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ECOSYSTEM SERVICES AS PART OF THE GROSS DOMESTIC PRODUCT ACCOUNT

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ŚWIADCZENIA EKOSYSTEMÓW W RACHUNKU PRODUKTU KRAJOWEGO BRUTTO

STRESZCZENIE: Celem opracowania jest próba zdefiniowania świadczeń ekosystemów i ich właściwości, wskazanie możliwości oraz warunków uwzględniania ich w wartości produkcji globalnej, w zużyciu pośrednim, w konsumpcji i inwestycjach, jako elementach rachunku PKB. Autorka jest przekonana, że taka integracja kategorii świadczeń ekosystemów i wartości wytworzonych w społeczeństwie w ciągu roku jest niezbędna. Analiza teoretyczna postawionego zadania wskazuje jednak na liczne ograniczenia i brak podstaw takiego rozwiązania, a nawet na podważenie zasadności stawiania takiego celu badawczego. Zarówno rozwijanie postawionej tezy, jak i jej podważenie wymaga dalszych analiz teoretycznych.

SŁOWA KLUCZOWE: ekosystem, usługi (świadczenia) ekosystemu, produkt globalny, zużycie pośrednie, produkt krajowy brutto, spożycie, akumulacja, korzyści ekosystemów

Introduction

Increasing interest in ecosystem services initiates new research fields and applicatory studies. One such issue pertains to the link between ecosystem services (benefits, ecosystem functions)[1] and the GDP account. In this particular case the GDP account constitutes a measure of goods and services generated by the economy in a designated amount of time. The GDP definition emphasizes the fact that the aforementioned measure expresses the value of all goods and services, and since ecosystems also provide service on account of production and consumption therefore they should be treated as a subject of the GDP account. The author of this paper intends to treat ecosystem benefits as a factor that is productive, can be purchased and may be utilized in the processes of production, consumption and investment.

This paper attempts to define ecosystem benefits and their properties and tries to point out the possibility and conditioning of incorporating them in the global production scheme. This pertains to indirect utilization, consumption and investments, which are treated as individual components of the GDP account. The author is convinced that such integration of ecosystem benefit categories as well as values that have been generated during one year within the community is essential. Theoretical analysis of tasks posed indicates numerous constraints, lack of principles of such a solution, and in extreme cases attempt to undermine this particular issue. It should be noted that thesis presented herein and its possible invalidation requires further theoretical analyses. This paper indicates both the scope and topics that are discussed.

Specificity of ecosystem services and the search for economic value

Ecosystem – a random fragment of the environment in which a group of organisms accomplishes production and decomposition processes, in another words the transfer of chemical bonds according to the laws of thermodynamics, albeit in partially enclosed matter cycle and energy flow, with the usage of information, which flows through this system[2]. The subject of economics and the economic account may not be regarded as simply the ecosystem itself, nor its economic value (it does not exist anyway), but as benefits (services) of the ecosystem. A question arises, whether economic value of such benefits does exist? In this aspect there certainly is a tremendous need for usage of such value in

[1] *Scaling up ecosystem benefits – A contriubtionto The Economics of Ecosystemsand Biodiversity (TEEB) study*, Environmental, European Agency, 2010, No. 4, p. 13.

[2] A. Michałowski, *Działalność gospodarcza a procesy przyrodnicze*, Wyższa Szkoła Administracji Publicznej ,Białystok 2009, p. 82.

many social sciences, and not just economics. For example we can mention biology and many disciplines that are related to biology.

Ecosystem benefits (functions, services) can be classified in many ways, but for the purpose of economics it is useful to classify them as follows[3]:

- resource,
- regulatory,
- cultural,
- supportive.

In a different approach we can subdivide ecosystem benefits (functions, services) into[4]:

- resource, production, transformation,
- regulatory and utilization,
- creation of space for human utilization,
- information.

Environmental services are also interpreted as material and intangible benefits (outcomes) achieved by the community from ecosystem metabolism[5]. It should be noted nevertheless, that ecosystem services are not constrained to just benefits; they are treated as natural processes in natural ecosystems. We can distinguish the following processes of ecosystem benefits (functions)[6]:

- conversion of matter,
- conversion of energy,
- transmission of information,
- conversion of space,
- stabilizing role – by maintaining the dynamic equilibrium of ecological condition to transfer matter, energy, information and space they integrate all other ecosystem servicing processes.

Functions that pertain to energy conversion, information and space may be (at least partially) included in the account of indirect costs and global production. This may be incorporated in a situation when the market prices are established at the level of indispensable costs (price of energy i.e. renewable, assessment labor price, prices for utilization of protected areas, climate taxes etc.).

It appears that stabilization services are rarely defined in scientific literature and hence they are by no means measurable in terms of economic standards (they're simply priceless). Stability determines rigidity and resistance of environmental systems in terms of any type of interaction. Stability can be characterized

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[3] The Millenium Ecosystem Assessment, *Ecosystems and Human Well-being: Synthesis*, Island Press, Washington 2005.

[4] E. Kośmicki, *Zrównoważony rozwój w warunkach globalnych zagrożeń i integracji europejskiej*, in: *Zrównoważony rozwój – doświadczenia polskie i europejskie*, ed. S. Czaja, Wydawnictwo I-BiS, Wrocław 2005, p. 227-248.

[5] A. Mizgajski, M. Stępniewska, *Koncepcja świadczeń ekosystemów a wdrażanie zrównoważonego rozwoju*, in: *Ekologiczne problemy zrównoważonego rozwoju*, ed. D. Kiełczowski, B. Dobrzańska, Wydawnictwo Wyższej Szkoły Ekonomicznej, Białystok, 2009, p. 12-16.

[6] A. Michałowski, *Stabilizacyjne usługi środowiska w świetle założeń ekonomii zrównoważonego rozwoju*, "Ekonomia i Środowisko" 2012 No. 1, p. 36.

by many properties but the most important are: equi-finality, permanence, inertia, resistance and flexibility. Equi-finality can be defined as the ability to achieve identical final state in development processes under different starting conditions and by employing quite different means. Stability is considered to be a system invariable in a given time frame. Environmental system maintains stability throughout the years and even millennia, although it is possible that they undergo evolutional and successive change. Inertia may be defined as a phenomenon that is observed after a certain amount of time of durability of external factors which disturb their nature. It constitutes a type of delay which may be elucidated by compensation and stabilization mechanisms. System resistance is associated with the occurrence of threshold values of system ambience parameters, in which case no change exists, or the changes are reversible after the occurrence of disturbances. Finally, flexibility is defined as the rate, level and the means of reflecting system properties after recession of disturbances[7].

Changes of environmental system states should be observed and described by employing the following processes or features: biomass production, number of species, inorganic nitrogen content, CO_2 combustion rate. This may be accomplished by constructing and studying models (theoretical analysis) and through experimental observation. The aforementioned models are greatly simplified and such experiments are very sophisticated. One indirect approach that may be used in the attempt to describe the scale and intensity of stabilization processes is energy usage. Energy initiates all stabilization processes and ensures endurance of macro-system life such as community-economy-environment[8]. Experts recommend to perform an analysis of environment service stabilization processes. This analysis should be carried out in terms of two aspects in particular – observation of geo-chemical cycles that were either forced by live organisms, or through the presence of mechanisms and successive processes. In this particular case we are dealing with a strong coupling of biological, geochemical and climate processes[9].

The usage of energy to measure stabilization processes and other ecosystem functions may be inscribed into the energy value theory, which was consequently derived from the entropy law. According to entropy law in natural processes there is a tendency to pass from lower to higher state of probability of energy, particle and atom distribution. In reference to social-economic development theory (which should be measured via GDP) this constitutes a recognition that survival of civilization is coupled with rational investment in low entropy resource (principally from the inner earth deposits and thermal energy of the sun). Introduction of the ever growing number of pollutants into the natural environment means increase in the entropy of social-economic systems. The negative consequences of this process are constrained by stabilization properties of eco-

[7] Ibidem.
[8] J. Weiner, *Życie i ewolucja biosfery. Podręcznik ekologii ogólnej*, PWE, Warszawa 2005, p. 265-282, quatation: ibidem, p. 38-39.
[9] A. Michałowski, *Stabilizacyjne usługi...,* op. cit., p. 39.

systems, under the condition that the level of pollutants does not exceed their threshold capabilities.

Law of entropy[10] enables to express social-economic processes (i.e. environmental damages) through the energy category, which is subsequently expressed by the primary load of sun energy by converting it to the unit of energy that has been utilized in the ecosystem. Energy allows us to estimate how distant are energy media that are used in many households from solar energy. For example if the energy use is identical, then higher energy means that entropy will increase. The ratio of energy to GDP[11] (so-called mono-energy) manifests the level of savings (wastefulness) in terms of natural resource investment (especially in energy) and expresses the level of energy conversion in reference to original solar energy. In addition it also informs us about actual need for energy including the one that is materialized in case of its import. When we consider traditional research of energy absorbency we can see that it does not overload in any way the GDP. The increase of energy in the national income indicates clear wastefulness of energy economy and at the same time indicates the decrease of social benefits (welfare) on account of utilization of energy resources[12].

The description and assessment of ecosystems, ecosystem benefits, ecosystem services and measurement of their economic value must come from other science disciplines. Economics should identify productive, energy, material and intangible content of ecosystem benefits and should attempt to estimate them both in terms of quantity as well as quality. It should be pointed out herein that one such measure is the GDP account.

Recent concepts pertaining to pricing of ecosystem services and its usefulness in the aspect of GDP

The search for an existing link between ecosystem services and GDP can be achieved by expressing these benefits in economic values. The Total Economic Value (TEV) comprises of the following values (T. Żylicz)[13]:

- Use Value (UV), which is subdivided into Direct Use Value (DUV) and Indirect Use Value (IUV);
- Non Use Value (NUV) which is also referred to as Passive Use Value (PUV).

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[10] T. Żylicz, *Ekonomia wobec problemów środowiska przyrodniczego*, PWN, Warszawa, 1989, p. 63; St. Czaja, B. Fiedor, Z. Jakubczyk, *Ekologiczne uwarunkowania wzrostu gospodarczego w ujęciu współczesnej teorii ekonomii*, Wydawnictwo Ekonomia i Środowisko, Białystok-Kraków, 1993, p. 84-119.

[11] D. Begg, S. Fischer, R. Dornbusch, *Ekonomia*, PWE, Warszawa 1993, p. 36.

[12] J. Famielec, *Straty i korzyści ekologiczne w gospodarce narodowej*, Wydawnictwo Naukowe PWN, Warszawa-Kraków 1999, p. 112-131.

[13] T. Żylicz, *Wycena usług ekosystemów. Przegląd wyników badań światowych*, „Ekonomia i Środowisko 2010, No. 1, p. 31-46.

A good example of Direct Use Value is swimming in a lake, and Indirect Use Value is the stability of the local water table as a result of lake protection. However both of these values cannot be interpreted in a comprehensive way and directly linked to the GDP account. In addition these values do not express the value of ecosystem benefits (functions). If the value of swimming in a lake can be measured by a specific fee to swim in this lake, then even in case when this price is dependent on the lake quality we will still have to deal with other costs (i.e. lake maintenance) which are the result of other economic activity and cannot be taken into account in this particular case.

In the second example – lake protection is considered a cost (investment) to maintain the quality of water ecosystem, but what is important it does not signify benefits from this system nor its costs. Furthermore to include swimming in lake within the GDP account we would have to carry out market transactions (act of purchase/sale of services provided by the lake). If this particular condition is met we are able to include these market transactions into the global production scheme, which consequently becomes the starting value in the GDP account. Swimming in lake is inevitably a form of ecosystem consumption and as such should be recognized as its benefit. However, there is no basis to include this type of consumption into the GDP value (swimming as public good, free of charge or one that is subsidized by the state) when we consider the process of establishment, division in the light of obligatory principles of managing such an account.

If somehow we are able to verify a translation of ecosystem services into the GDP value then it has to be performed in terms of usefulness category. Usefulness is the fundamental category of welfare theory, which was destined to substitute the value theory based on labor[1413]. The usefulness theory is defined as an ensemble of mental pleasures which are sensed by a person on account of purchasing, gathering and consuming a particular good. The founders of the usefulness theory (H.H Gossen) assumed that this category is measurable. Co-authors of this theory (i.a. L. Walras) assumed that a rational consumer makes adequate economic choices and therefore should possess the opportunity to identify usefulness and be able to measure this value. At that time scholars believed that usefulness does exist and that people are able to recognize the usefulness of individual extreme goods albeit the measurable category was not the same. Scholars devised models (neutrality curves) and performed sophisticated mathematical interpretations. In such a model a usability index is attributed to each basket of goods. The function of usefulness describes subjects' behavior within the economy that operates according to specific regulations. Such economy is targeted to maximizing the goods of individual citizens.

Traditional usefulness function may be expressed by an equation below[15]:

$$Ui = Ui(xi1,xi2,...,xin) \quad (1)$$

where xij(i = 1, ... i = m; j = 1,..n) signifies quantity j-of good, purchased by i-consumer.

[14] A. Becla, S. Czaja, A. Zielińska, *Analiza kosztów –korzyści w wycenie środowiska przyrodniczego*, Difin, Warszawa 2012, p. 28.

[15] H. R. Varian, *Mikroekonomia*, Wydawnictwo Naukowe PWN, Warszawa 1997, pp. 84.

It is assumed that the usefulness function is continuous and possesses continuous partial derivatives of first and second order. This enables to determine formal conditions which are essential so that the consumer selects a basket of goods that maximizes usefulness and its value is equal to its income. A characteristic usefulness entry comprises of ranking baskets of goods. Values of the usefulness functions are important due to the fact that they categorize various consumption baskets. The magnitude of the usefulness difference between two given consumption baskets is in this particular case immaterial. This particular type of usefulness is referred to as ordinal usefulness[16].

Without further explanation of these difficult issues pertaining to the usefulness function (this needs to be pursued by the developing science called mathematical economics) it is recommended that marginal utility should be employed for analysis of ecosystem benefits (functions). Marginal utility enables to assess the change in consumer's usefulness if he obtains more of accessible good. This "more of accessible good" may signify more energy used for this particular good, which is expressed in the value of ecosystem function. For instance this may include a house in a pristine environment, production of electronic subparts in pure environment etc.

It should be pointed out that usefulness has never been described or measured in scientific aspects. This applies to the Victorian era when usefulness was treated as a numerical measure of human happiness and in contemporary times when it is expressed in categories of consumers' preferences. Scholars have managed to construct usefulness functions (Cobb-Douglas) however their usability does not exceed past theoretical analysis of consumer behavior, even when we take into account a number of principles that simplify reality.

The principal criterion of the assessment of consumers' behavior is reaction to changes in price of goods and the assumption of consumer's rationality. Basically this means that the consumer always chooses best items that he can afford. However the consumer or other person which is perceived a potential consumer does not always behave according to the established economic model. This type of situation may be verified for ex post scenario but there is no rational background to project preference functions ex ante.

The application of usefulness function and welfare theory to describe and assess ecosystem benefits (functions) is conditioned by numerous factors, and the most important ones (according to the author) are presented below:

- identification of ecosystem basket;
- comprehension of consumption process pertaining to these benefits and their measurement;
- existence of economic market and market prices of such benefits.

Identification of potential ecosystem benefits (functions) is presently making considerable progress but selection of comprehensive basket of goods and ecosystem services may not be possible for some time without more profound integration of biology, chemistry and physics with social sciences. A group of scholars

[16] Ibidem.

led by Constanzy has identified 18 ecosystem types such as: boreal forest, marshy land and others as well as 17 key services such as climate regulation, pollination and recreation. Each ecosystem can supply any type of service mentioned above but their scale is diversified. Subsequently we obtain a 18×17 matrix (another words 306 components) and each of them may contain the value of a specified service that is provided per one acre of the ecosystem. Most of these components are empty because there are no proper estimates for individual issues. It should be noted that estimates which have been performed using this matrix calculated a sum of 33 billion USD (in 1994), which consequently was greater than the value of global GDP.

It should be emphasized at this point that this value may be only compared with the GDP but cannot be assessed based on the GDP. "*There is absolutely no reason to think that ecosystem services are part of market transactions and their value should be linked with the GDP*[17]". This remark undermines the legitimacy of the approach assumed by the author of this paper. We can concur with such an assumption if we take into account the procedure and principles of these estimates. This is also strongly supported by numerous reservations in terms of reliability and credibility of these estimates. However it is difficult to undermine the assumption that ecosystem benefits category should not be a component of the GDP value. This is justified by the fact that there exists a common agreement that ecosystem benefits constitute welfare value and in addition the GDP is so far the only applicable measure of such welfare in all possible social-economic systems.

In the years 2001-2004 the General Secretary of the United Nation has devised a concept of economic assessment pertaining to changes of ecosystem services. This concept focuses on the changes in ecosystem services in the light of human welfare. In this project 37 different categories of ecosystem services have been distinguished, and subsequently they were subdivided into four groups[18]:

- fundamental, which condition life on earth (i.e. photosynthesis capability, primary production, natural cycle of important radicals and substances such as carbon, oxygen and water;
- supportive, such as food, water, wood, fiber, biofuels;
- regulatory; such as absorbance of pollutants, climate conditioning, mitigation of flood crest, effect on soil erosion, pollination;
- cultural such as esthetical, recreational, religious.

Over 1300 scientists from all over the world managed to achieve qualitative assessment of the direction of changes of benefits magnitude, which has taken place in the second half of the twentieth century. Research methodology and interest of various scientific disciplines concerning ecosystem services has been viewed upon as added value. It should be noted however, that no numerical es-

[17] T. Żylicz, *Wycena usług ...,* op. cit., p. 39.

[18] A. Mizgajski, *Świadczenia ekosystemów jako rozwijające się pole badawcze i aplikacyjne*, „Ekonomia i Środowisko" 2010, No. 1, p. 14-15.

timates have been elaborated and translation to the measure of welfare has not been accomplished (including the GDP).

The author would like to mention the initiatives implemented by the International Science Society regarding the issues of ecosystem benefits (functions). The author believes they are quite useful in discussing the nature of ecosystem benefits. These initiatives attempted to define the payment model of ecosystem benefits, which is consequently an indispensable condition in acknowledging the subject of market transaction and its further incorporation into the production, consumption, cost, and investment account (within the GDP account). The author proposes to define payment for receiving ecosystem benefits by employing the following set of criteria:

- Transaction is voluntary,
- Ecosystem benefits (or ones that ensure land use) are precisely structured,
- There is at least one benefit buyer,
- Benefits may be ensured by the provider of services.

As previously emphasized the definition and precision of ecosystem benefits (functions) has many restrictions. Both the buyer and the seller exist in conditions of intelligent and highly skilled market of goods and ecosystem services.

According to T. Żylicz typical goods and ecosystem services are ones for which "the market does not exist, no market prices exist for which a consumer could resist[19]". For the aforementioned reasons environmental goods and services can be treated according to the so-called market conditions.

Conditional market includes pure good, the institutional context of its provision and means of financing transactions. What is important, is the fact that in reality goods and services are not provided. A hypothetical situation is created in which the respondent (potential purchaser, investor) behaves as if he was functioning on a real market[20]. The value of potential transaction and the magnitude of market price is estimated on the basis of the following components: by studying the declared preferences of the consumer and his willingness to pay (WTP) for a given service, status of the environment and willingness to accept compensation for losing either the good or services (WTA). The above mentioned methods as well as others, which pertain to pricing of non-market goods, are accepted by the economists because they reveal preferences. This point is crucial when it comes to transactions and purchasing a product.

They are thoroughly elaborated and are applied more often. This new technique referred to as the Choice Experiment was applied for example to assess the value of possible public goods provision in case of the Bialowieski Virgin Forest. This research project involved the estimate of the tendency of paying for greater biodiversity. For example the residents have been asked wheer they are inclined to pay taxes (10-year period) on the account of specific environmental

[19] T. Żylicz, *Wycena usług ...,* op. cit., p. 35.

[20] J. Famielec, *Straty i korzyści ekologiczne w gospodarce narodowej,* Wydawnictwo Naukowe PWN Warszawa-Kraków 1999, p. 112 oraz 154-155.

attributes. Such studies are estimated as credible and they develop the knowledge pertaining to economic parameters of potential transactions on the service market and maintain biodiversity[21].

The above-mentioned methods of assessment of environment economic value are not sufficient in terms of the application to the ecosystem benefits (functions) in the GDP account. We would need to construct many conditional markets of ecosystem benefits but currently the major obstacle is that we are not familiar with the principles of service consumption in this matter. These services are usually consumed indirectly in the production of goods and services, in the material realm (i.e. manufacturing high-class electronic equipment in pure environment) and intangible realm (curing of rashes after surgical operations, which require pure air, or functioning in spas that are located in protected areas).

So far it is possible to use estimations of certain damages and environmental benefits by applying the aforementioned methods of estimates. Scientists attempt to include and distinguish this methodology in the GDP account (table 1). In this case the subject of pricing are resources and the process of their utilization. Ecosystem benefits are only one possible component associated with atmosphere and hydrology services.

This concept assumes that utilization of environment resources provides certain benefits (income, receipts) but it also requires certain costs and expenses which may be included in the global production account. In addition it needs to take into account indirect costs, but only in such cases where they constitute independent components (i.e. water treatment) or they are fully integrated with production processes (i.e. filters in the power plants). Subsequently results of the aforementioned processes constitute the subject for market transactions and they may be assessed in terms of market prices.

A separate problem is the access to natural resources and their property as well as political situation. As example we can mention the current Israel – Palestine conflict regarding water issues. In that region water is present in sufficient amounts but it is not accessible for many Palestine residential areas, due to legal and political restrictions imposed by Israel. Such complications prevent the assessment of the value of benefits on account of water resources. On one hand the irrigated deserts are "green" and provide a wide variety of products, which can be estimated using an economic approach. On the other hand the absence of water access in this area (Palestine case) suggests lack of benefits in this matter. What is vital is that unfortunately there is no background for voluntary transactions and adjusting market price for water.

The concept of benefits and losses is useful but not sufficient to solve the problem of including ecosystem benefits (functions) in the GDP account[22]. Environmental losses and benefits are defined as decreased benefits (incurred losses), wasted benefits (lost opportunities), and benefits acquired which are strictly as-

[21] T. Żylicz, *Wycena usług ...* op.cit., p. 38-39.

[22] J. Famielec, *Korzyści i straty ekologiczne w ekonomii sektora publicznego*, „Ekonomia i Środowisko" 2010, No. 1, p. 46-63.

Table 1.
Selected natural environment resources as part of the GDP account

Resource type	Included components	Excluded components
geological • minerals • soil • water resevoir	• income and costs of private and public resource yield • income from cultivation, cultivation production costs • investing expenses and costs due to water consumption	• depreciation of resources • depreciation of soil quality • depreciation of water reserves • free of charge water consumption
biological • forests • shoal of fish • wild life	• costs and revenue from timber acquisition • revenue and costs of fish catch • recreation expenses	• depreciation of a given resource • non-market benefits • expenditure for one's own usage • non-consumption benefits on account of wild life
biosphere • atmosphere • hydrosphere	• environment protection expenditure • health costs	• ecosystem depreciation • value of ecosystem services

Source: Author's elaboration based on: J. Famielec, *Straty i korzyści ekologiczne w gospodarce narodowej*, Wydawnictwo Naukowe PWN, Warszawa-Kraków 1999, p. 58.

sociated with the environment. They can comprise production value, their small component (included in the market price) or they can be a part of the component of production cost (included in the GDP account).

Table 1 indicates that there are many examples of costs and environmental costs not included in the GDP account because they are not estimated and they do not have a direct character of production or indirect costs. Only some of the losses and benefits may express the value of ecosystem benefits (i.e. revenue from timber acquisition). It should be noted that costs and environmental costs comprise the results obtained or incurred by the producer, investor and consumer on the account of environment utilization. Meanwhile ecosystem (functions) should express the results of environment services because in this case they will be perceived as expenditure (cost) for its purchase, or a revenue that is obtained from sales. Cost of treatment is not a value of ecosystem benefit. It is perceived as an indirect measure of environmental losses.

Opportunities of incorporating ecosystem benefits into the GDP account

Construction and utilization of the GDP analyzed by the Principle Statistical Bureau (current market price) can be expressed with the following equations:

$$\text{GDP} = \text{Global Production} - \text{indirect utilization} + \text{+taxes derived from products} - \text{subsidized products.}$$

$$\text{GDP} = \text{consumption} + \text{accumulation} + \text{balance of products exchange abroad.}$$

The GDP comprises the following components[23]:

- value of all goods and services generated in specific time period in the territory of a given country,
- flow measurement of current production,
- value of investments goods including consumption goods.

We could include the value of ecosystem benefits (functions)in the aforementioned equation on condition that they be expressed in currency and designated on the basis of the market price scale system. Prices are the only necessary tool used in aggregation of various components of the GDP.

The GDP account has many constraints in general, but if we take into account the possible value of ecosystem benefits there are particular constraints. A list of these constraints is presented below[24]:

- summing up values that pertain only to goods, which are aimed for direct consumption and subsequently which are used in the investment process. We can mention here environmental services which do not possess the character of direct consumption goods, or investments; they merely create conditions for stabilizing life processes. Also we can mention human functioning and the course of economic processes, which are not the subject of accounting and statistical documentations, and consequently the cannot be aggregated into the flow of GDP account;
- omission of the value of indirect goods that have been utilized by the producers of finished goods (i.e. semi-products, energy, resources) – environmental goods possess this character
- does not reflect the values of goods and services, which are not the subject of market transactions (i.e. household activity) – ecosystem services are neither the subject of market transactions nor they constitute basis for calculating prices in market transactions – the reason is that majority of these services cannot be identified and they are treated as voluntary goods, which are utilized or consumed free of charge. Also the property status of these benefits are not regulated, which is indispensible to carry out any market transaction (this is referred to as the necessity to hand over property right for these goods),
- does not include purely fiscal transactions (such as state transfer, non-returnable payment transfers), which are so far the only means of fiscal flows that can be measured (i.e. environmental taxes, public aid for environment protection, budget expense for maintaining research institutions and protection of biodiversity etc,

[23] L. Zienkowski, *Co to jest PKB? Jego rola w analizach ekonomicznych i prognozowaniu*, Dom Wydawniczy „ELIPSA", Warszawa 2001, p. 85 and following.

[24] M.G. Woźniak, *Wzrost gospodarczy. Podstawy teoretyczne*, Wydawnictwo Uniwersytetu Ekonomicznego, Kraków 2008, p. 13-14.

- value of benefits/services is calculated on the basis of production costs (benefit costs) with the exclusion of indirect taxes. It should be noted that ecosystem services do not constitute the subject of market pricing and therefore they do not have a price.

The GDP account may be calculated using three different methods:

- summing up the added value generated in all enterprises of state economy,
- measurement of the flow of expenditures allocated for goods and services,
- measurement of income from productions factors

The inclusion of ecosystem benefits value into the GDP account would be possible if we employ the method which measures the revenue of investment participants on account of the involvement of production factors. This is conditioned by one important fact, the prices for labor, rent of space, interests and profits would have to be „sensible" to both quantity and quality of ecosystem services and we could devise a way to internalize benefits and costs of utilization of ecosystem benefits for market transaction pricing. So far the only existing market instrument associated with environment protection features trade of rights to emit pollutants. However it does not fulfill its role due to its free of charge character, public aid etc. The second possible instrument features environment taxation (they do not exist in Poland). *„Market mechanisms can play a crucial role in improving change, for example in constructing a new „green" economy. To be honest even a simple change (warranty) that prices properly effect the state of natural resource depletion in the long run would create a significant headway"*[25].

If we assume further progress in identification of ecosystem benefits by natural sciences as well as the possibility to assess its participation in production and consumption processes (cause-effect functions) the economists could perform the following tasks in terms of linking ecosystem benefits with the GDP account:

- keeping pro forma accounts of ecosystem benefits values – advantages and costs for production and consumption processes in the economy,
- Identifying values and components of generation price factors in the current balance of income, costs, investments and consumption of the organism production value. The purpose of these tasks would be to designate a generative factor, which has not been established thus far. This factor would be much broader than land and would constitute ecosystem services.

At the same time it is vital to seek new measures of welfare – the current GDP index causes many damages in terms of the evaluation of economic growth and development as well as aims and priorities for future generations. It is also necessary to make economics more "environmental" including the GDP account.

25 J.E. Stiglitz, *Freefall. Jazda bez trzymanki*, PTE, Warszawa 2010, p. 229.

Summary

Social-economic development and its assessment is often times the background for making political, financial, investment and consumer-related decisions. The most common category of measures employed are the GDP and economic growth. It should be noted that economic growth refers to the real sphere of economy, which subsequently comprises material production base including natural resources, population, and changes in its structure as well as production and consumption that are generated[26].

The above-mentioned natural resources do not include ecosystem benefits (functions) and free of charge goods. The GDP account only expresses the growth of generated goods and services (related to consumption and production) or in another words only selected means of satisfying human needs. The GDP measure does not fulfill its role in measuring the effects of the real economic sphere, because it omits the value of goods and services that are not the subject of market transactions. It also omits purely fiscal transactions. It should be pointed out that the GDP measures the scale of production in a given time period – not the welfare[27] or usability. The latter features are sought after in order to include the values of ecosystem benefits, or at least basic attributes of environmental development (social-economic and environmental order).

It is possible to propose such an order[28], formulated on the basis of the Ordoliberal theory (Walter Eucken et all) and the policy of accomplishing such an order in the form of social market economy[29] (Ludwig Erhard, the author of the concept and subsequent policy „German economic miracle"). The above-mentioned issues are to extensive to be included in this elaboration. It is worth mentioning though that the author proposes a very bold thesis – welfare for everyone. Unfortunately this type of welfare will not generate growth[30]. Maybe if we take into account this approach we would have more room for incorporating the values of ecosystem services as ecosystem benefits?

[26] M.G. Woźniak, op. cit., p. 9 and following.
[27] L. Zienkowski, op. cit., p. 85 and following.
[28] Wskazuje na taką potrzebę i szansę: B. Fiedor, *Trwały rozwój a koncepcja społecznej gospodarki rynkowej*, in: *Kształtowanie zrównoważonego rozwoju w reakcji na kryzysy globalny*, ed. A Graczyk, Wydawnictwo Uniwersytetu Ekonomicznego, Wrocław 2011, p. 13-29.
[29] T.T. Kaczmarek, P. Pysz, *Ludwig Erhard i społeczna gospodarka rynkowa*, Instytut Studiów Politycznych PAN, Warszawa 2004.
30 T. van Treeck, *„Wohlstand ohne Wachstum" braucht gleichmäßige Einkommensverteilung*, „APuZ aktuell" 2012, No. 27-28, p. 32-51.