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Environmental Accounting of Korea

A. Pilot Compilation of Environmental-Economic Accounts in Korea (Korea Environment Institute)

1. Introduction: national strategies on environment and development

1.1. Environmental legislation

Environmental issues were first added to the Government's political, economic and social agenda in the 1980s when increasing concern were expressed over deteriorating environmental trends under rapid economic growth. Even though the first major environmental law (Environmental Pollution Act) was enacted in 1963, the right to a clean environment was not added to the Constitution of the Republic of Korea until 1980. The enactment and amendment of several environment related laws, including an amendment to the 1977 Environmental Preservation Act and the establishment of an Environmental Administration, followed later. In January 1990, the Environmental Administration, which had been a vice-ministrial office, was upgraded to the Ministry of Environment (MOE) under a cabinet ranking minister. In 1991 and 1992, the original Environmental Preservation Act was replaced with more specific environment legislation relating to environmental policy, air quality preservation, water environment preservation, noise and vibration control, hazardous chemicals controls, environmental pollution damage disputes, solid waste management and marine environment.

The MOE was responsible for the preparation of the National Report of the

Republic of Korea to UNCED in 1992. This document presents a comprehensive statement with respect to the environment and sets out the basic principles and mechanisms underpinning the ESSD strategy. These principles include the pursuit of environmental impact assessment of major development projects and various market-oriented mechanismus associated with the "polluter pays principle".

1.2. Sustainable development strategy

Under the environmentally sound and sustainable development strategy (ESSD), the main concepts include proper valuation of the environment, extension of the time horizon of development to include long-term benefits and costs, and equity concerns. The general principles embodied in the ESSD include:

a. maximization of citizens' quality of life including material well-being, the environment and social stability;
b. stemming of urbanization through control of population influx and industrial concentration;
c. consideration of environmental protection in all development projects to ensure the optimization of both economic growth and environmental protection;
d. proper valuation of environmental stocks and continuous examination of environmental capacity;
e. equity, both within and between generations;
f. recognition of environmental problems of global dimensions and Korea's role for their protection;
g. active role of all constituents, institutions and agents in attaining sustainable development

The main action of the Government since the 1992 UNCED summit has been to consolidate follow-up of the ESSD strategy. The Government of the Republic of Korea has subscribed to the main components of Agenda 21 which has includes the recommendation that all governments implement the SEEA.

1.3 Public awareness and environmental action programmes

Structural transformation of the economy through industrialization has been basis for increasing prosperity in Korea. This has led, however, to a commensurate rise in pollution and other environmental disbenefits. Although environmental concerns were expressed increasingly by the public in the 1960s, the problem of environmental deterioration did not receive much attention until the 1970s. The Fourth Five-Year Plan (1977-1981) introduced pollution abatement as a major new plan objective. Under the Fifth Plan (1982-1986), environmental conservation was specified as an offical "goal" of national economic development. This was followed by the enactment of the Environmental Preservation Act and the creation of a number of operating agencies and research institutes dealing specfically with the environment. The Sixth Plan (1987-1991) included an Environmental Conservation Plan with new and precise action programmes for areas and sectors. During the Sixth Plan an extensive network of air and water pollution monitering stations was established to provide recurrent indicators for the assessment of air and water quality.

The Seventh Five-Year Plan (1992-1996) presents a more comprehensive statement on proposed action for environmental protection and improvement. The Ministry of Environment drew up a five-year master plan for the environment (1992-1996), incorporating goals for the supply of clean water, treatment of sewage, disposal of soild wastes, recycling of materials and the systematic management of the environment. As a result, sanitary wastes treated rose from 27% to 90%. The Plan involves only projects relevant to environmental improvement run by the central government ministries and local governments. The Ministry of Environment expects to be able to provide guidelines for the budgeting of environmental programmes for the central and local governments, as well as for the implementation of detailed regional environmental management plans. The Seventh Plan has subsequently been revised under the new Government with amended targets and objectives.

2. Korean System of integrated Environmental and Economic Accounting (KORSEEA)

2.1 Objectives of KORSEEA

The framework of KORSEEA was designed to assess these functions, especially when new scarcities of natural resources may threaten sustained economic productivity and degradation of environmental quality may impair the waste absorption capacity of environmental sinks. Accordingly, the main objectives of KORSEEA are:

a. segregation and elaboration of environment-related flows and stocks of the economic accounts;
b. linkage of physical resource accounts with monetary environmental accounts and asset accounts;
c. assessment of environmental costs, including the use (depletion) of natural resources and changes in environmental quality from pollution and other impacts of production and consumption;
d. accounting for natural capital, including minerals, forest, fish, land, air and water;
e. elaboration of environmentally-adjusted indicators , taking into consideration environmental depletion and degradation costs; indicators include environmentally-adjusted value (EVA), its sum total, environmentally-adjusted net domestic product (EDP), and net capital accumulation, among others.

2.2. KORSEEA framework

KORSEEA reflects the accounting structure of the SEEA and is tailored to the environmental concerns and data availability in Korea. KORSEEA is derived by adding to the Supply and Use Table (SUT) and produced assets accounts of the central System of National Accounts (SNA) (Commission of the European Communities *et al.*, 1993), environmental accounting elements.

They include:

a. *expenditures on environmental protection and environmental charges and subsides*. These categories are made explicit as "of which" items including value added of environmental protection industries, intermediate use of environmental protection products, exports and final consumption of environmental protection products by households and government, gross capital formation for environmental protection, and environmental charges and subsidies;
b. *supply of natural resources* in the country, i.e. outputs of extraction industries and imports of natural resources. These products are also identified as "of which" categories of output and imports;
c. *non-market uses of natural assets by industries and households.* Such uses include the depletion of natural resources by production and final demand, and changes in environmental quality resulting from emissions or dischanges of air and water pollutants, and soild wastes by industries and households;
d. *asset accounts of non-produced "economic' and "environmental" assets*, including the stocks, changes in stock through depletion and degradation, and other volume changes of land, minerals, forest, fish, air (degradation only) and water.

The SUIT includes data on the supply of products, consisting of output and imports, and the use of products in intermediate consumption, final consumption by households, government and non-profit institutions serving households (NPISH), capital formation and exports. The columns of the SUT are detailed by industries according to the Korean Standard Industrial Classification (KSIC) (NSO, 1991) as are gross fixed capital formation and consumption of fixed capital. In this manner, the importance of each activity can be determined not only in terms of value added, but also investments.

Three basic accounting identities apply to the central SUT:

a. *supply and use identity* : output + Imports = Intermediate consumption + Exports + Final consumption + Gross capital formation

b. *value added identities*:

(i) Net value added = Output – Intermediate consumption – Consumption of fixed capital

(ii) Net value added = Compensation of employees + Taxes (less subsides) on production and imports + Operating surplus;

c. *net domestic product* : Sum of net value added = Exports – Imports + Final consumption + Net capital formation

In the first extension of the SUT, environmental protection expenditures are identified separately within the economic accounts for output, intermediate consumption, final consumption of households and government, gross capital formation, taxes and subsidies on production, imports and value added. Environmental expenditures are those expenditures that prevent and mitigate or restore environmental deterioration. They are classified according to the environmental media they affect, i.e. land, air and water. Their separate identification is to assess the efforts of implementing environmental protection programmes. Environmental charges reflect a lower-bound estimate of the cost of non-compliance with environmental laws and regulations, borne by households, enterprise and other institutions.

The second extension of the central framework consists of a separate identification of natural resources in outputs and imports as indicators of potential depletion.

The third extension assesses the cost of natural resource use and changes in environmental quality. The cost data are deducted from the value added of industries causing depletion and degradation. The depletion of minerals is accounted for as a cost deduction from the value added of the mining industry. For forest, given the extensive reforestation programmes in Korea and increase in forest stock, it can be assumed that no depletion took place in the years 1985-1992. Fish stocks are known to be decreasing because catch per unit effort (CPUE) has decreased since 1970. However, lack of data on fish stocks and maximum sustainable yield (MSY) for the different species prevented the allocation of depletion cost to the fishing industry. Degradation is valued at the "maintenance cost" of preventing or treating the emission of pollutants and wastes, using best available technologies. Degradation caused

by households is treated as cost of household production activities, identified as a separate industry in KORSEEA.

The fourth extension consists of the modification of the asset boundaries to include in the asset accounts non-marketed natural resource assets "in the wilderness" such as land, forest and fish, and other "environmental" assets.

2.3. Physical and monetary asset accounts

Asset accounts for non-produced "economic" and "environmental" assets are compiled both in physical and monetary terms. Non-produced economic assets include non-renewable natural resources, such as land and minerals, and renewable resource such as forest and fish. Asset accounts for environmental assets record only the cost of discharge of residuals into the different environmental media of land, air and water. Physical asset accounts for non-produced economic assets include :

a. opening stocks;
b. depletion;
c. other volume changes;
d. closing stocks.

Physical stocks are valued, multiplying (a) and (d) by unit net prices at the beginning and end of the year, respectively. Stock changes are valued by multiplying (b) and (c) by the average unit net price of the beginning and end of the year. Net price is calculated as the difference between the actual market price of the resource output the average (as an approximation of marginal costs) exploitation costs including a normal return to capital. For land, market prices observed in statistical surveys are used instead of net prices. A revaluation item is estimated for monetary asset accounts as the remaining difference between closing stocks and opening stocks after accounting for volume changes. Revaluation thus includes, beyond asset price changes, measurement errors and other "statistical discrepancies".

Emissions of pollutants into air and discharge of wastes residuals into land and into water are presented in physical and monetary terms. The emissions are valued using unit

costs of the best available technology in preventing or treating emissions, including construction expenditures and current expenses of waste disposal and wastewater treatment plants, cost of end-of-pipe technology such as scrubbers, filters, catalytic converters etc. Environmental costs caused by households are shifted from degradation cost record in the column of final consumption to the column of "adjustments and statistical discrepancies" in the row of shift in environmental cost". The purpose is to deduct these cost from net domestic product (NDP) in the calculation of an environmentally-adjusted net domestic product (EDP).

2.4 Data sources

The following institutions are the most important producers of environmental and related economic data required for integrated accounting in Korea.

The Bank of Korea (BOK) publishes national accounts, and fiscal and financial statistics. For the compilation of KORSEEA, the national accounts of Korea for 1985-1992 were used (BOK, 1991 and 1994)

The National Statistical Office (NSO) of the Korean Government publishes a wide range of relevant data of which the most important for the present study are :

a. Korea Statistical Yearbook, an annual publication with times series since 1980 of major economic activities (NSO, 1993);
b. National Wealth Survey of Korea (decennial), which measures tangible fixed assets, stocks and net foreign claims (NSO, 1989);
c. Report on Mining and Manufacturing Survey (NSO, 1987-1989, 1991-1994)
d. Report on the Construction Work Survey (NSO, 1986-1993)
e. National Survey of Family Income and Expenditure (NSO, 1986-1993)

The Ministry of Environment (MOE) issues the Yearbook on Environment Statistics (annual) (MOE, 1989-1992), which contains comprehensive data on environmental trends based on the environmental monitoring system of the MOE

Sectoral and other supporting statistics, which include information mainly on natural (non-produced) assets and environmental trends by sector, and supplement the information

from the MOE, BOK and NSO. The main sectoral statistics were obtained from:

a. Forestry Administration (1986-1993) –forest stocks, logging and extraction trends etc;
b. Ministry of Agriculture, Forestry and Fisheries (1986-1993) – agricultural land use, erosion and degradation; fish stocks and landings;
c. Ministry of Construction (1986-1994) –water resources and land, physical planning data;
d. Ministry of Trade, Industry and Energy and Korea Energy Economics Institute (1993)- energy conservation; proven economic reserves of minerals and non-minerals

The two main Government bodies directly concerned with the development of accounting systems and environmental accounts in Korea are the BOK and the NSO. As already mentioned, the BOK is responsible for the publication of the final national accounts and will implement the 1993 SNA. Prior to this project, no proper framework existed for constructing separate (satellite) environmental-economic accounts. The NSO is responsible for the compilation of regional accounts, notably gross provincial domestic product, and a wide range of supporting production and income statistics.

3. Compilation results of the pilot SEEA

Estimation results for the System of Integrated Environmental and Economic Accounts (SEEA) in Korea for the period 1985-1989 are presented in Table 1 in summary form. The estimation followed the basic framework and was based on data availability given in the previous sections. The estimates here do not reflect the exact EDP (environmentally adjusted net domestic products) or EVA (environmentally adjusted net value added) of Korea due to a lack of consistency in the estimates stemming from data availability and the limitation of accounted environmental assets covered.

Table 1 was compiled based on current prices. Tables 2 and 3 show the analytical measures derived from Table 1 and the original compilation. The figures in Table 3 were valued by deflating the current price estimates of the environmental costs of resource depletion and environmental degradation by 1990 prices. The “Shift of Environmental Costs

by Households" in Table 1 is, by following the 1993 SNA, to record the shift of social costs by environmental degradation from the household sector to the production sector.

In interpreting the outcomes in Table 1, 2 and 3, some cautions are in order. First, the according scope is limited in that all the environmental factors are not included to estimate the costs of environmental degradation and depletion of natural resources. For the depletion of natural resources, only mineral resources of iron, limestone, tungsten, coals and copper were accounted. In accounting for environmental degradation, only the amounts of BOD unloaded to water bodies by domestic and industrial wastewater were included for the water pollution problem.

Emissions of SO2, Nox, TSP and CO were analyzed for the air pollution proble, and only general wastes were included in the accounting. Secondly, there is a lack of consistency in the accounting scope when calculating the annual EVAs. The depletion of natural resources reflects only mineral resources, excluding the depletion of tungsten ores in 1985 and 1986 at the same time. In light of the inconsistency of the accounting scope and data limitations, the comparisons of the estimated EVAs are possible for certain years. For example, when the costs of mineral resources depletion are not included in estimating EDP, the comparison of annual EVAs for the period 1985-92 is possible.

When depletion costs of mineral resources are included, the comparison of 1985 and 1986 and the comparison of 1987 to 1992 period respectively are possible. Also, the depletion or accumulation of some natural resources was not measured in the monetary unit due to a lack of data. For example, a portion of forests are managed for commercial uses. Thus, the net increase of the growing stock of commercial forests should be reflected as the postive value adding to EDP. However, this has not been done due to data limitation. Finally, in valuing environmental assets such as forests and fishes, the reliability of the estimates is relatively low since more detailed information on net prices was not available.

Despite these problems, the provided tables give us several noteworthy results. As we can see in Table 3, the growth rates of real EVA (EDP) for 1986, 1987 and 1991 are a little higher than those of real NDP while they are lower than those of real NDPs for other years. The rations of EDP to gross output have generally been in an upward trend since 1987 as have been the value-added output ratios. The output-capital ratios, here the NDP-capital

ratios, by nominal prices increased slightly from 1985 to 1989, decreased in 1990 and began increasing again in 1991. The ratios of EDP to the sum of produced assets and non-produced assets are very small compared to the NDP-capital ratios and have declined since 1988. However, their general moving trend can not be found. This trend depends on how many environmental assets are included in the cost estimation of resource depletion. Thus, the cautious interpretation of the numbers in Tables 2 and 3 is required.

The costs of depletion of natural resources and environmental degradation were estimated by industry types in the pilot compilation, but their details are not reported here.

4. Concluding remarks

The present study implemented a system of integrated environmental and economic accounting for Korea (KORSEEA) with existing statistics. The compilation of the accounts served the purposes of training national staff, identifying data sources and gaps, and presenting first results and analyses of the environmentally modified national accounts.

For improving data quality and coverage of environmental concerns, the authors of the study recommended enhancing data collection, particularly in the following areas:

a. *environmental protection expenditures*: data on the use/intermediate consumption of environmental protection products could not be obtained from available statistics. The BOK has recently undertaken a survey on environmental protection expenditures by households, industries and government; future compilations of environmental accounts might benefit from these surveys. Value added of the environmental protection industry was estimated from different data sources (MOE, 1986-1992, 1994; Korea Development Bank, 1991 and 1994) for selected industries. Data from different sources are not consistent, and the industrial classification used is not in line with KSIC utilized in the compilation of national accounts. Moreover, environmental protection expenditures are not available according to the Classification of Environmental Protection Expenditures (CEPA). Harmonization and implementation of these classifications is an urgent task;
b. *fishery resources* : the study reveals an important data gap, concerning fish stock and maximum sustainable fish catch. Although catches per unit of effort have

generally decreased, an indication that fish stocks have decreased rapidly- no reliable information on overfishing, i.e. fish stock depletion, is available. This data gap needs to be closed to obtain a more comprehensive of natural resource depletion in Korea;

c. *water resources*; the study did not address one of the major environmental concern in Korea, that is the availability of freshwater of certain quality standard. Further studies and data collection activities, in both physical and monetary terms, should be undertaken to improve data availability and increase the coverage of Korea's natural resource base;

d. *industrial breakdown of actual environmental protection expenditures and "imputed" environmental (depletion and degradation) cost*: lack of detailed data for economic sectors and industries limits data analysis to the aggregate national level. For structural policies, e.g. of environmental cost internalization aiming at environmentally sound production and consumption, detailed databases need to be built up.

Filling the data gapes and establishing coordination data producers would be facilitated by the permanent institutionalization of environmental accounting in Korea. The responsibility for recurrent integrated environmental and economic accounting could be assigned to the KNSO(Korea National Statistical Office), responsible for compiling the National Wealth Surveys, MOE(Ministry of Environment), responsible for basic statistics, and be charged with continuing research and analysis in a new and evolving area of applied statistics.

B. Pilot Compilation of Environmental-Economic Accounts in Korean Agricultural Sector (Korea Rural Economic Institute)

Environmentally sound and sustainable development was the basic theme of the United Nations Conference on Environment and Development, held at Rio de Janeiro in June

1992. A consensus emerged in the Conference was to develop the link between environmental accounting and the system of national accounts(SNA). A number of countries have now prepared environmental -economic accounts, including the United States, Japan, Netherlands, United Kingdom, Norway, etc.

Many economists warn against using GDP(Gross Domestic Product) as a measure of welfare since GDP does not take into account household and voluntary work, stocks of natural assets, and externalities such as pollution affecting third parties. It has been suggested that environmental degradation and depletion of natural resources should be valued and subtracted from GDP as costs of production. This resultant 'green GDP' would then give a better measure for the true-value added through the economy.

The objectives of this study are i) to provide a conceptual basis of environmental-economic accounts that describe the interrelations between the natural environment and economy, ii)to compile physical accounting of agricultural environment in Korean agriculture, and iii)to attempt a pilot estimation of green GDP by commodities in Korean agricultural sector.

In the absence of international agreement on which method is the most appropriate to environmental-economic accounts, a system of integrated environmental and economic accounting(SEEA) proposed by the United Nations, National Accounting Matrix including Environmental Accounts(NAMEA) of Netherlands, and the pilot United Kingdom Environmental Accounts(UKENA) are reviewed in order to provide the conceptual basis of environmental-economic accounts.

The SEEA incorporates environmental accounts as satellite system to the SNA, while the NAMEA or UKENA deals with physical accounts of environment along with the traditional SNA. The former has its focus on the monetary valuation of the burden of economic activities on the environment, mainly on emissions. Thus flows and transformation within the natural environment are not covered in the SEEA. Unlike the SEEA, the NAMEA or UKENA covers physical aggregation of emissions according to their contribution(weight) to a limited number of environmental themes such as the greenhouse effects, eutrophication, acidification, etc.

In order to compile physical accounting of environment in Korean agricultural sector, five types of environmental themes - eutrophication, the greenhouse effects, soil degradation, acidification, and photochemical smog are covered. Each environmental theme indicator aggregates a few residuals from agricultural activities according to their contribution to the environmental problem. Agricultural emissions of the greenhouse effects consist methane(CH_4) from livestock and its manure, carbon dioxide(CO_2) from crops and livestock, and nitrous oxides(N_2O) from fertilizer. Agricultural emissions of eutrophication include nitrogen(N), phosphate(P), and biological oxygen demand(BOD) from fertilizer, agricultural chemicals, livestock manure, and other agricultural residuals. Agricultural emissions of soil degradation include heavy metals from fuel use and agricultural chemicals. Acidification, photochemical smog consists oxides of nitrogen(NOx) and sulphur dioxides(SO_2), NOx and HC, respectively, from fuel use in agricultural sector.

The greenhouse effect indicator in agricultural sector turned out to be negative, implying agricultural activities contribute diminishing greenhouse gases. This result mainly caused by the net effect that the positive effect of inhalation of CO_2 gas by crops exceeds the negative effects of emissions of CO_2, CH_4, and N_2O from crops, livestock, and fertilizer. However, size of the net effect has been slowly decreasing due to the decrement of crop acreage and increment of livestock heads.

Agricultural contribution to eutrophication had been increasing up until early 1990's. Since then, however, agricultural contribution to eutrophication has been decreasing, which may be mainly affected by the extension of livestock manure treatment system from early 1990's and partly by the decrease of fertilizer and chemical use. By agricultural commodities, livestock section is the main source of eutrophication, especially cows and swine.

Agricultural contribution to acidification and photochemical smog has been steadily increasing along with the rise of fuel use in agricultural sector. Agricultural contribution to soil degradation has been increasing except recent few years.

With the economic use of natural assets, natural assets change quantitatively (depletion) as well as qualitatively (degradation). The imputed environment costs are the costs of depletion and degradation of natural assets associated with the economic activities and should thus be excluded when the net value-added generated by economic activities is to

be obtained in full consideration of their impact on the environment.

Environmentally adjusted net domestic product or the eco domestic product (EDP) is the value-added obtained by subtracting the imputed environmental costs from net domestic product(NDP), where NDP is the value-added obtained by subtracting consumption of fixed capital from gross domestic product(GDP). (EDP is so called green GDP.)

This study limits the monetary valuation of the imputed environmental costs to the degradation costs reflecting the qualitative deterioration of natural environment by the residuals(emissions) of agricultural activities, since the valuation of quantitative depletion of natural assets needs prior information on the stocks and transformation of natural assets in agricultural sector which may be beyond this project. Thus green GDP estimated in this study is the NDP diminished by the degradation costs of natural assets only, which is not exactly the same concept as the EDP (rather bigger than EDP).

Degradation is valued at the "maintenance costs" of preventing or treating the emissions of pollutants and wastes, using the best available techniques.

The imputed environmental degradation costs incurred by agricultural activities has been steadily increasing, except recent two years. Overall eutrophication contributes the largest portion of the total agricultural environmental degradation costs, whereas soil degradation by heavy metals, acidification and photochemical smog contribute small portion of the total agricultural environmental degradation costs. On the other hand, the greenhouse effect has brought negative environmental costs, that is, net environmental benefits. This mainly resulted from the positive effect of inhalation of CO_2 gas by crops which surpassed the negative effects of emissions of CO_2, CH_4, and N_2O by crops, livestock, and fertilizer.

The estimated EDP or green GDP in Korean agricultural sector, here defined as the NDP subtracted the environmental degradation cost only, has been decreasing slowly over the last two decades. The ratio of the estimated EDP to the NDP in agricultural sector has been decreasing 100.6% to 99.5% in the period 1980 to 1997.

During the same period, the ratio of EDP to NDP in crop section has been decreasing 102.2% to 104.4%, while livestock section has been increasing 82.4% to 86.1%. Overall crop section has both positive and negative environmental effects, furthermore the positive effect

is rather bigger than the negative effects, while livestock section has only negative environmental effects.

In the absence of previous studies on environmental-economic accounts in agricultural sector and under the lack of data compilation, this study has some limitations. Firstly, this study covers only degradation of natural environment caused by agricultural activities and does not take into account quantitative depletion of natural assets, which may be the future topic in this field. Secondly, multi-functional (positive) effects of agriculture, such as flood control and amenity, are not considered in the environmental effects of agriculture because these effects are usually valued at non-market prices which is not consistent with the market price valuation.

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C. Korea Environmental Economic Accounting (Korea National Statistical Office)

1. Background and Purpose of Korea Environmental Accounting

- Statistics and accounting provide quantiative models of the actual situation, their task is not to set standards/political targets. Hence, there is a need for a close co-operation between statistics, scientific research and the political setting of standards. Futhermore, there are two working areas in the close neighbourhood of accounting which must well co-ordinated with accounting activities and frameworks : basic statistics and indicators.

- Basic statistics, indicators and accounting provide information for different utilisations. Their quality profils (accuracy, actuality and level of detail) have to be different, accordingly. Separated user groups and user needs require a menu of statistical data which observe one specific item from selected angles

- Nevertheless, accounting can and should be used as a tool to improve consistency and performance of the production and analysis of statistical figures in general.

- Keeping these conditions in mind, it seems to be meaningful to distinguish between a narrow set of environmental accounts, being in line with the main concepts and formal rules of national accounting

1.1. Methodological Concept

- Korea Environmental Economic Accounting(KEEA) approaches the statistical coverage of changes in "natural capital" due to economic activities. The idea is to calulate depreciation for nature as it is done for produced assets

- Environmental Economic Accounting is to show in statistical terms which natural resources are used, consumed, depleted, or destroyed by the economic activities (production/consumption) for a period, and what expenditure is done or nessary for countermeasures. All this is based on the process of creating value added as reflected in economic statistics.

- The development of environmental accounting is a long-term project. This is why priorities have to be identified for its establishment and further development.

- The concept as a future work by the Korea National Statistical Office(KNSO) includes five subject areas which are structured in accordance with the pressure-state-response approach, which is becoming established internationally, and allow the overall concept to be developed on a step-by-step basis:

1) Material and energy flow accounts (pressure)
2) Use of land space (pressure)
3) Indicators for the state of the environment (state)
4) Environmental protection measures (response)
5) Imputed avoidance costs relating to compliance with standards/depreciation (response)

1.2. Material and energy flow accounting of KNSO

- In the last several years there has been a lot of interest generated in OECD countries in the development and use of material flow models as one way of looking at the state of the environment. The material flow models are analogs to economic flow models. Economic flow are measured in dollars where material flows are measured in tons of material.

- In the material flow model, tons of material provides a natural for gauging the physical flows inherent in production and consumption activities which include the flow of natural resources, pollutants, and wastes created by industrial economy.

- As a methodolgical part of KEEA, the material and energy flow analyses use the material sciences as a background to enlarge the material flow concept of the economy in to the " industrial metabolism".

- Characteristics of the concept are ;

· Nature is taken into account by putting an additional asset/stock account both on the input and the output side of the system of national accounts;

· The border between the economy and nature is defined explicitly: raw materials are extracted from the nature and residues are discharged into the nature

· The material and energy flows within the system borders (e.g. domestic economy,

activities of production and consumption, technical process) are calculated by taking the law of conservation of material and energy into account

- Within the system borderlines raw materials(material and energy) will be transformed into products or groups of products and environmental burdens e.g. air emissions, waste and wastewater. Depending on the system borderlines, economic activities can be interpreted as a technical network aiming at the production of goods and services. In relation to KEEA, it is relvant to cover the material and energy flows caused by activities of the domestic economy

<Table 1> Summary of the Pilot Compilation of SEEA in Korea

(unit : billion Won)

Supply/use	1992	1991	1990	1989	1988	1987	1986	1985
Total Output (T.O.)	531,469.6	481,215.3	411,321.6	348,111.6	314,915.6	270,472.6	228,341.4	197,870.3
of which :								
T. O. for Ext. Env. Prot.	3,634.9	2,976.0	2,235.4	1,616.2	1,524.5	1,045.9	841.1	913.2
Intermediate Consumption (I.C)	291,077.4	265,480.5	231,782.5	198,946.6	181,781.7	158,342.2	132,605.0	115807.9
of which :								
I.C. for External Env. Prot.	1,592.8	1,251.8	986.3	690.6	687.8	487.4	375.6	394.3
I.C. for Internal Env. Prot	974.4	784.1	559.5	504.8	393.7	261.9	221.9	163.3
Gross Value Added (G.V.A)	240,392.2	215,734.8	179,539.1	149,165.0	133,133.9	112,130.4	95,736.4	82,062.4
of which :								
G. V. A for Env. Prot.	2,042.1	1,624.2	1,249.1	925.6	836.7	588.5	465.5	518.9
Consumption of Fixed Capital	23,925.9	21,590.1	18,587.0	15,687.7	14,051.8	11,590.7	9,466.4	8205.6
Net Value Added (N.V.A)	216,466.3	194,144.7	160,952.1	133,477.3	119,082.2	100,539.7	86,270.0	73856.3
Compensation of Employees	113,876.0	101,360.4	81,740.1	66,367.9	55,714.0	45,386.5	37,726.4	32904.2
Operating Surplus	75,247.8	69,177.5	58,648.9	50,977.6	48,547.2	42,605.3	37,671.1	31545.4
of which :								
Emission Charges	10.4	21.6	10.2	103.9	9.2	3.0	14.4	1.7
Environmental Subsides	24.2	34.9	16.5	10.7	11.4	9.8	17.5	18.3
Income from Rivers and Streams	94.0	91.3	72.5	56.9	47.1	37.9	65.7	101.9
Non-refunded Deposit	27.1			n.a	n.a	n.a	n.a	n.a
Indirect Taxed	27,342.4	23,606.9	20,562.8	16,131.8	14,820.8	12,547.6	10,872.5	9407.3
Statistical Discrepancy								
Between G.V.A. and Expenditures	-988.2	-82.6	-384.3	295.4	589.2	133.3	196.9	401.1
Natural Resources Depletion (Mineral Resource)	123.5	147.1	210.6	229.2	267.1	268.8	277.1	224.3
Environmental Degradation	4,337.8	3,834.3	3,449.8	2,876.1	2,516.8	2,069.6	2,063.1	1939.3
of which :								
Water pollution	32.3	27.3	48.9	16.0	17.9	13.6	11.3	12.7
Air pollution	4,305.4	3,830.6	3,400.9	2,860.2	2,498.9	2,056.0	2,051.8	1926.5
Shirt of Environmental Cost by Households	1,261.8	1,191.3	1,042.5	893.4	791.6	742.3	884.2	832.6
of which :								
Air pollution	530.4	500.3	462.0	452.2	399.4	388.4	376.6	345.6
Water pollution	709.7	667.2	573.1	425.7	381.3	345.0	500.5	466.8
Domestic wastes	21.6	23.9	7.3	15.5	11.0	8.9	7.1	20.2
Environmentally Adjusted Value-added(E.V.A)	210,743.3	188,972.0	156,249.3	129,478.6	115,506.4	97,459.0	83,045.6	70,800.7

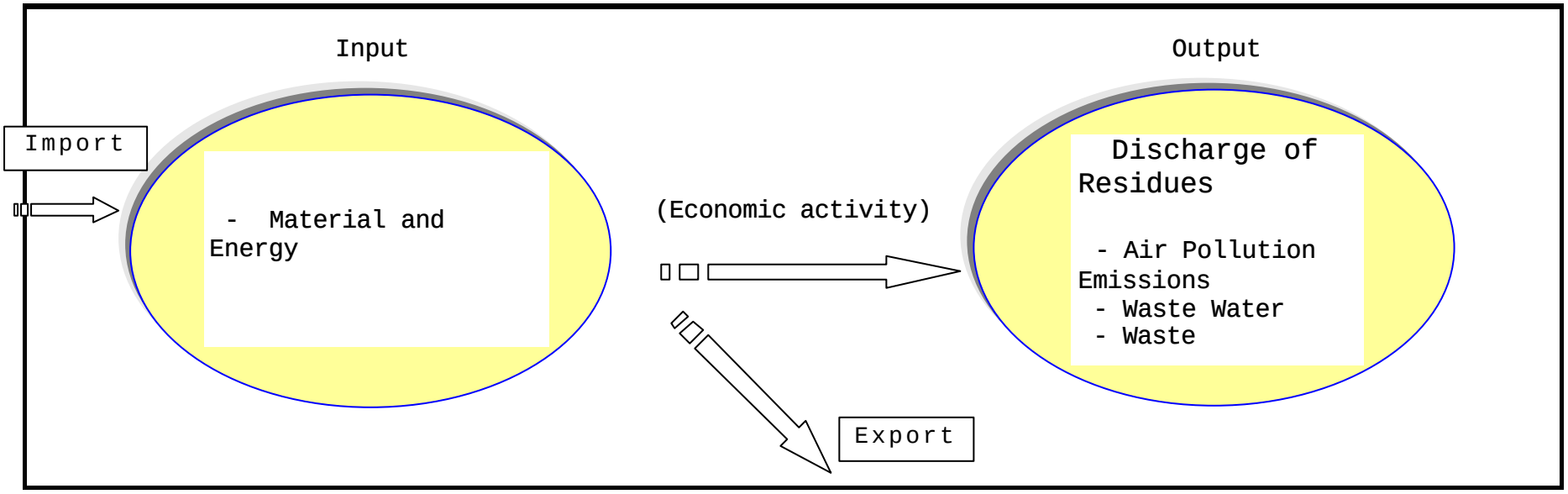
<Table 2> Analytical Measures by Current Prices

	1992	1991	1990	1989	1988	1987	1986	1985
1. Gross output	531,469.60	481,515.30	411,321.60	348,111.60	314,915.60	270,472.60	228,341.40	197,870.30
2. GVA	240,392.20	215,734.80	179,539.10	149,165.00	133,133.90	112,130.40	95,736.40	82,062.4
growth rate (%)	11.43	20.16	20.36	12.04	18.73	17.12	16.66	
3. NVA	216,466.30	194,144.70	160,952.10	133,477.30	119,082.20	100,539.70	86,270.00	73,856.80
growth rate (%)	10.47	20.62	20.58	12.09	18.44	16.54	16.81	
4. 1. Nat. Res. Depletion (A)	123.47	147.10	210.56	229.21	267.14	268.83	277.14	224.27
4. 2. Env. Degradation (B)	4,337.78	3,834.30	3,449.79	2,876.06	2,516.85	2,069.60	2,063.08	1,939.3
4. 3 Shift of env. cost(C)	1,261.78	1,191.29	1,042.46	893.44	791.64	742.29	884.16	832.62
4. 4. A+B+C	5,723.03	5,172.69	4,702.81	3,998.71	3,575.63	3,080.72	3,224.38	2,996.15
5. EVAI (3-4.1-4. 2)	216,342.83	193,997.60	160,741.54	133,248.09	118,815.06	100,270.87	85,992.86	73,632.53
growth rate (%)	10.49	20.69	20.63	12.15	18.49	16.60	16.79	
6. EVA II (3-4.1)	212,005.05	190,163.30	157,291.75	130,372.03	116,298.21	98,201.27	83,929.78	71,693.27
growth rate (%)	10.43	20.90	20.65	12.10	18.43	17.00	17.07	
7. EVA III (3-4. 1-4. 2-4. 3)	210,743.27	188,972.01	156,249.29	129,478.59	115,506.57	97,458.98	83,045.62	70,860.65
growth rate (%)	10.46	20.94	20.68	12.10	18.52	17.36	17.20	
8. GVA/Gross output (%)	45.23	44.80	43.65	42.85	42.28	41.46	41.93	41.47
9. EVA I/Gross output (%)	40.33	40.29	39.08	38.28	37.73	37.07	37.66	37.214
10. EVA II/Gross output (%)	39.51	39.49	38.24	37.45	36.93	36.31	36.76	36.23
11. EVA III/Gross output (%)	39.28	39.25	37.99	37.19	36.68	36.03	36.37	35.81
12. EVA III/NDP (%)	97.33	97.34	97.08	97.00	97.00	96.94	96.26	95.94
13.1. Prod. +Non-prod. Stock	3,398,857.41	2,866,159.49	2,705,404.34	2,211,531.55	1,308,026.33	1,037,109.51	886,730.31	748,063.78
13.2 produced stock	778,515.10	713,465.20	650,652.50	526,542.00	464,336.90	402,802.00	350,065.90	309,242.40
13.3 Non-produced stock	2,620,342.31	2,152,694.29	2,054.84	1,684,989.55	843,689.43	634,307.51	536,664.41	438,821.38
14. NVA/ prod. Stock	0.28	.0.27	0.25	0.25	0.26	0.25	0.25	0.24
15. EVA I/ prod. +Non-prod. S.	0.06	0.07	0.06	0.06	0.09	0.10	0.10	0.10

<Table 3> Analytical Measures by 1990 Price

	1992	1991	1990	1989	1988	1987	1986	1985
1. GVA	205,860.30	195,435.60	179,539.10	163,950.30	154,110.00	138,499.20	124,193.70	111,329.80
growth rate (%)	5.28	8.91	9.51	6.39	11.27	11.52	11.55	
2. NVA	185,172.20	176,174.80	160,952.10	146,839.60	137,986.30	124,584.30	112,330.50	100,759.50
growth rate (%)	5.11	9.46	9.61	6.42	10.76	10.91	11.48	
3.1. Nat. Res. Depletion (A)	116.27	139.57	210.56	231.93	278.28	290.53	317.09	271.19
3.2. Env. degradation (B)	4,108.66	3,716.77	3,449.79	2,954.38	2,646.15	2,238.90	2,225.61	2,072.86
3.3. Shift of env. cost (C)	1,178.48	1,126.45	1,042.46	927.30	836.28	803.46	962.36	894.98
3.4. B+C	5,287.14	4,843.22	4,492.12	3,881.68	3,482.43	3,042.36	3,187.97	2,967.84
3.5. A+B+C	5,403.41	4,982.79	4,702.30	4,113.61	3,760.71	3,332.89	3,505.06	3,239.03
4. EVA I	185,055.93	176,035.23	160,741.54	146,607.67	137,708.02	124,293.77	112,013.41	100,488.31
growth rate (%)	5.12	9.51	9.64	6.46	10.79	10.96	11.47	
5. EVA II	180,947.27	172,318.46	157,291.75	143,653.29	135,061.87	122,054.87	109,787.80	98,415.45
growth rate (%)	5.01	9.55	9.49	6.39	10.66	11.17	11.56	
6. EVA III	179,768.79	171,192.01	156,249.29	147,275.99	134,225.59	121,251.41	108,825.44	97,520.47
growth rate (%)	5.01	9.56	9.48	6.33	10.70	11.42	11.59	
7. EVA I/NVA (%)	99.94	99.92	99.87	99.84	99.80	99.77	99.72	99.73
8. EVA II/NVA (%)	97.72	97.81	97.73	97.83	97.88	97.97	97.74	97.67
9. EVA III/NVA (%)	97.08	97.17	97.08	97.20	97.27	97.32	96.88	96.79
10.1. B/NVA (%)	2.22	2.11	2.14	2.01	1.92	1.80	1.98	2.06
10.2. B+C/NVA (%)	2.76	2.75	2.79	2.64	2.52	2.44	2.84	2.95
10.3. A+B+C/NVA (%)	2.92	2.83	2.92	2.80	2.73	2.68	3.12	3.21

Material and Energy Flow through the domestic economy



? Basic Statistics
1. Economic Statistics(Korea National Statistics, Bank of Korea)
2. Environment Statistics(Ministry of Industry and Resources, Ministry of Environment)

Methodological Concept:
Environmental Economic Accounting of Korea