Environmental Accounting and Sustainable Development- with Specific Attention to the Air[1]

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ABSTRACT

Environmental adverse consequences of economic development and ignoring social and environmental developments, leads to the reaction of international organizations and attends their attention to Sustainable Development concept, which is a simultaneous development in all three aspects of economic, social and environmental. To review the status and completion progress of sustainable development, social accounting was introduced in 1970, and subsequently in later it has been expanded to environmental accounting. In Iran, Sustainable development has been highlighted by signing the Kyoto Protocol in 1997; but unfortunately after that signature, has not done any practical action. Lack of environmental and sustainable accounting, is a huge vacuum in accounting and sustainable development, which is one the reasons of not adverting of companies to the environment. This study discusses practical environmental accounting in Iran and determines cost derivers base on sustainable development view. It tries to provide drivers that both satisfy information needs of decision makers and financial statements users, and reflect the correct information of the reality in the view of environmental experts and accountants. This study just concentrates on the sustainable indexes of the air, because of extensiveness of sustainable development in environmental dimension. First, we recognized environmental development indexes of the air by Driver-State-Response model, and examine these indexes between 4 groups of environmental experts, accountants, municipality managers and citizens, using a questionnaire to collect required data; then, categorized Tehran municipality activities by the confirmed indexes and determined cost pools, so that related cost drivers can be identified. Lastly we allocated costs by related cost drives.

KEY WORDS: environmental accounting, sustainable development, sustainable development indexes, air pollution

INTRODUCTION

Sustainable development is fulfilling the needs of current generations without compromising future generations (Brantland Commission 1987); therefore sustainable development meets all aspects of development and grows simultaneously. Different dimensions of sustainable development can be classified in three groups: economic, social and environmental dimensions. In this research, sustainable development indexes is provided to prepare quantitative reporting and practical way of environmental accounting running in the municipality, which satisfy information needs of decision makers and stakeholders of sustainable development, and have pervasive effects on the people's activities in environmental protection. First we prepared the sustainable development indexes, which are compatible with economical, social and environmental zone of Iran, by Driver-State-Response model; then these indexes were matched with information users' needs. According to environmental accounting cost categorization, the approved indexes were categorized in two groups, the indexes of preventing pollution, and the indexes of removing pollution. Categorized indexes were put in cost pools which are determined according to information need priorities and prepare suitable cost diver for them. At the end municipality activities sit in related cost pool. The progress of evolution of

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environmental accounting and how to integrate environmental accounting and sustainable development is reviewed. Then in Theoretical research framework, the theoretical frameworks of index making are introduced and the Driver- State¬ Response model is discussed in detail. The methodology of research presented in the research methods and the steps that passed for achieving goals are discussed.

The history of research

Environmental accounting can be reviewed in two areas, micro and macro. In macro area, System of Integrated Environmental and Economic Accounting (SEEA) is prepared to relating economical and environmental statistics; and environmental accounting information is compatible with national accounts, so environmental information can be compared directly with popular economical indexes, such as Gross Domestic Product (GDP), inflation and investment rates. In micro area, have done some exercise in some countries, such as Canada and Japan. In some published regulations and principals, environmental cost recategorized to prepare useful information for decision makers. For instance Japan published a guideline in 2005 which divide environmental accounting in preventing pollution costs and costs of removing pollution; revenues were divided in real revenues and estimated revenues.

Environmental Accounting was introduced in 1970 with the raising of social accounting, and was being one of the subsidiaries of social accounting. According to the Mathews classification in 1997, the process of completion of environmental accounting before 1997 is categorized in three periods, in the first period, which is 1970 to 1980, because of the lack of theoretical basis and the voluntarily environmental and social disclosure, most of the studies were empirical researches and there were no consistency in organizations' disclosure.

In the second period which is 1981 to 1990, environmental accounting was considered more than before, and normative modeling in environmental accounting was begun in this period, the researches after 1981, were changed both direction and complication. In this period while the environmental information is still associated with social information, researchers were examining the extension of disclosure of social information (Mathews, 1997). Of normative views, one of the features of the period after 1980, as in previous periods, is the lack of modeling (Mathews, 1997). In the third period, environmental accounting overcomes the social accounting; Gary (1995) also noted the fading of social accounting in 1995. A number of recent researches are studied on the effect of environmental and social information (Ronald P. Guidry and Dennis M. Patten, 2010). For example, Chan and Milne (1999), in a research about the effect of the disclosing negative or positive environmental information on the decision of accountants and financial analyzers, found that disclosing negative information increase the amount of investing, but positive information have so little impact.

Holm and Rikhardsson (2008) found that the release of positive environmental performance changes investing in the various investment positions. Milne and Patten (2002) gave some evidence for neutralizing the negative environmental performance data by disclosing positive one. Milne and Patten (1999) disclose more social information than environmental one, and found that environmental information have little impact of investment decisions. Guidry and Patten (2010) concluded that the reaction rate and the quality of reports have direct relationship; it means that by enhancing the quality of reports, the amount of positive or negative reaction increases.

After 1995, measuring environmental performance became one of the environmental accounting duties, and then by entering environmental management accounting, environmental accounting was more practical and useable and found more important role in managers' decisions. since 1990, some studies initiated connecting environmental accounting to sustainable development (Lamberton, 2005); the Brantland commission by discussing sustainable development in 1995 and needs to have a tool for measuring environmental costs and benefits increase the speed of the development of environmental accounting, environmental management accounting and entrance of sustainable development concept in these areas.

Many factors affect promoting sustainable development thinking; some effective and important factors are increasing hunger and poverty in the world, and disturbing degradation of the environment and natural resource because of usage of technology (Zahedi, 1998). First reaction to environmental pollution and sustainable development, begun in late 1960s; and discussed the quality of environment in front of economical growth. Based on this, in June 1971 in Switzerland, a board of development and environment experts gathered and argued the emergency needs of developing. Recommendations of the committee are known as the Founex recommendations, and were discussed in the next seminars. The term sustainable development was used for environment and development, in the early

years of the 1970s. Applying this term was more pervasive in academic literature after the Rio conference in 1992 (Zarrabi, A and M. Azan, 2001). But the major role in explaining and attending to sustainable development relates to two conferences and one commission; Environmental Conference of Stockholm in 1972 AD, Rio Conference in 1992 which is known as Agenda 21 and Global Environment and Development Commission in 1987 as Brantland Commission. Gray is attributed with much of the conceptual development of sustainability accounting. Gray (1993) identifies three different methods of sustainability accounting: Sustainable cost, Natural capital inventory accounting, and Input–output analysis.

Sustainability costs are imaginary costs to restore the land to a condition that was before the impact of organization; in the other words, it is the amount of money that the organization need to spend at the end of an accounting period for returning the environmental situation the same as the beginning of the accounting period (Gray, 1994).

To achieve sustainable profits or losses, sustainable development costs are deducted from earnings. The practical problem of this method is measuring external costs such as air pollution. Gray (1992) recognized abundant risks of natural capital by a cost driver framework that is the same as traditional accounting (cooper, 1992; Hines, 1991; Lehman, 1996; Maunders & Burritt, 1991; Lamberton 2005).

Natural capital inventory accounting involves the recording of stocks of natural capital over time, with changes in stock levels used as an indicator of the (declining) quality of the natural environment (Lamberton 2005). Various types of natural capital stocks are distinguished to enable the recording, monitoring and reporting of depletions or enhancements within distinct categories (Gray, 1994). Gray suggests four categories of natural capital: Critical, for example, the ozone layer, tropical hardwood, biodiversity; Non-renewable/non-substitutable, for example, oil, petroleum and mineral products; Non-renewable/substitutable, for example, waste disposal, energy usage, and Renewable, for example, plantation timber, fisheries.

Input–output analysis accounts for the physical flow of materials and energy inputs and product and waste outputs in physical units. It aims to measure all materials inputs into the process, and outputs of finished goods, emissions, recycled materials and waste for disposal (Jorgensen, 1993). Input-output analyses express physical flow of materials, internal energy, products and wastes in physical units (Lamberton, 2005)

We choose the cost of sustainable development method; according to this method all the environmental cost is categorized in two groups, costs of preventing pollution and costs of eliminating pollution.

For preparing appropriate indexes, which can reflect the status of sustainable development accurately, there are several frameworks; from presented frameworks, one is selected that is approved in scientific view and with present facilities and information of Iran running itwould be possible; most useable frameworks are:
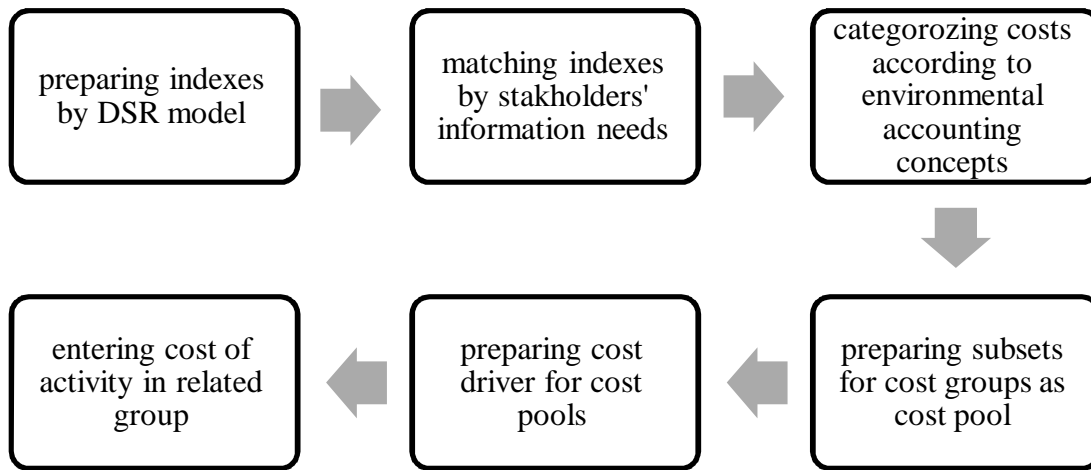
- Pressure -State - Response framework and its derivatives (often limited to environmental issues);

- Human health / ecosystem health;

- Frameworks based on title/subtitle; and

- Accounting framework based on capital accounting (it is used in economic and environmental dimension of sustainable development) (Economic and social affairs, 2007)

This frameworks and lots of the other frameworks have been created on 1990s, but only a few of them were accepted at the international level. PSR framework and capital accounting framework have been created before the concept of sustainable development, but lots of efforts have done for using them as sustainable development framework. The PSR framework have been create for environmental statistics in Canada, then expanded in international level and was used in international methodologies and national researches (Friend, Rapport, 1997; UN 1984, 1988; UN 1991). UNEP developed one of the other derivations of the PSR framework; it was Driver-State-Response, which is used in universal environmental research. (GEO 1997, 1999 and 2002)

MATERIALS AND METHODS

The Goal of this research is preparing the possibility of environmental cost reporting, research general process is shown in following flowchart.

Flowchart 1: general process of research

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┌─────────────────┐      ┌─────────────────┐      ┌─────────────────┐
│ preparing indexes│  →   │ matching indexes │  →   │ categorozing costs│
│  by DSR model    │      │ by stakholders'  │      │   according to   │
│                  │      │ information needs │      │  environmental   │
│                  │      │                  │      │   accounting     │
│                  │      │                  │      │    concepts      │
└─────────────────┘      └─────────────────┘      └─────────────────┘
                                                            ↓
┌─────────────────┐      ┌─────────────────┐      ┌─────────────────┐
│ entering cost of │  ←   │ preparing cost  │  ←   │ preparing subsets│
│ activity in related│    │ driver for cost │      │ for cost groups as│
│     group        │      │     pools       │      │    cost pool     │
└─────────────────┘      └─────────────────┘      └─────────────────┘
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Sustainable development indexes have been prepared based on DSR model, because of the available ability of DSR's information, and its simple and useable concepts. DSR model is a cause and effect chain in environmental components and categorize pollution components into three groups, pollution drivers, which are the main reason of increasing and decreasing pollution, state of pollution, which show the present situation of pollution, and response to the pollution is whole the activities that is done for preventing or demolishing pollution. To ensure the coverage of all areas, Report of State of Environment (SOE) of Tehran (1991-2007) were used.

For passing the above steps, first indexes were extracted by DSR models and to ensure the reliability of prepared indexes were scrutinized from two perspectives, one from the perspective of information users, including citizens and municipal managers to be aware of their information needs; and other one, the perspective of accountant and environmental experts, to ensure that indexes are precise and reflect the correct information. For testing the above indexes, we designed a questionnaire consists 37 indexes, which were developed based on the DSR model and using SOE of Tehran.

Respondents were asked to grad the importance of each index in the 5 range of Likert, so that for the index which is important, mark 5, and for one that is not important, mark 1. Population and its increase or decrease, and immigration are driver indexes of air pollution. The indexes that shows the state of air pollution are Deaths due to air pollution, Heart and lung diseases due to air pollution, annual emissions of Carbon dioxide, lead, mercury, particulate in Tehran, the amount of annual greenhouse gas emissions in Tehran, the number of vehicles in traffic in the city, single passenger cars in traffic in Tehran, energy consumption in household, industry and transport sectors, the amount of being pollutants of the household, industry and transport sectors. indexes related to the response to pollution are the cost of CNG production, The ratio of CNG using to whole the fossil fuel, The cost of technical check of vehicles, the number of vehicles with hybrid systems, the cost of gasoline consumption in comparison with volume equivalent to CNG, rising fuel prices, The ratio of approved vehicles to the whole vehicles , the number of active vehicles in public transportation, the cost of traveling per person by public transportation system, metro and bus usage, pollution sources, The cost of removing per kilogram of carbon from the air ,The cost of eliminating pollution from air for municipality, the cost of preventing pollution for the Tehran municipality, The cost of preventing pollution, The cost of creating per meter of green space, the amount of green space increases. At the end of the questionnaire, a table was prepared that individuals determine their top ten priorities and arrange them in order of importance. By this table, the users' priority of information needs is determinable. After recognizing information needs of the users and preparing their information propriety, information was classified in a way that satisfies them.

After data gathering, first, the average of importance of each question is compared with mean and total average; the importance average of household polluting is 3.47 that is the minimum average in all indexes, and the importance average of Heart and lung diseases due to air pollution is 4.55, that is the maximum average. In general the total average of importance is 4.11, which is more than mean (2.5); It shows that all the indexes are important and are approved.

To facilitate the study, questions categorized in 3 groups based on DSR model, and the states of each group of questions reviewed in the view of environmental experts, accountants, municipality managers and citizens. Results show that the indexes of pollution drivers are more important for managers of municipality than the other groups; it can be because of their information need for decision making and preventing the pollution. Environmental experts have the maximum average in both groups of state and response indexes; its main reason can be their knowledge about environment.

The obtained average for each indicator in each of the groups of environmental experts, accountants, managers, municipalities' managers, and citizens need to reflect the information needs of them, so for comparing whether the information needs of each group are different or not NOVA (comparing the average of several groups) statistics used; it results that there is a significant difference between the information needs of various groups. managers have significant difference with citizens and accountants on the driver indexes, on the state indexes, there is significant difference between accountants and environmental experts, and on the response indexes there is significant difference between environmental experts and all other groups. These differences come from differences in information needs.

To check whether there is correlation between individuals considers in different groups of questions (driver, state, response), regression statistics is used. Before testing regression statistics, its basic assumptions (independence of errors and normal samples) should be reviewed; assumptions are established, and the indexes of driver, state, and response have correlation. The correlation between driver and state indexes is 46%, between driver and response indexes 37%, and between response and state indexes 62%.

According to the reviewing the prepared indexes, it is resulted that all the indexes are important, but based on the cost-benefit principal of the information creators, disclosing all the information is not possible, so most important information should be disclosed. For discovering the most important and useable information, we designed a table at the end of questionnaire that respondents select ten priorities between announced indexes and set there.

To determine priorities, the frequency statistics were used; so that in each priority, the most frequent index selected. In some priorities there were near frequencies so both of the indexes were selected.

The first priority is Tehran population; and its changes are the second priority.

Deaths due to air pollution is selected as the third priority, its importance average is 4.48, which shows its high importance. In this priority, the frequency of the deaths due to air pollution and the amount of carbon dioxide are equal, so both of them is selected as the third frequency, the average importance of the lead emission is 4.39 and has the maximum frequency in the forth priority. Although the amount of migration to Tehran was not the most frequent index in the first four priorities, but it is on the second frequencies; so it can be one of the priorities. The fifth frequencies are the amount of pollutant being of the industry and transportation sectors. The average importance of the being pollutant of the industry and transportation sectors are 4.13 and 4.25.

The amount of particulate emissions in the air is selected as the sixth priority; its average importance is 4.28. The importance of metro usage is more than bus usage, also in the priorities, the metro usage selected as the seventh.

The source of polluting is one of the indexes that its average importance is 4.45 and has the most frequency in the eighth priority; increasing the green space and the cost of removing pollution for municipality, is selected as the ninth and tenth priorities.

By reviewing the selected priorities, the most useable and most important information in the view of stakeholders are selected, and the reports can be prepared so that it can satisfy the stakeholders' needs. From 13 propriety indexes, 3 of them are from driver group, 6 of them are from the states group, and 4 are from the response group; from 37 recommended indexes, 4 are driver, 14 state, 19 response; selecting 3 of 4 driver indexes as priority shows the importance of driver indexes for reporting, and selecting 4 of the 19 indexes of response shows that the indexes of this group are not important for information users.

Table 1- priority of indexes

Priority	Indexes
The first priority	The population of Tehran
The second priority	The increase of population
Third priority	Death due to the air pollution Carbon Dioxide Emission
forth priority	Lead emission Migration to Tehran
Fifth priority	The amount of being pollution of the industry The amount of being pollution of the transportation
Sixth priority	Emission of particular
Seventh priority	Metro usage
Eighth priority	Source of pollution
Ninth priority	Increase the green space
Tenth priority	The cost of removing pollution

To measure the indexes, we recategorize them in two major groups of the costs of preventing the pollution and the costs of removing pollution to conform activities with environmental costs, they divided into two groups, activities of preventing pollution and activities of removing pollution; then in a detailed categorization similar activities with the same cost driver put in the same groups.

As table 2 shows, because of the importance of polluting information of the different sectors for stakeholders, the activities of preventing the pollution disclose in three groups of household, industry and transportation. The related cost driver is determined from the factor that effects the polluting of each sector; for example the amount of energy consumption is one of the factors that have direct effect on polluting, and decreasing the pollution needs some actions for decreasing the energy consumption. More than this three groups of preventing pollution; one other group is added for covering activities that would not be in the told subgroups. This subgroup covers activities such as public education.

Second group is activities of removing pollution, which includes the activities of creating green space, that have direct relation with the area of green space and its increase.

Table2: preparing cost pools and related cost drivers base on Activity Based Costing (ABC)

Main group	Subgroup	Proposed driver
Activities of preventing pollution	Activities of preventing pollution in household sector	Population Amount of energy usage
	Activities of preventing pollution in industry sector	Amount of energy usage
	Activities of preventing pollution in transportation sector	Amount of vehicles Amount of fuel usage
	Activities of preventing pollution in other sector	Population
Activities of removing pollution	Green space	area of green space

After preparing cost pools and related drivers, environmental accounting activities of Tehran municipality which is done for reducing air pollution, is sat on related pools, and is shown in third table. The gathered costs can be allocated by suitable drivers.

Table3- classification of the Tehran municipality according to determined cost pools

Activities of preventing pollution	Transportation sector	• preventing the traffic of polluting vehicles • assessing the polluting vehicles • closeness of the work to living • odd and even project for vehicles • promote (teach) carpooling • use vehicles which consume clean fuels • consume less polluting fuels • use vehicles which consume less fuel • use vehicles with hybrid systems (CNG and gasoline) • throwing away old vehicles • Increase the number of CNG stations • Increase the number of technical examination centers • Provide the facilities to change the vehicles system to hybrid system • Pay subside to CNG for encouraging people to consume clean energy • Decrease the cost of technical examination • Free engine setting • Increase the number of metro stations • Increase the number of bus stations • Diversity of the bus paths • Increase the number of public transportation • No change in the rent of the public transportation for citizens • Increase the access to the public transportation • Decrease the time waiting of the bus • Decrease the time waiting for the metro
	Industry sector	• Use filters in factory chimneys to prevent from entering pollutants to the air • Send out polluting industries from urban area • Consume clean energy in industries • Monitor the type of fuel use in the industries • Encouraging industries to use new and clean technologies • Fining industries for polluting base on the polluting units • • Targeted monitoring to reduce industrial pollutants • Providing investing opportunities in green industries by getting credit to artisans • Prevent from creating polluting units since a date • Required polluting units to create green space near the factory • Required polluting units to use some methods to prevent the entering of pollution to the air
	Household sector	• Required insulation building on the time of constructing • Teaching the correct use of energy • Use the equipments by less energy consumption • Consume clean energy at house • Helping to mass productions to construct the buildings according with environmental standards
	others	• Transferring Tehran population out • Reducing Tehran charms as a metropolis • Preventing from Tehran expansion • Population balance in Tehran • Transfer Tehran's facilities to nearby cities to decrease immigration to Tehran • create employment opportunities in nearby cities • Informing patients • Quick access to medical centers • prevent the population density in populated places • Not giving new construction permits
Activities of removing pollution	green space	• Preventing from degradation of natural green spaces around Tehran • the area of created green space • The cost of maintain available green space • Encouraging people to create green space • Encouraging mass productions to create green space in exchange for constructing a number of resident units • Supervision on creating enough green space in new cities to prevent crises of future pollutions • Transfer properties to the gardens' owners to encourage them to assign gardens to municipality • Giving credit to garden assignor to municipality • Prevent the conversion of the agricultural land to residual

SUMMERY AND DISCUSSION

Approving all prepared indexes by respondents, shows the importance of indexes in the view of them and their reliability in reflecting information.

Categorizing indexes base on driver, state, response and reviewing the respondents' ideas shows that different respondents groups have different ideas about indexes, because of different information needs and different consciousness degree; and respondents' idea in different aspects have correlation. Index prioritizing shows that indexes of pollution drivers are more important than the indexes of the other groups.

United Nation's sustainable development indexes in the field of atmosphere, survey air Quality in three general groups, weather changes, Ozone depletion, and air quality. In the field of weather changes, greenhouse gas emission; in the field of Ozone depletion, the amount of usage of Ozone depletion materials; and in the field of air quality, consumption of air pollutants are introduced as index; these indexes reviewing air pollutants so general, but for satisfying stakeholders information needs, we need more detailed indexes that can help us in tracing the costs and finding the main reason of increase or decrease. For instance in present research, components of greenhouse gas are considered separately as Carbon Dioxide, mercury and aerosols; or for measuring air quality, pollutants are categorized in industry, household and transportation pollutants.

One of the main restrictions of this research is some non-quantitative indexes, for instance the amount of death because of air pollution, which is related to humanity and people's life, is not quantifiable in accounting, because no value can be determine for human's life; so it is suggest that do some research for finding some ways to make this indexes measurable in accounting.

This research is concentrated on air pollution, so suggest for future researches attend to sold and water pollutions and offer some samples for environmental reporting that be matched with stakeholders' information needs.

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