformed into benefits) and on the other hand,

remediation costs. The B/C ratios are on average slightly higher than 1.4 for water, agriculture/landscape and energy, and higher than 1 for the other environmental domains (Table III)[1] bringing the average B/C ratio to 1.34.

Table III - Benefits/costs ratios of the Greater Irbid, by environmental domains

Environmental Domains	B/C
Water	1.42
Air	1.22
Agriculture	1.49
Waste	1.17
Energy	1.52

These ratios are the first indications of the existence of environment-economic priorities. It is thus interesting for the Greater Irbid to more closely consider the following domains: firstly energy then landscape and agriculture and water. The waste B/C ratio is very close to one. However this does not mean that its control would not be profitable, but underlines a damage cost evaluation that lies closer to the remediation cost evaluation compared to other domains. Priorities for the Greater Irbid seem thus to be concentrated (all DIC included) around an energy, agriculture, and water axis (Table IV).

Table IV - Order of environment-economic priority

Damages	Inefficiencies
• Water	• Waste
• Air	• Energy

In these domains the role of the different actors in the Greater Irbid is also important. It is thus interesting to further disaggregate the results in this manner (re: following figures).

With respect to water, the evaluations seem to indicate that the bigger losses are located in the following areas: over-pumping, quality of the resource, and water discharged into the environment, i.e. the category of water as a natural capital resource (Figure 1).

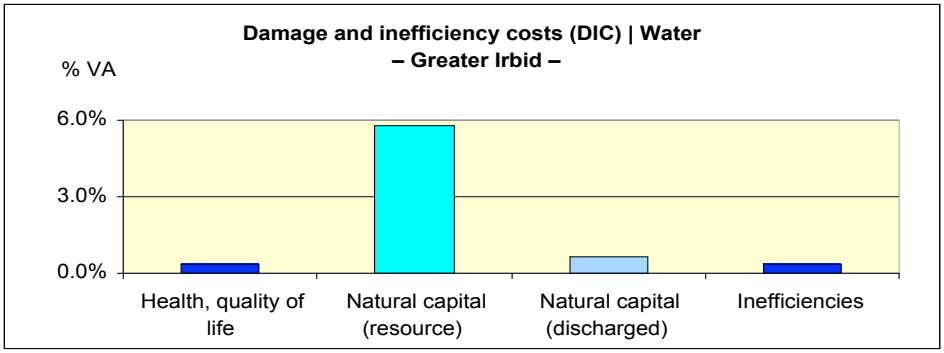

Figure 1: Disaggregated damage costs related to the "Water" domain

[1] 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 actions). In case of net benefits the ratio will be greater than unitary one.

As for the "Air" domain, the questions of public health due to urban pollution and indoor pollution are the most important. They are accompanied by quality of life and traffic and congestion (Figure 2).

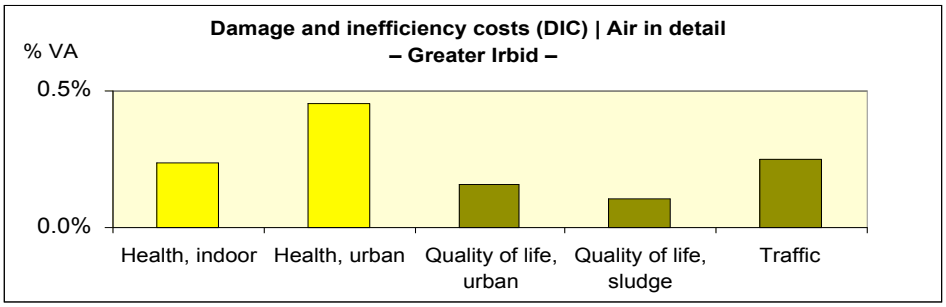

Figure 2: Disaggregated damage costs related to the "Air" domain

These damages are caused by and have an effect on the different actors in the Greater Irbid. How can we highlight this? Indeed, there is often confusion between emitters and receptors when discussing environmental damages. It hence seemed more relevant for the study to underline which actors in the Greater Irbid were the most *"concerned"* by damages and inefficiencies.

For water, households are the most *"concerned"*, as well as, to a lesser extent, the government, water authorities and big consumers (Figure 3).

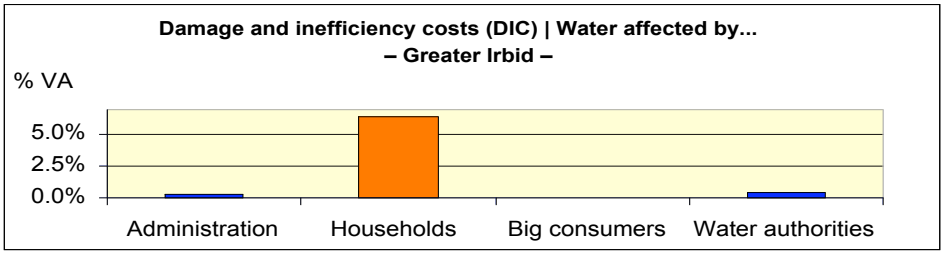

Figure 3: Disaggregated damage costs related to the "Water" domain, by actors

For air, households are again the main party *"concerned"*. The second actor is transport (Figure 4).

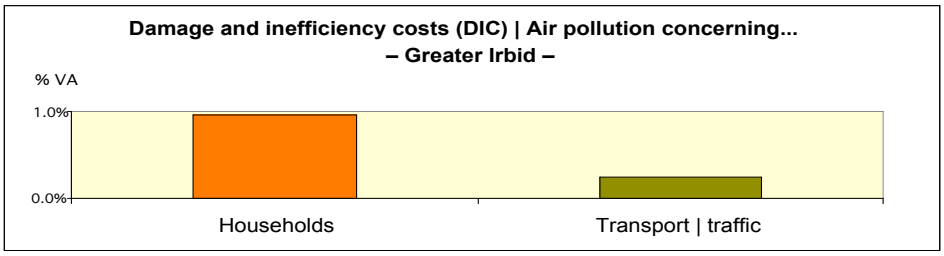

Figure 4: Disaggregated damage costs related to the "Air" domain, by actors

What is highlighted in this priority evaluation is that, from an environment-economic point of view, the Greater Irbid should try to aim at bettering and protecting households as these are the main actors concerned when causes and consequences are linked. Indeed they account for three quarters of the total damages and inefficiencies of the Greater Irbid.

Finally, by situating the Greater Irbid in a national context of the evaluation of environmental degradation costs (3.3% GDP; higher bound; World Bank-METAP 2003), it seems that the costs of damages of Greater Irbid (except inefficiencies and global environment) account for 18% of the aforementioned costs. It would hence appear that the Greater Irbid contributes more to the national damages than to the national product. However, the results for Irbid, due to a more comprehensive study of the environmental degradation (meso estimates), can be considered a higher bound appraisal while the results at the national scale (macro appraisals) must be considered a lower bound estimate. Moreover, in order to better appreciate this discrepancy, further analyses on a time series perspective are needed. In view of current studies it is not possible to say whether the share of damages of the Greater Irbid is rising or falling with time.

Conclusions.

The evaluation of the costs of damages and inefficiencies are mainly distributed in the areas of water and waste: 9.5% of Greater Irbid's VA (out of 12% DICs in total).

The total damages and inefficiencies, excluding the global environment, are close to JOD 54'009'169 (i.e. 76 million USD). Environmental damages (health, quality of life, natural capital) are estimated at approximately JOD 40'310'200 a year or 56.8 million USD (9% of VA of the Greater Irbid) and inefficiencies at 13'698'969 JOD/yr or 19.3 million USD (3% of VA of the Greater Irbid).

Summed, the damage costs and inefficiency costs correspond to an annual value of 12% of the VA of the Greater Irbid. The damages to the global environment are estimated at 0.4% of the VA.

Remediation costs are estimated at 9.04% of the VA of the Greater Irbid, i.e. JOD 40'239'951 (56.7 million USD).

The average benefits/costs ratio is hence situated at approximately 1.3 (B/C = DIC / RC) or at JOD 13'769'218 (19.4 million USD) for the net benefit (benefits – costs).

An overall summary is given by Table V.

Table V - Overall Summary

Scale, data, estimations	
Scale of the analysis:	Urban community of the Greater Irbid; 455'165 inhabitants;
Data sources:	Municipality, local and national Directorates Available on CD-ROM : • Data Collection (environment-economic inputs and outputs) • Environment-economic meso-analyses - Calculations of damage and inefficiency costs (DIC) - Calculations of remediation costs (RC) - Generation of benefits/costs ratios (B/C)
Priorities	
For damages:	Water, air
For inefficiencies:	Waste, energy
Main results and figures	
Damage and inefficiency costs:	12% of the VA of the Greater Irbid
Remediation costs:	9% of the VA of the Greater Irbid
Benefits/Costs Ratio:	Average of 1.3 (between 1.05 and 1.5)
National damage costs:	3.3% of Jordanian GDP (higher bound)
Greater Irbid share of national damage costs:	18% of national damage costs

References.

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*, Paris, N° 577: 5-8.

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

ECOSYS, 2000. *Appraising Externalities of Swiss Agriculture.* Swiss Federal Office of Agricultrure, Berne.

EPE – SBA, 2002. *Guide d'auto-diagnostic environnemental,* Paris et Lausanne.

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

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

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

Pillet, G. and K. Zein, 2003. "Meso-Economic Indicators of Environmental Costs and Benefits for the Cement Sector in Mashreq and Maghreb Countries"*. AUCBM 4th 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 – The Case for Algeria"*. Cement and Building Materials Review* – issued by AUCBM [Arab Union for Cement and Building Materials, Damascus], 12, June, pp. 46-49.

Pillet, G., K. Zein, N. Benyahia, E. Stephani et T. Golliard, 2004. *Analyse méso-économique du Grand Agadir, DDC et Wilaya de la région Souss-Madra-Drâa*, 38 pp., CD.

WORLD BANK-METAP, 2003. *High level meeting on Economic Tools for Environmental Sustainability, Presentation of first results*, Beirut.

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