EMERGY SYNTHESIS OF ALBANIA FOR 2007

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Abstract

This first attempt of emergy synthesis in Albania aims at demonstrating the potentiality of this methodology in analyzing and integrating different systems on a common basis. Some emergy indices are calculated by identifying most of the emergy flows from within and outside the system. Renewable carrying capacity at present living standard (R/U) · (Population) with a value 4.52x 10^5 means that some 14.3 % of the actual population of $3.16x10^6$ might be an optimum level for sustainable economic development of Albania. Sustainability index SI = 0.25 suggests an increase of attention to improve the ratio between Emergy Yield Ratio (EYR) and Environmental Load Ratio (ELR). In 2007 Albania`s Emergy/GDP ($) ratio was 5.39 $x10^{12}$ while the Emergy/GWP ($) was $5.59x10^{11}$. This means that in the international trade Albania gives 9.6 times more emergy than it receives for each dollar of exports. The aforementioned fact is combined with a four fold negative trade balance (Net Exports = $-3.09x10^9$). These two indicators give a somehow pessimistic view of Albania`s economic development for the time being. Calculation of emergy synthesis for several years might offer a better understanding of development tendencies, and consequently better recommendations for people involved in policy making and environment management. Emergy synthesis might orient them towards more rational approaches to find out the best alternatives in harmonizing economic profits with the environment health.

Key Words: Emergy Sustainability Index (ESI), Emergy Yielding Ratio (EYR), Environmental Load Ratio (ELR)

1. Introduction

Emergy synthesis of states is proposed by different authors as a rational method to harmonize economic interests with environment resources for providing a sustainable development in the long run, [9, 3] etc. The procedure includes the calculation of several emergy indices [10] that help drawing conclusions and offering recommendations to people who might have some impact in policy making and environment management. The emergy indices revealing the sustainability of nature and human made systems are of special interest [2, 6, 7], etc. The publications of the above mentioned authors have been the starting point to undertake the emergy synthesis of Albania for 2007. This study aims at offering some preliminary conclusions and recommendations for people involved in economic development policies and environment management in Albania.

2. Materials and Methods

The guiding methodology for this study was the emergy synthesis theory, as well as

some other studiesë [2, 1, 3, 5, 9]. Most of data processed in this study were obtained from the website of Albania`s Institute of Statistics, except for the data on mineral extraction that were provided from the Albania`s Ministry of Economy, Trade & Energy. Data on Gross World Product (GWP) were obtained from the IMF website. This study was revised lately after the consultation with some studies published in the proceedings of former Emergy Conferences [6, 8, 7].

3. Results and Discussions

Figure 1 shows Albania`s main emergy flows for the year 2007. Table 1 shows a negative trade balance of $ –3.09E+09 ($1.08E+09 – $4.17E+09) while the emergy exchange ratio is 9.6 (5.39E+12 sej/$: 5.59E+11sej/$). This means that for each dollar of export Albania loses 9.6 times more emergy than it receives for each dollar of imported goods and services. These two indices reveal a somehow pessimistic picture of country`s economy and environment exploitation for the time being.

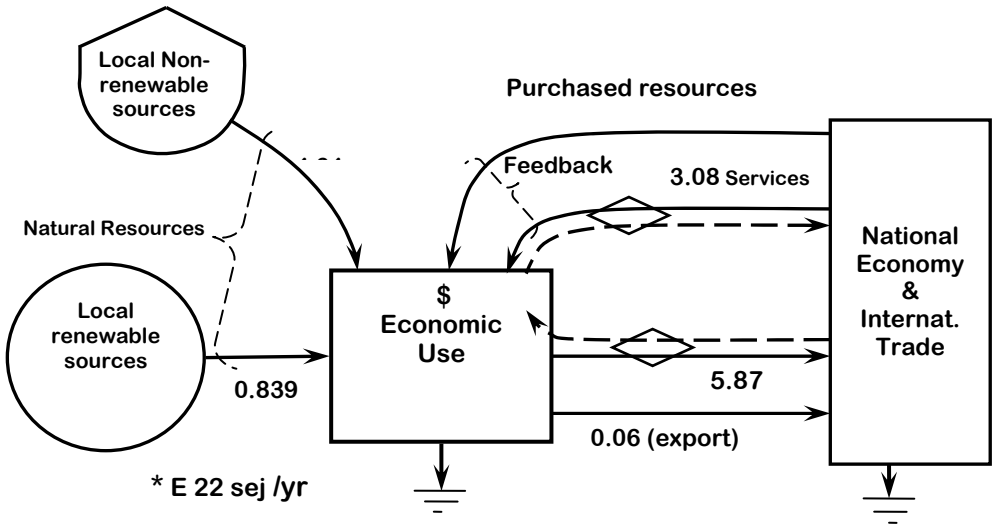

Figure 1: Diagram of Albania`s main emergy flows for 2007

Table 1 shows several emergy indices. Most of them aim at giving recommendations for a sustainable economic development. Among these indices the Emergy Sustainability Index (ESI=0.25) seems to be the most synthetic indicator on sustainability level of Albania`s economic development. This value of ESI suggests a shift towards the exploitation of more renewable resources than non renewable ones.

Comparisons of Emergy Investment Ratio (EIR) with Emergy Footprint Ratio

(EFR) show that most of natural resources used by the Albania`s economy in one year are mainly non-renewable ones (EFR=7) and the feedback from the economy seems relatively small compared to natural resources R + N (EIR=0.73). These comparisons suggest a shift towards the use of more renewable resources and an increase of the feed back from the economy to support the recovery of natural resources as the feedback usually reinforces nature`s production processes.

Table 1: Some emergy indices for Albania in 2007

Nr	***Name of index***	sej/yr
1	Renewable sources (R)	8.39E+21
2	Non-renewable sources from within the state (N)	4.34E+22
3	Dispersed rural source (No)	2.86E+22
4	Concentrated use (N_1)	1.49E+22
5	Exported without use (N_2)	9.29E+19
6	Imported inputs (I)	6.90E+21
7	Emergy of services (S)	3.08E+22
8	Feedback Imports + Services (F)	3.77E+22
9	Total emergy used (U), sej/yr	5.87E+22
10	Empower density (U/(area), sej/m^2/yr	2.04E+12
11	Fraction used locally renewable (R/U)	0.14
12	Use per person (U/population)	1.86E+16
13	Renewable carrying capacity (R/U)(population)	4.52E+05
14	Emergy Yield Ratio (EYR)	**2.37**
15	Environmental Load Ratio (ELR)	**9.67**
16	Emergy Sustainability Index (ESI=EYR/ELR)	**0.25**
17	Emergy Investment Ratio (EIR=F/R+N)	0.73
18	Emergy Footprint Ratio (EFR=U/R)	7.00
19	Ratio of electricity to total use (Elect/U)	0.09

Table 2 presents a simulation of Albania`s ESI if we suppose that soil erosion is reduced to none with a good land management and fossil fuels from within the country are replaced with renewable energy. By comparing the real value of ESI (table 1) with the simulated one (table 2) we conclude that Albania`s ESI may be increased seven fold (1.73 / 0.25 ≈ 7) if good management practices would be implemented. This example may help in remodeling the interface of Albania`s nature with its economic activities.

Table 2: Simulation of Albania`s EYR, ELR, and ESI

Input data (sej/yr)		*Ratios*		Emergy indices	
R (0.839E+22) + (2.93E+22)	3.77E+22 *	**R/F**	1.00	EYR	2.37
N (4.34E+22) – (2.93E+22)	1.41E+22 **	**N/F**	0.37	ELR	1.37
F **(feedback)**	3.77E+22	**R/N**	2.67	ESI	1.73

*- R increased with the amount subtracted from N; **- N without soil loss and Albanian fossil fuels.

Evaluation of Albania`s potentiality for economic development

Based on the procedure presented in figure 2 a potentiality of economic development is evaluated for Albania (table 3) if its Emergy Investment Ratio would equal the average investment ratio of Italy and Greece [8].

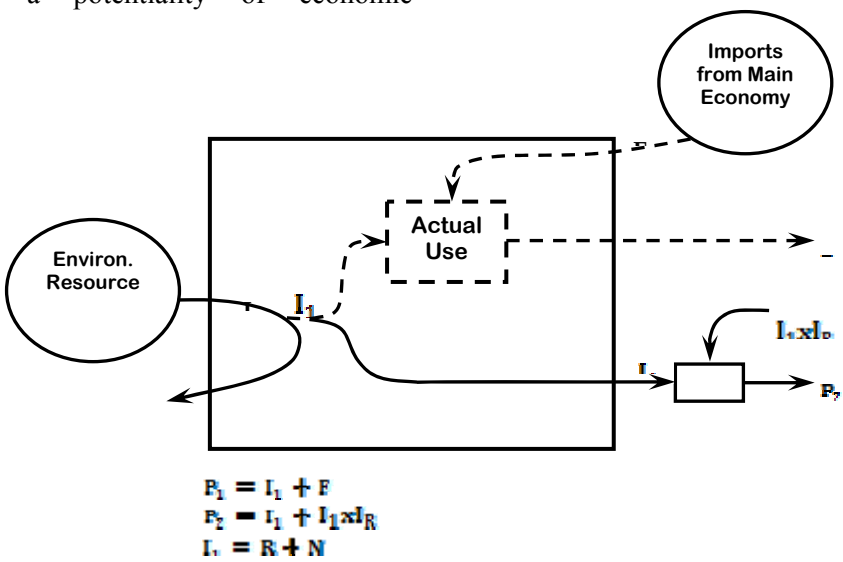

Figure 2: Comparison of actual economic development (P_1) with potential development (P_2).

Table 3: Albania`s potentiality for economic development if Emergy Investment Ratio (EIR) would be comparable to the EIR average value of Italy and Greece.

I_1	*Average* I_R	$I_1 * I_R$	$I_1 + I * I_R$	*sej/$ ratio*	Potential development (em$/yr)
5.18E+22	2.33	1.20E+23	1.72E+23	5.39E+12	**3.20E+10**

5. Conclusions

- Due to soil erosion annual loss of Albania`s natural capital is more than $ 5 billion (2.79E+22 sej/yr divided by 5.39E+12 sej/$ = 5.18E+09 $/yr). A remodeling of the sustainability index (ESI) from 0.25 to 1.73 may result in positive changes for the environment-economy interface.
- Renewable carrying capacity at present living standard (R/U) · (Population) with a value 4.52x 10^5 means that some 14.3 % of the actual population 3.16 x10^6 might be an optimum level for sustainable economic development of Albania.
- In 2007 Albania`s Emergy/GDP ($) ratio was 5.39 x$10^{12}$ while the Emergy/GWP ($) was 5.59 x$10^{11}$. In the international trade Albania gives 9.6 times more emergy than it receives for each dollar of exports. The aforementioned fact is combined with a four fold negative trade balance (Net Exports = -3.09x10^9). These two indicators give a somehow pessimistic view of Albania`s economic development for the time being.
- Calculation of potential economic development based on the exploitation of natural resources shows that Albania has the capacity to increase its economic performance in the future by almost 3.2 times more than 2007 GDP.
- Calculation of emergy synthesis for several years might offer a better understanding of development tendencies, and consequently better recommendations for people involved in policy making and environment management.

6. Note:

This study was presented to the 6th Biennial Emergy Conference held at the University of Florida, USA, on January 14-16 2010.

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