LINKING SOCIO-ECONOMIC DEVELOPMENT AND ENVIRONMENTAL PRESSURES

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Abstract
Sustainable development paradigm requires new approaches to the study of linkages between socio-economic development and its accompanying environmental pressures. To this end, a three-level regional geographic model of interactions has been developed. This new index attempts to evaluate the level of general balance of development in each country or region, upgrading well established human development index by an environmental aspect (i.e. ecological footprint) and consequently strongly modifying deeply rooted images of well-being in the world.

Key words: sustainable development, methods, ecological footprint, human development, development balance index

POVEZOVANJE SOCIALNO-EKONOMSKEGA RAZVOJA IN OKOLJSKIH PRITISKOV

Izvleček
Paradigma trajnostnega razvoja terja nove pristope k proučevanju povezav med socialno-ekonomskim razvojem in njegovimi okoljskimi pritiski. V ta namen je bil oblikovan tristopenjski interakcijski regionalnogeografski model. Nov indeks predstavlja poskus vrednotenja stopnje splošne uravnoteženosti razvoja v posamezni državi ali regiji, saj nadgrajuje že uveljavljeni indeks človekovega razvoja z okoljsko razsežnostjo (t.j. ekološkim odtisom) in posledično močno spreminja uveljavljene predstave o svetovni blaginji in razvitosti.

Ključne besede: trajnostni razvoj, metode, ekološki odtis, človekov razvoj, indeks uravnoteženosti razvoja.

1. INTRODUCTION

The processes of deepening of social and economic disparities on the one hand and of increasing environmental problems on the other, have characterized global and regional development patterns of the last decades. Accordingly, a comprehension is coming to the fore that it is possible to solve contradictions of socio-economic and environmental development only in a joint framework, such as a concept of sustainable development. Therefore, the article focuses on the possibilities of coincident consideration and weighing of economic, social, and environmental aspects of development.

The main aim of the article is an investigation of the relation between socio-economic development and environmental pressures in the countries of the world. For this purpose, a three-level regional geographic model of interactions has been used. At the third level of the interactions model, an alternative development index has been developed (so called development balance index), upgrading well established human development index by an environmental aspect. This new development index attempts to evaluate the level of general balance of development in each country or region. Consequently, it modifies strongly our deeply rooted images of overall development and general well-being in the world.

2. THEORETICAL AND METHODOLOGICAL APPROACH

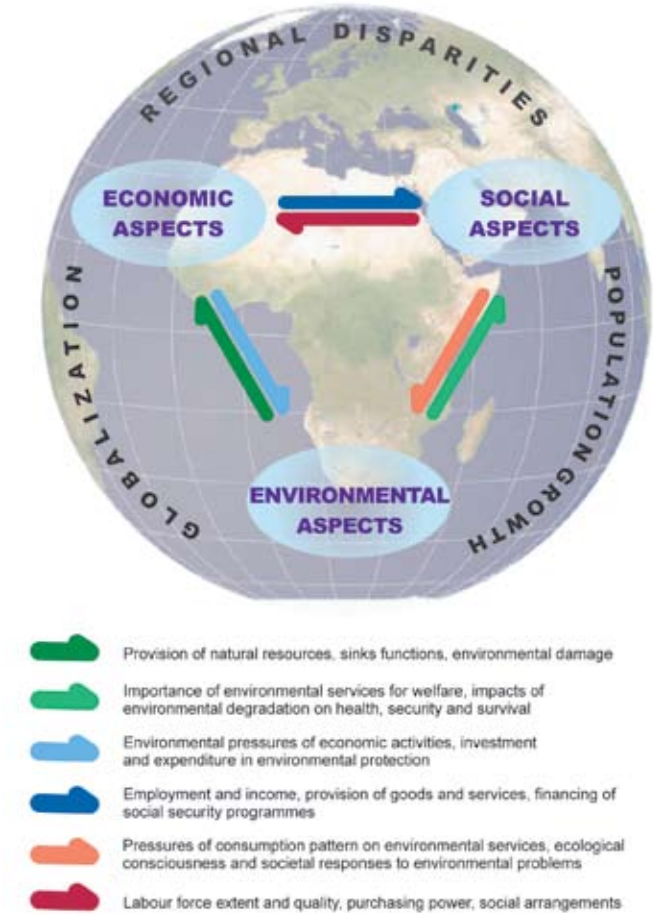
Contemporary understanding of the relationship between environmental protection and socio-economic development has been upgraded to the concept of sustainable development as a new developmental paradigm for humankind. Sustainable development forms a theoretical and methodological basis of our research. In this regard, sustainability is not defined as "a fixed state but rather an ongoing dynamic system that can continue to evolve without self-destructing" (Hardi et al., 1997, 3). Therefore, for the system to be sustainable, different forces that act on this particular system must be in balance. At its core, the concept of sustainable development requires adapting human activities to the carrying capacities of the environment. The methodological approach used in this research is trying to answer the fundamental question to what extent society and economy put pressure on the environment.

Socio-economic and environmental aspects of development are closely interrelated and interdependent, and should therefore be treated within a single framework (Vintar Mally, 2006, 44). The majority of contemporary sustainability researches is based on the so-called theme model (also called an issue- or theme-based framework), which places at the highest hierarchical level three main areas of development: economic, social, and environmental (Hardi et al., 1997; Indicators…, 2001). Each area is usually represented by a number of relevant issues, which are expressed through quantitative and rarely also through qualitative indicators. Although theme model is easily understandable and logically organized, it nevertheless neglects the search for linkages between the included issues or indicators respectively. Interactions between economic, social, and environmental aspects of development are multi-layered and complex, especially when taking into account that regional disparities, population growth, and globalization processes exert different effects on different geographical areas (Figure 1). Due to the rapid population growth and the striving after the decrease of socio-

economic lagging, particularly the developing countries are not up to the task of preserving the natural environment for future generations while improving the quality of life of their current inhabitants.

Therefore, the investigation of the environmental and socio-economic linkages requires a detailed analysis of selected economic, social, and environmental aspects of development and their causal-consecutive linkages. The later enables not only a detailed analysis of individual countries, but also an assessment of their future developmental possibilities. Thorough analysis is based on a set of selected indicators, which provide essential information in a simplified and concise form. Analyzing numerous individual indicators and investigating their mutual interactions forms only the first level of our research model.

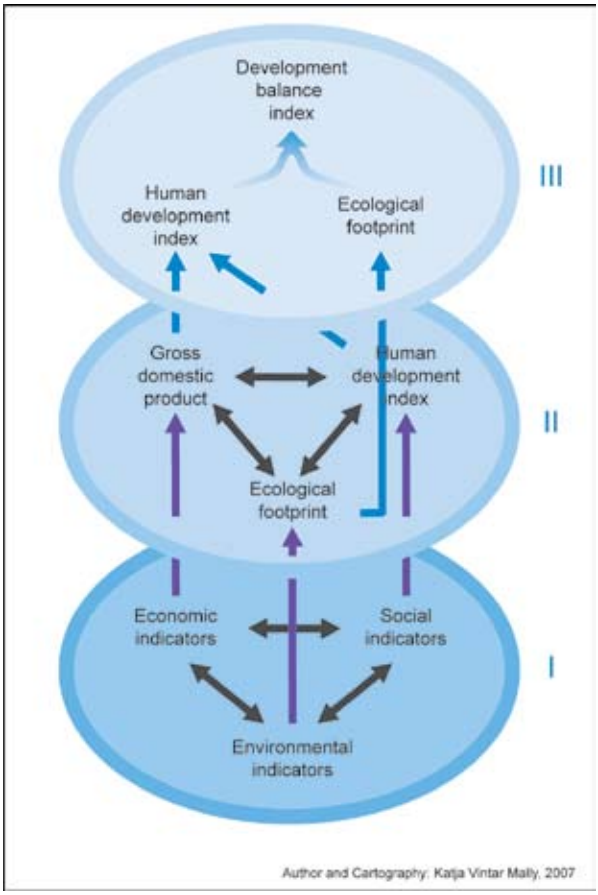
Figure 1: Interactions between economic, social, and environmental aspects of development



Author and Cartography: Katja Vintar Mally, 2007
Picture of the World from: One Planet..., 2005, 91.

The research of linkages between different developmental aspects is based on a constant intertwining of theoretical and empirical findings, complementing each other and gradually upgrading. At the second level, the presented model of interactions is upgraded by using representative synthetic indicators for each of the three basic developmental areas as well as by an assessment of their (statistical) linkages. Finally, at the third level of the model, these synthetic indicators are aggregated and upgraded, offering a complex evaluation of overall development in each country of the world (Figure 2).

Figure 2: Socio-economic and environmental development: regional geographic model of interactions



At the level of social, economic, and environmental spheres of development, a number of internationally established indicators can be used as a basis for further comparisons. For example, especially recommendable for country studies are (Vintar Mally, 2006a):

- **economic indicators** focusing on GDP per capita, economic growth rate per capita, and economic structure;

- **social indicators** focusing on population growth rate, total fertility rate, level of income distribution equality, education of population, life expectancy at birth, child mortality rate, and people living on fragile land;
- **environmental indicators** focusing on greenhouse gas emissions, consumption of ozone depleting substances, globally threatened species, deforestation rate, rural population density, withdrawals of available water sources, population with access to improved water source, and burden of disease from major environmental risks.

It is important to stress, that any individual group of economic, social or environmental indicators must be interpreted in connection with the other two groups, since only in this way an integrated view of the functioning of the area studied can be ensured. In the presented case, the functioning of the particular country studied.

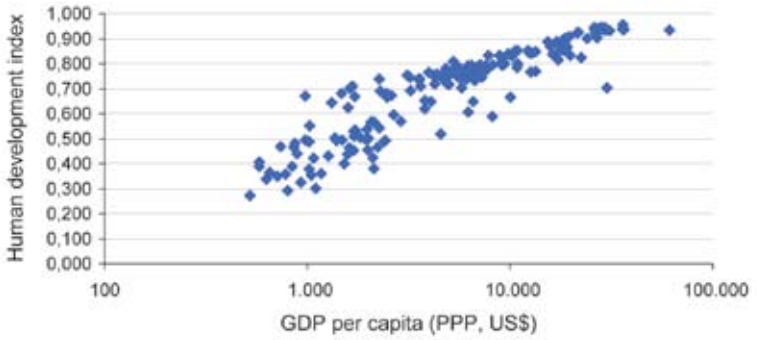
At the second level, only one representative synthetic indicator is used for each development area. In order to study state, trends, and linkages, gross domestic product per capita (expressed in terms of purchasing power parity) for economic area, human development index for wider understood social area, and ecological footprint for environmental area were used. The calculation of human development index includes not only indices of longevity and education, but also gross domestic product as a measure of standard of living. Therefore, at the third level of the model, only human development index and ecological footprint were aggregated into development balance index. This new index equally includes the achievements of human development and the coincident environmental pressures, and is therefore an alternative measure of overall development.

3. LINKING ECONOMIC, SOCIAL AND ENVIRONMENTAL DEVELOPMENT

The assessment of linkages between economic, social, and environmental aspects of development at the second level of the interactions model uses representative synthetic indicators, one for each area. Despite some deficiencies, gross domestic product is for decades one of the most established and widely used economic indicators. On the other hand, the concepts of human development and ecological footprint won recognition at the end of the 20th century. Within the presented interactions model, they are for the first time brought to a common denominator.

While including the material standard in its concept, human development surpasses the usual understanding of social development. Thus the average progress in human development is measured by human development index, which focuses on its three measurable dimensions: living a long and healthy life (as measured by life expectancy at birth), being educated (as measured by adult literacy rate and the combined primary, secondary, and tertiary enrolment ratio), and having a decent standard of living (as measured by GDP per capita, PPP) (Human…, 2004). Although the human development index is an important and useful measure, it does not include some other significant aspects of human development (for example, political freedom, social safety and justice, quality of living environment).

Figure 3: Relationship between GDP per capita and human development index, 2002



The scatter graph for 175 countries of the world with adequate data (Figure 3) clearly confirms that economic growth is an important means to human development. While on the one hand, economic growth is nourished by the fruits of human development (for example, by improvements in workers' knowledge, skills, and health), slow human development, on the other, can put an end to fast economic growth (Soubbotina, Sheram, 2000). Conversely, economic growth also advances human development, providing more resources to invest in health and education (Human…, 2003). However, wealth is not automatically translated into human development. The later is proven by the data points that are far from hypothetical regression line. Some countries have disproportionally high incomes, while their indices of health and education are lagging behind (for example, Algeria, Equatorial Guinea, Gabon, Oman, Qatar, Saudi Arabia, United Arab Emirates, etc.). These examples highlight the need for efficient policies of investing higher incomes in human development achievements. In other countries the gap is widening because of the disease burden, especially due to HIV/AIDS incidence, primarily lowering life expectancy in Sub-Saharan Africa (for example, in Botswana, Lesotho, Namibia, South Africa, Swaziland, etc.). Despite some exceptions, the correlation between human development index and gross domestic product is positive and large, with Pearson correlation coefficient reaching 0.730. With both variables, having a skew in the opposite directions, the actual correlation is probably even larger.

Similarly large is also the correlation between gross domestic product per capita (PPP, US$) and ecological footprint per capita, calculated for 143 countries of the world with available data for both variables (Figure 4). The correlation is positive (Pearson correlation coefficient is 0.827) and indicates growing pressures on environment, accompanying economic growth in particular and economic development in general. The concept of ecological footprint is experiencing growing use worldwide. This aggregate measure examines the ecological capacity required to support country's consumption of products and even entire lifestyles (Hawken et al., 2004, 51). It presents the total area required to produce the food and fibre that each country consumes, the area needed to absorb the waste from country's energy consumption, and to provide space for its infrastructure. Resources and ecological services that originate

from all over the world and are being used in a particular area, are added up in the footprint and divided by the number of its inhabitants (Living…, 2004, 10). Despite the continuing methodological development, this indicator still does not include some significant aspects of resource consumption and waste production (for example, freshwater withdrawals and land use intensity, which are becoming strategically more and more important). Nevertheless, ecological footprint (expressed in global hectares per capita) offers for the time being the most synthetic evaluation of total environmental pressures of a given area, especially when compared to its biocapacity.

Figure 4: Relationship between GDP per capita and ecological footprint per capita, 2001-2002

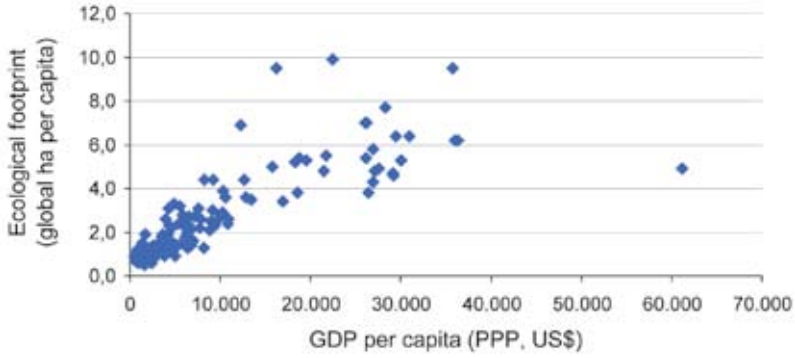
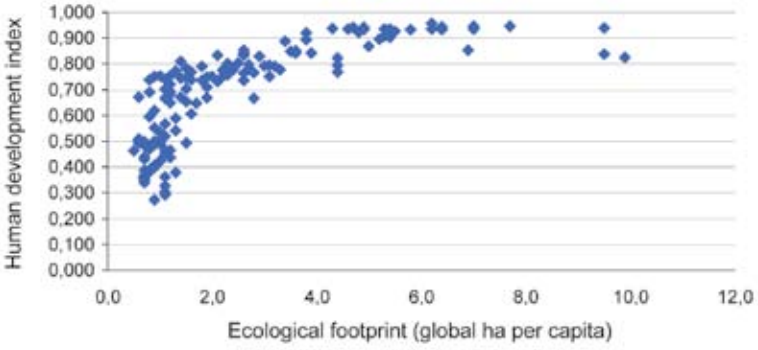


Figure 5: Relationship between ecological footprint per capita and human development index, 2001-2002



From the standpoint of sustainable development it is especially worrying that developing countries are following the wasteful development patterns of industrialized and economically developed countries. Nevertheless, it would be oversimplified to suggest that growing gross

domestic product is the only driving force behind environmental pressures. Ecological footprint of a country changes not only with its population size and per capita material consumption (dependent on their purchasing power) but also with the efficiency of energy and material use (dependent on available technologies).

Comparison of ecological footprint per capita and human development index of 135 countries of the world (Figure 5) also reveals large and positive correlation (Pearson correlation coefficient is 0.735; despite the skewness of variables in the opposite directions) between both examined variables. Some countries have disproportionally high ecological footprint compared against the level of human development achieved. In this regard, some high-income developing countries stand out the most (for example, Israel, Kuwait, Saudi Arabia, United Arab Emirates). They are not only unsuccessful in translating high incomes into human development but also put great pressures on the environment. Their ecological footprints are comparable to those of developed countries with similarly high incomes, but on the other hand developed countries exhibit better education and health performance.

According to presented data and calculations, it can be concluded with great certainty that in economically developed as well as developing countries socio-economic welfare is being achieved at the expense of environmental deterioration. Such development path leads away from sustainability goals and is environmentally and socially worrying, especially when taking into account limited ecological services and resources, as well as the predicted population growth in the future.

4. DEVELOPMENT BALANCE INDEX

Coincident consideration and weighing of economic, social, and environmental aspects of development is one of the main requirements of sustainable development paradigm. However, different attempts so far failed to form an aggregate measure of sustainability. Usually they were using numerous indicators and aggregating them, applying more or less complicated statistical methods. On the contrary, our research of interactions between economic, social, and environmental aspects of development is upgraded with a single, synthetic indicator, which equally combines these aspects in a simple, transparent and comprehensive way. This alternative index, named development balance index, combines calculations of human development index and ecological footprint. To this end, the same standardization is applied as in the calculation of human development index.

The human development index is actually a simple average of the three dimension indices: life expectancy index, education index, and gross domestic product (GDP) index. Minimum and maximum values or goalposts are chosen for each underlying indicator in order to calculate the performance in each dimension, expressed as a value between 0 and 1. The following general formula is applied (Human…, 2004, 259):

$$\text{index} = \frac{x_i - x_{min}}{x_{max} - x_{min}}$$

with xi being actual value for the variable, xmin being minimal value and xmax being maximal value. Accordingly, the life expectancy index measures the relative achievement of a country in life expectancy at birth, using formula, where maximum value is 85 years and minimum value is 25 years. Agreed maximum value for GDP is 40,000 US$ (PPP) and minimum value is 100 US$ (PPP). In calculations of the GDP index the logarithm of income is used, because achieving decent level of human development does not require unlimited income. The education index includes two indices: an index for adult literacy and one for combined gross enrolment. In both cases, minimum value is 0% and maximum value is 100%. To calculate the education index these two indices are combined, with two-thirds weight given to adult literacy and one-third weight to combined gross enrolment (Human…, 2004, 259). Such standardization with preset minimum and maximum values allows comparisons over time and across countries.

In order to incorporate the calculations of ecological footprint into this scheme, the above presented standardization formula has to be adjusted. In contrast to longevity, education, and incomes, increasing values of ecological footprint or increasing environmental pressures respectively, do not contribute to overall welfare or sustainability. Therefore, standardization formula applied is:

$$\text{ecological footprint index} = 1 - \frac{x_i - x_{min}}{x_{max} - x_{min}}$$

or shorter:

$$\text{ecological footprint index} = \frac{x_{max} - x_i}{x_{max} - x_{min}}$$

Maximal value used for the ecological footprint index calculation was 10.0 global ha per capita. At the beginning of 21st century no country exceeded this limit, while in many countries ecological footprint was less than 1.0 global ha per capita. Therefore, minimum value was rounded up and set at 0.0 global ha per capita, representing (theoretically) minimal possible pressures on the environment. Finally, all indices (GDP index, education index, life expectancy index, and ecological footprint index) can be added up and average value (i.e. development balance index) for each country calculated. Development balance index does not only upgrade human development index by an environmental dimension (i.e. ecological footprint), both indices differ also in the weight assigned to particular indicators involved. From the standpoint of sustainable development, the development balance index is more appropriate as it gives an equal (one-third) weight to the common achievements in the economic (GDP per capita), social (life expectancy at birth, literacy rate, combined primary, secondary, and tertiary gross enrolment ratio) and environmental area (ecological footprint per capita):

development balance index = ⅓ (GDP index + ½ (education index + life expectancy index) + ecological footprint index)

Figure 6: Human development index, 2002

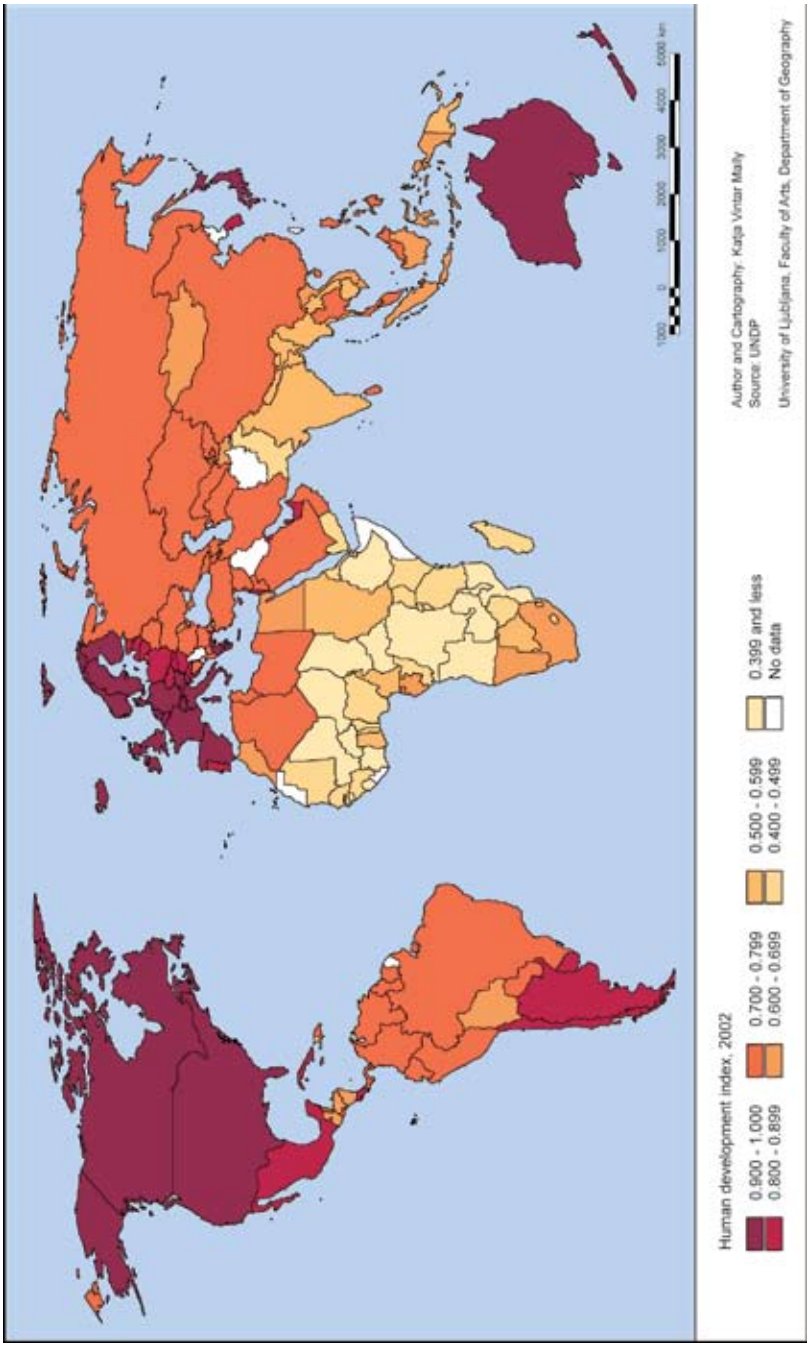
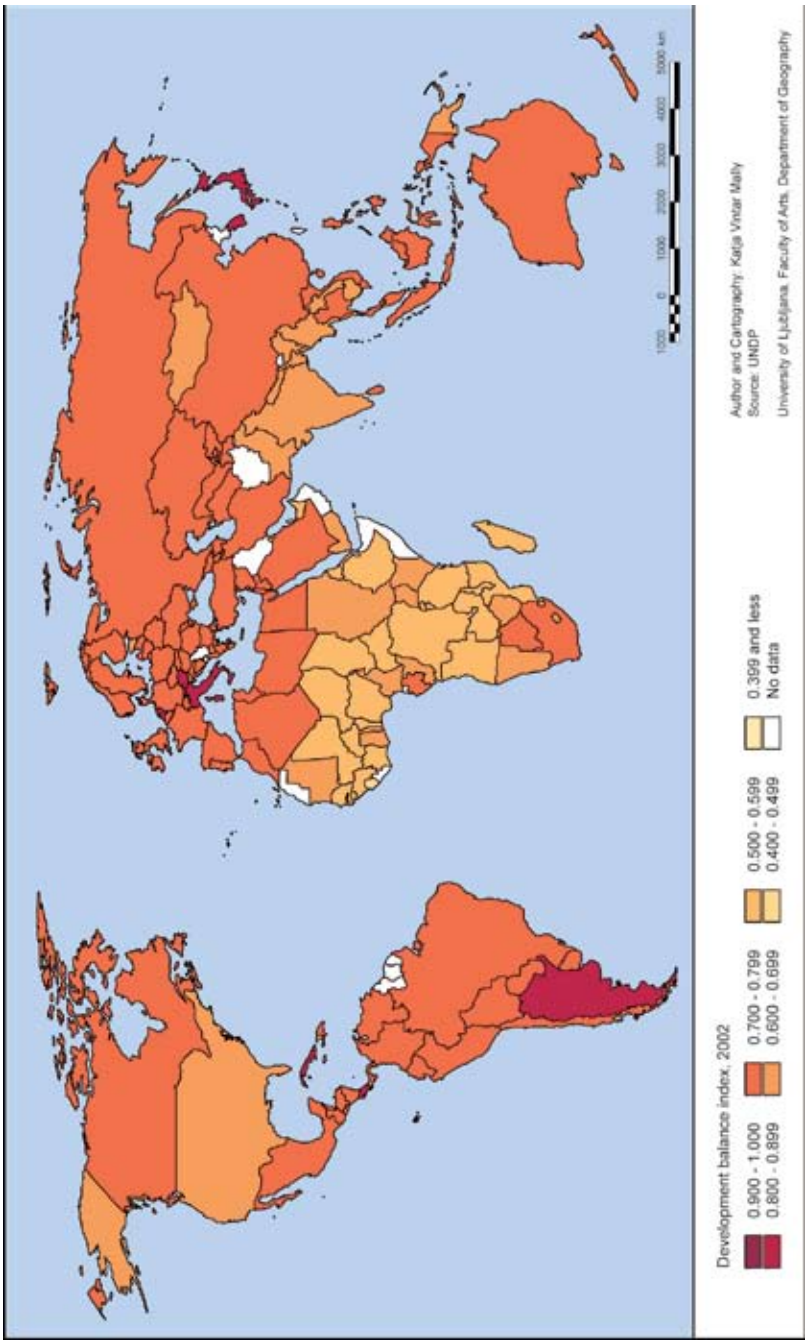


Figure 7: Development balance index, 2002



Comparisons of the human development index (Figure 6) and development balance index (Figure 7) calculations reveal a strongly modified image of development and general well-being in the world. Due to the described inclusion of ecological footprint, the differences in the resulting development balance index values are much smaller than in the case of human development index. Development balance index value varies from 0.486 in Sierra Leone to 0.822 in Italy. Sierra Leone is also the only country with index value below 0.500 (i.e. threshold of low human development), while index values of only nine countries (Italy, Japan, South Korea, the Netherlands, Costa Rica, Austria, Argentina, Luxembourg, and Cuba) still exceed 0.800 (i.e. threshold of high human development). Although developed countries still rank high, some developing countries with relatively low ecological footprints and good health or/and education performance are keeping pace with them. For example, among the top 25 countries by the value of development balance index are Costa Rica, Argentina, Cuba, Chile, Columbia, Peru, Uruguay, Trinidad and Tobago, Panama, Thailand, and Tunisia. On average, Latin American and Asian countries rank higher in development balance index than in human development index, with the exception of some high income developing countries (for example, Kuwait, United Arab Emirates, Saudi Arabia, and Israel), whose ranking deteriorated considerably. Nevertheless, due to extremely unfavourable indices of human development, the majority of African countries ranks lowest (28 out of 30 last ranking countries are African countries), irrespective of their low per capita environmental pressures. However, the calculation of the development balance index does not include political freedom, social safety and justice, and some other important circumstances, affecting the quality of everyday life in the area studied. The inclusion of these aspects and the improvement of the indices included would further correct the above presented development picture.

5. CONCLUSIONS

At the beginning of the 21st century, humanity's ecological footprint is already exceeding global biocapacity by more than 20% (Living…, 2004). In other words, environmental pressures of the global socio-economic development already exceed the carrying capacities of our planet. The methodological approach used in the research highlights these contradictions, especially through the calculation of the development balance index. This alternative index illustrates, how successful are individual countries in balancing development requirements in economic, social, and environmental area. The limitations and advantages of the development balance index derive from the limitations and advantages of included indicators, available data, and standardization method. There is still significant room for improvement in all areas mentioned before, which would bring about better image of overall development in the world. Dealing with socio-economic development and its accompanying environmental pressures in a joint framework, development balance index represents an attempt to build more just measure of overall development and human welfare. As argued above, its calculations prove the fact that, from the point of view of the sustainable development paradigm, all countries of the world can actually still be considered as developing countries.

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POVEZOVANJE SOCIALNO-EKONOMSKEGA RAZVOJA IN OKOLJSKIH PRITISKOV

Povzetek

Procesi povečevanja socialnih in ekonomskih razlik na eni strani ter poglabljanja okoljskih problemov na drugi strani so zaznamovali globalne in regionalne razvojne vzorce zadnjih desetletij. Posledično se je uveljavilo spoznanje, da je reševanje protislovij socialno-ekonomskega in okoljskega razvoja mogoče zgolj znotraj enotnega ogrodja, kakršnega predstavlja paradigma trajnostnega razvoja. Prispevek se osredotoča na možnosti sočasne obravnave in tehtanja ekonomskih, socialnih in okoljskih vidikov razvoja. Glavni cilj je proučevanje razmerij med socialno-ekonomskim razvojem in njegovimi okoljskimi pritiski na primeru držav sveta. V ta namen je bil oblikovan tristopenjski interakcijski regionalnogeografski model.

Prva stopnja modela je pravzaprav nadgradnja široko uveljavljenih in uporabljanih tematskih modelov, ki proučevane vsebine delijo na ekonomske, socialne in okoljske, medtem ko jih v tem primeru nadgradimo še s proučitvijo njihovih medsebojnih povezav. Proučevanje na prvi stopnji temelji na uporabi številnih posameznih kazalcev, ki jih na drugi stopnji modela zastopa po en sintezni kazalec z vsakega razvojnega področja. Za ekonomsko področje je uporabljen bruto domači proizvod (v USD, po pariteti kupne moči), za široko pojmovano socialno področje indeks človekovega razvoja in za okoljsko področje ekološki odtis na prebivalca. Razsevni grafikoni in predloženi statistični izračuni dokazujejo tesno statistično povezanost med obravnavanimi sinteznimi kazalci. Opozarjajo predvsem na dejstva, da se gospodarski razvoj plemeniti z dosežki človekovega razvoja, kot so izboljšanje znanja, spretnosti in zdravja prebivalcev, medtem ko lahko država z večanjem gospodarske

razvitosti presežke dohodka vlaga v človekov razvoj. Zaskrbljujoči so primeri držav (npr. skupina držav v razvoju z visokimi dohodki), v katerih se pridobitve gospodarskega razvoja ne odražajo v splošni blaginji prebivalstva. Večinoma iste države dosegajo visoke dohodke prav na račun obsežnih pritiskov na okolje (izraženih z ekološkim odtisom). Z višanjem dohodkov in socialno-ekonomske blaginje se praviloma poveča obseg izčrpavanja naravnih virov in obremenjevanja storitev okolja, kar vodi v zaskrbljujočo ugotovitev, da države v razvoju sledijo energetsko in surovinsko potratnim razvojnim vzorcem gospodarsko razvitih držav, zlasti še v želji po zmanjšanju socialnoekonomskega zaostajanja in ob soočanju z večinoma hitro prebivalstveno rastjo.

Na tretji stopnji modela interakcij je predstavljen predlog nadgradnje mednarodno uveljavljenih sinteznih kazalcev, ki so bili uporabljeni na drugi stopnji proučitve. Ker je bruto domači proizvod že vključen v izračun indeksa človekovega razvoja, sta bila združena le indeks človekovega razvoja in ekološki odtis na prebivalca. Tako pridobljeni indeks – indeks uravnoteženosti razvoja – skuša vrednotiti uspešnost držav pri uravnotežanju socialnih, ekonomskih in okoljskih razvojnih prioritet. Za pridobitev indeksa je uporabljen enak način standardizacije kot pri indeksu človekovega razvoja, le da se za razliko od ostalih vključenih kazalcev povečevanje ekološkega odtisa šteje za negativni prispevek h končni vrednosti indeksa uravnoteženosti razvoja. Ob tem so vsa tri vključena razvojna področja enakomerno obtežena. Tako imajo vključeni kazalci z ekonomskega (bruto domači proizvod na prebivalca), socialnega (polovico teže v delnem indeksu prispeva pričakovana dolžina življenja, polovico pa skupaj kazalca stopnje pismenosti odraslega prebivalstva in kombinirane stopnje vpisa na različne ravni izobraževanja) in okoljskega področja (ekološki odtis na prebivalca) po tretjino vpliva na končno vrednost indeksa uravnoteženosti razvoja. Primerjava indeksa človekovega razvoja in indeksa uravnoteženosti razvoja pokaže, da so se z upoštevanjem okoljskih pritiskov razlike med državami močno zmanjšale in da so se gospodarsko razvitim državam na vrhu lestvice pridružile tudi nekatere (zlasti latinskoameriške) države v razvoju z relativno nizkimi ekološkimi odtisi in sorazmerno dobrimi izobrazbenimi in/ali zdravstvenimi dosežki. Zaradi izredno šibkih socialnih in ekonomskih dosežkov pa na dnu lestvice še vedno ostajajo zlasti države Podsaharske Afrike, nizkim ekološkim odtisom navkljub.

Indeks uravnoteženosti razvoja lahko označimo kot globalno pravičnejši indeks, ki ob pridobitvah človekovega razvoja upošteva tudi sočasne posege v naravne vire in ekosistemske storitve kot osnovo dosežene blaginje. Vsebinske in metodološke omejitve takšnega sinteznega kazalca izhajajo ne le iz načinov agregiranja, ampak tudi iz omejitev posameznih vključenih kazalcev, ki ne pokrivajo vseh pomembnih področij človekovega razvoja (npr. politične svobode, človekovih pravic ipd.). Vračunavanje okoljskega bremena gospodarskega in družbenega razvoja v državah z visokimi dohodki, v večini teh držav relativizira njihove dosežke, na drugi strani pa se pokaže tudi uspešnost nekaterih razvitih držav in držav v razvoju glede zagotavljanja enakomernosti razvoja. Na podlagi slednjega lahko trdimo, da so z vidika širših razvojnih konceptov, kakršen je trajnostni razvoj, še vse države sveta pravzaprav države v razvoju.