Environmental accounting

A key to sustainable development

Greening the national accounts is necessary specially in the developing countries like Bangladesh both for economic and environmental policy formulation. Bangladesh is centered generally on natural resource based economy and characterized by high population growth and pressure on natural resources.

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THE concept that every nation might acknowledge the economic role of the environment in its income accounts is neither a hasty shift nor a quick practice; it has been under discussion globally since the 1960s. Unfortunately in Bangladesh the contribution of the environmental goods and services in the national economy has been ignored for a long time. In the changing circumstances of global climate it is high time that we wake up and recognize the contribution of the environment to sustain our economy.

For a long time, conventional indicators like Gross Domestic Product (GDP), Gross National Product (GNP) and Net Domestic Product (NDP) were used around the world to construct national accounts and as a measure of the economic progress of a country and standard of living. However, these traditional measures of economic activity failed to be responsive because of the fact that economy cannot operate without the support of the natural environment. National accounts allow depreciation allowance for manufactured assets, while the contributions of environmental assets to economy are not valued and hence no depreciation allowance is made for these assets. Thus, in Bangladesh, omission of the degradation and depletion of the country's natural capital will lead to over estimation of the national income figures.

Why we will change

Governments all over the world develop economic data systems familiar as System of National Accounts (SNA) to calculate macroeconomic indicators like GDP, GNP, savings rates, and trade balance figures, using a framework developed, supported, and disseminated by the United Nations Statistical Division (UNSTAT). The time to reform the SNA has arisen because the accounts as now defined do not include the full economic value of environmental resources or the economic value of natural ecosystem services, which they play in productive economic activity. Some of the elements missing are:

Environmental expenditures: Environmental expenditures like the cost of the pollution control equipment purchased by factories, catalytic converters installed in cars, medical expenses for diseases caused by pollution, high-tech treatment of drinking water due to excessive water pollution, cleaning up of rivers etc. are misleadingly reflected in the traditional SNA. These expenditures are already included in the income accounts, along with all other intermediate or final consumption. As a result, the expenditures incurred in restoring the environmental quality are accounted as increases in national income and product, and therefore all expenditures are shown as increases in GDP.

Environmental goods and services: The traditional measures of SNA are focused mainly on goods and services that are bought and sold in markets and ignore the non-marketed services provided by nature. The environment provides many goods which are not sold but which are nevertheless of value. For example, fuel wood and building materials consumed by forest dwellers, fish and medicinal plants consumed by the villagers. Similarly, the environment provides many unsold services, such as flood control, protection of soil erosion and watershed by forests, crop fertilization by insects, carbon sequestration and the waste assimilative capacity of the environment, which are not recorded in the national accounts.

Exhaustion of natural assets: The SNA conflictingly treats the man-made and natural assets, because national income accounts treat the depreciation of manufactured capital and natural capital differently. Physical capital, a building or a machine, for instance, is depreciated in accordance with conventional business accounting principles to adjust against the income generated by this particular asset. Natural capital is not accounted so rather all the consumption of natural capital is treated as income. Thus the accounts of a country that harvests its forests unsustainably will show high and misleading income for a few years and will not reflect the destruction of the productive forest asset. Again, when forested land use are transferred to non-forested land use, the national accounts record only the expenditure incurred in clear-felling of the forests, and do not account the loss incurred to society as a result of this relocation.

Hence, this outmoded system of accounting infers that the environmental assets like air, water etc. may be despoiled due to economic activity, whereas corresponding adjustment need not be made in the accounts resulting in a lessening of social welfare. Further, overlooking the contribution of non-market value of environmental goods and services as well as natural resource depletion will result in twisting the current well-being and distorts the economy's production and substitution possibilities.

What other countries are doing

Bureaucrats, researchers and other protagonists of some twenty-five countries have commenced and been doing environmental accounting activities over the past few decades. One of the first countries to build environmental accounts is Norway, which began collecting data on energy sources, fisheries, forests, and minerals in the 1970s to address resource scarcity. They use these data as an input into a macro-economic model with which they explore the environmental and economic feasibility of different growth strategies. The Netherlands routinely constructs the "National Accounting Matrix Including Environmental Accounts (NAMEA)", an extended form of the national accounts input-output matrix, which tracks pollution emissions by economic sector. More recently, a number of resource-dependent developing countries have become interested in measuring depreciation of their natural assets and adjusting their GDPs environmentally. Indonesia was the first country for which forest depletion was calculated and integrated into a "green GDP." Chile's Central Bank undertook a project to develop environmental accounts focusing on the forest and minerals sectors. Costa Rica undertook a forest depletion exercise similar to that of Indonesia. Namibia began work on resource accounts in 1994, addressing such questions as whether the government has been able to capture rents from the minerals and fisheries sectors, how to allocate scarce water supplies, and how rangeland degradation affects the value of livestock.

The Philippines has been working on environmental accounts since 1993. Their work applies a method, which treats the environment as a productive sector in the economy, and integrates the valuation of pollution impacts, non-marketed goods and services, and other economic aspects of the environment into the conventional accounts. It is widely accepted that Bangladesh will be the hardest hit of the global warming induced natural resource depletion, but still our policy makers are not aware and active to construct a true natural resource portfolio similar to those developing countries cited here.

How we can change

A number of ways has been developed, for environmental accounting, which diverges from one another in different aspects, remarkably depending upon the magnitude of the speculation required, the impartiality of the data, the aptitude to associate different kinds of environmental impacts, and the brands of policy drives to which they may be realistic. Here are some of the methods currently in use:

Natural resource accounts: We can expand the conventional economic accounts with physical statistics about the natural environment and its status. These basically embrace data on stocks of natural resources and changes in them caused by either natural routes or human use. Such accounts may characteristically cover physical statistics of agricultural land, fisheries, forests, minerals and petroleum, and water. For example the relevant ministry can provide portfolio on physical indicators for forests like the area under dense forests, open forests, volume of stock of timber, area disturbed by fire etc. Such type of information can also be arranged in conventional input-output type of matrices, like the Netherlands has used.

Emissions accounting: This system may identify pollutants emitted from different economic sector of Bangladesh. Eurostat, the statistical arm of the European Union, is ministering EU members to put on this approach as part of its environmental accounting program. In case of Bangladesh, data can also be separated by type of emitted pollutants to understand the impact on domestic, transborder, or global environments. If pollutant emissions are valued in monetary terms, these values can be also be used to determine the economic cost of avoiding environmental degradation, as well as to compare costs and benefits of environmental protection.

Disaggregation of conventional national accounts: Sometime data in the conventional accounts are taken apart to detect expenditures specifically related to the environment, such as those acquired to prevent or mitigate harm, to buy and install protection equipment, or to pay for charges and subsidies. Over time, revelation of these data makes it conceivable to observe links between changes in environmental policy and costs of environmental protection.

Environmentally idyllic Bengal.

Value of non-marketed environmental goods and services: Non-marketed environmental goods and services, such as the benefits of an unpolluted lake or a scenic panorama, are ignored in the traditional SNA, so they can be incorporated. The value of these items is crucial to assess trade offs between economic and environmental goals.

Green GDP: We can go for a green GDP or some other economic index to replace the conventional GDP or NDP. This green GDP can be accomplished by subtracting pollution expenditures from the conventional GDP or adding the factors like negative costs of urbanization etc. We can also provide depletion for natural assets like forests, mineral stocks, fish stocks and soils in order to ensure equal treatment of natural capital in the computation of net income.

Concluding remarks

Greening the national accounts is necessary specially in the developing countries like Bangladesh both for economic and environmental policy formulation. Bangladesh is centered generally on natural resource based economy and characterized by high population growth and pressure on natural resources. Thus, in Bangladesh, oversight or the missuse and exhaustion of the country's natural capital will lead to extended valuation of the national income figures. This gives a false illusion that our economy is growing when in fact natural wealth the future wealth) is declining. By having some green indicators like environment adjusted domestic product (EDP), green GDP, our policies can be designed to enhance economic growth without extensive depletion of natural resources.

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AQUATIC ECOSYSTEM

Assessing arsenic and cadmium susceptibility

Surface water reserves are getting polluted due to discharges of unmanaged industrial effluents and urban waste water. So this sector is in a potential risk of being severely affected by various pollutants' toxicity but no proper attention has yet been paid to understand the toxic effects of arsenic and cadmium especially at the molecular level on fish and other aquatic organisms.

Aquatic eco-system.

MAHDI HASAN

BANGLADESH is a developing country where fisheries and aquaculture remain very important as a source to supplement animal origin nutrition, employment generation, improving environmental condition and earning revenue in foreign exchange. Environmental pollution now-a-days poses a great threat to human beings as well as to animal kingdom over the world. Water resource, being the prominent component of the environment, is getting polluted over the decades. Contamination of water environment with various pollutants has increased considerably in resent years in many parts of the world. Various heavy metal ions such as As, Cd, Zn, Cu, Cr, Ni, Pb, Hg etc. are entering into environment through various processes.

Arsenic is a well-known chemical element that has the symbol As and atomic number 33. Arsenic was first documented by Albertus Magnus in 1250 (Emsley and John, 2001). Its atomic mass is 74.92. Arsenic is a metalloid that is prevalent in the environment, occurring both naturally and as a consequence of pollution. Arsenic is ubiquitous in the biosphere and occurs naturally in both organic and inorganic forms in water, food, soil, dust, wood and other materials. The most important inorganic arsenic compounds are arsenic trioxide, sodium arsenite, arsenic trichloride, arsenic acid and arsenites (trivalent forms) and lead and calcium arsenates (pentavalent forms).

Inorganic arsenic is more toxic than organic and the trivalent forms are more toxic than pentavalents. Common organic arsenic compounds are arsanilic acid, methylarsonic acid (MMA), dimethylarsinic acid (DMA), and arsenobetaine (Friberg et al. 1986; Lau et al. 1987). In the nature, arsenic can also be found to a small extent in elemental form. Arsenic is one of the toxic environmental pollutants which has recently attracted attention because of its chronic and epidemic effects on human health.

Cadmium(Cd) is a silver-white, blue-tinged, lustrous metal that melts at 321°C and boils at 765°C. This divalent element has an atomic weight of 112.4 and an atomic number of 48. It is insoluble in water, although its chloride and sulphate salts are freely soluble (Windholz, 1976). The availability of Cd to living organisms from their immediate physical and chemical environs depends on numerous factors, including adsorption and desorption rates of cadmium from terrigenous materials, pH, Eh, chemical speciation, and many other modifiers. The few selected examples that follow demonstrate the complex behaviour of Cd in freshwater systems. A substantial toxicological data base for cadmium and freshwater biota demonstrates that ambient cadmium water concentrations exceeding 10 ppb are associated with high mortality, reduced growth, inhibited reproduction, and other adverse effects. In case of fish Cd accumulation is higher in liver, kidneys and other organs but low in flesh. Cadmium encourages kidney disease, high blood pressure to man and also may lead to kidney and lung damage. Resistance to cadmium is higher in marine than in freshwater organisms; survival usually is higher at lower temperatures and higher salinities for any given level of cadmium in water.

Cadmium contamination of the environment is especially severe in the vicinity of smelters and urban industrialized areas. There is no evidence that cadmium, a relatively rare heavy metal, is biologically essential or beneficial; on the contrary, cadmium is a known teratogen and carcinogen, a probable mutagen, and has been implicated as the cause of severe deleterious effects on fish and wildlife. The concentrations of 0.80 to 9.9 µg/L in water is lethal to several species of aquatic insects, crustaceans, and teleosts and concentrations of 0.70 to 570 µg/L is associated with sublethal effects such as decreased growth, inhibited reproduction and population alterations.

Fish are ideal indicator of heavy metal contamination in aquatic systems because they abound different trophic levels in aquatic ecosystem. Some heavy metals have accumulation effect in fish and poses potential risks of heavy metal contamination. Culture of fish and other aquatic organisms that is known as aquaculture, depends completely on the respective qualities of water, i.e. qualities of the aquatic environment. Suitable water quality parameters are prerequisite for a congenial aquatic environment and for the growth of adequate fish food organisms. In Bangladesh, elaborate data is available for arsenic only on tube-well water, very little work has been done on the presence of arsenic, cadmium and others heavy metals in freshwater fish, livestock and livestock products, as well as in human and animal food chains.

Many scientists suggest that arsenic is not a problem for human alone but it may accumulate in animal tissues and animal products (Calvert and Smith, 1980; Awal, 2007), thus human exposure may occur through their food chain. Many scientists from different countries are working on the arsenic problem in Bangladesh, especially on ground water. But effects of heavy metals and nanoparticles on aquatic and terrestrial organisms are yet to acquire research imperative for the human health concern.

The bioaccumulation of arsenic and cadmium compounds were analysed in gill, muscle, intestine and eye in three major carps viz. grass carp, Ctenopharyngodon idella (herbivore), catla , Catla catla (planktivore); and mrigal; Cirrhinus cirrhosus (debris feeder) collected from10 different ponds at Chaugachha Upazila in Jessore district. The experiment emphasized on arsenic and cadmium concentrations in pond water, depth of groundwater which was used for fish culture and trophic position of species. The digestion of samples and chemical analysis were carried out by using Atomic Absorption Spectrophotometer at Arsenic Detection and Mitigation Laboratory (ADM Lab), Department of Pharmacology and Professor Mohammad Hossain Central Laboratory Bhaban, Bangladesh Agricultural University (BAU).

The arsenic and cadmium concentrations in pond the water ranged from 0.004±0.001 to 0.013±0.002 and 0.012±0.002 to 0.015±0.002 ppm respectively. The mean concentrations of arsenic and cadmium were observed 0.006±0.001 and 0.013±0.002 ppm. The highest concentrations of arsenic and cadmium were found in 61.0 m and 46.0 m depth of underground water respectively. Water quality parameters were monitored and found suitable except PH and total alkalinity. The order of heavy metal (Arsenic) concentrations were found in the gill, muscle, intestine and eye of the three Indian major carps viz. grass carp: intestine> muscle> eye> gill; 0.031±0.003, 0.004±0.001, 0.003±0.002, 0.003±0.001 catla: intestine> muscle> gill, eye; 0.030±0.003, 0.004±0.002, 0.003±0.001, 0.003±0.001 and mrigal: intestine> gill > eye > muscle; 0.023±0.002, 0.006±0.002, 0.004±0.001, 0.003±0.001 µg/g (wet weight) respectively. The order of bioaccumulation in four tissues of three fishes was Cd> As. The mean concentrations of arsenic and cadmium in different tissues of three fishes were significantly different (Tukey tests, $p<0.005$). The highest accumulation of arsenic was found in intestine of three species compared to the rest of the tissues which was below the maximum permissible level (WHO, 2001). The mean concentrations of cadmium accumulated on fish tissues were much higher than that for human acceptable range (WHO, 2001).

In fisheries sector, ground water is readily used in various stages such as in hatchery operation and in brackish water aquaculture. Furthermore surface water reserves are also getting polluted due to discharges of unmanaged industrial effluents and urban waste water. So this sector is in a potential risk of being severely affected by various pollutants' toxicity but no proper attention has yet been paid to understand the toxic effects of arsenic and cadmium especially at the molecular level on fish and other aquatic organisms in Bangladesh. Therefore, further research is imperative to develop biomarkers based analysis by applying modern genomic techniques and to investigate incorporation and intracellular localization of heavy metals and nanoparticles in aquatic living organisms.

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