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Material flow management: A tool for small and medium-sized enterprises in Bangladesh to combat environment pollution

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1. INTRODUCTION

Small and Medium Enterprises (SMEs) are treated as lubricant for the economic development of a nation, likewise in Bangladesh. SME act as both forward and backward linkage to the large and high-tech firms and plays important role as primary and secondary input provider. Despite severe lack of comprehensive data regarding SMEs, recent studies suggest that SME sector in Bangladesh is composed of approximately 20,000 manufacturing firms and 10,000 service firms^[6]. Even some other studies shows the number is more then triple the CII estimates. Whatever the number, the contribution of SMEs in Bangladesh economy is enormous. By the combined contribution of both large and small scale industries, in terms of the UN Millennium Development Goals (MDG), Bangladesh has some remarkable achievements in social and economic areas, but still lack far behind environmental issues. One reason for lacking behind is overlooking the SMEs environmental issues. Besides traditional technology or labor intensive industries like, textiles, tannery, tea, food processing or paper pulp, the SME sector in Bangladesh is one of the important units causing environmental degradation. The global summits, conferences and other international meetings are focusing on sustainable development where environmental issues are getting more and more attention. Social and economic policies are better in shape

and getting close to be achieved, whereas environmental issues still needs more effort, time and modification. The pace of industrialization is also causing more pollution while contributing for more GDP. This paradox is the prime concern of the global leaders, politicians, academics and researchers. Many attempts are in progress, many treaties are made and many initiatives are still to be tested. As the earth's carrying capacity is vulnerable to pollutions in any form, industrialization is hindered by several specific local and global rules and regulations. Under such condition, Material Flow Management (MFM) can be a tool applying which SMEs can contribute for economic growth keeping the environment pollution least possible. MFM, as a tool for resource efficiency, can optimize the existing system and as an obvious benefit can bring environment pollution to the lowest possible limit. MFM enjoys its superiority on the factor that the owners are self-motivated once they come to know what MFM deals with and how it brings benefits.

2. Overview of SMEs in Bangladesh

Though the units are of heterogeneous in nature, food, handlooms, shoe-making, bamboo and cane products, light engineering, ornaments, etc. are important. Due to lack of structured database of industries, there is no specific information about how many SME units are working in Bangladesh at the moment, and the

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data exist varies a lot. The latest BSCIC estimates suggest that there are currently 55,916 small industries and 511,612 cottage industries excluding handlooms. Including handlooms, the number of cottage units shoots up to 600,000 units. Another study by Planning Commission shows that Small and Cottage Industries to be between 100,000 to 150,000. Different set of definitions of the SME and different coverage of SME families are at least the two reasons for the huge difference in estimation (BEI Report). SME accounts for over 98% of the industrial enterprises in Bangladesh by number and contribute over 80% of total industrial employment and roughly 40%-45% industrial value added (BEI Report). Only small enterprises has contributed around 4.97 % of total GDP of Bangladesh in the year 2006-07 (provisional) calculated at current market price^[1] and including hotel restaurant, wholesale and retails, fisheries, agriculture and medium sized industries, contribution to GDP can be up to 40% for the year 2006-2007 (provisional). During the same the year, growth of small scale manufacturing units has been calculated as 10.28 % comparing previous year^[1].

Bangladesh Small and Cottage Industries Corporation (BSCIC) is the premier body for promotion and extension of small and cottage industries in the country. BSCIC is working through 64 district offices, 70 industrial estate offices and 183 project offices in the upazilas (also known as Sub-district) to promote investment and production in the small and cottage industries sector in the country. During FY 2006-07, BDT 8306.60 million has been invested in SME sector through BSCIC, different banks and other financial institutions including entrepreneurs equity amounting BDT 2404.30 million. The investment has created employment opportunities of about 92,000 people in FY 2006-07^[2].

2.1 Current problems of SMEs causing environment pollution

In the most cases, neither the concept of product integrated environmental protection nor any material and energy managements strategies are applied to improve the production efficiency and social benefit as well as to limit environmental impact. With the growth of the SMEs, environmental pollution are also increasing and the neighboring region (indirectly the entire earth) are

suffering from it. The resources used and the level of emission and waste volume is not observed in Bangladesh almost in all industry. In case of SME, this is even more severe as the traditional out-of-date technology (if the process is technology-based) does not have the system of data storage and the owners are not in position or even willing to change the technology as long as the oldest set of machinery and equipment can produce desired output level. In case of indigenous labor-intensive system too, the intention of owners are almost the same and by avoiding such recordkeeping, owners can save taxes. The practice and man behind the practice are both equally responsible for not observing the resource issues relating core and ancillary production process. The basic problems that are degrading the environment are waste and emission. In addition to these, energy issue is also overlooked. As energy consumption is integrated with the production process, this issue is to be also considered in same priority, but which is not observed.

Emission reduction is the “Goal 7”: Ensure Environmental Sustainability of UNMDGs. The high level of emission is causing global warming and risk for habitats. As the database is not strong in Bangladesh, there are also no data regarding emissions from SMEs. Emission or pollution from a single large SME unit is not at all comparable with even a small unit of paper and pulp production unit. It is proved that the SME is not as other big polluters; but impact of statistical *law of large number* is the main concern for thinking about future SME conditions. The environmental problems created by SME can be categorized as

- Emission Problem
 - Emission to Air
 - Emission to Water
 - Emission to Land Surface
- Waste Problem
- Energy Problem

A clean air supply is must for human survival and for that of the environment. But the quality of air is deteriorating every day, every minute. The issue of air quality is now a major concern for the global citizens. Air pollution kills almost half a million Asians every year, with motor vehicles as major contributors to the problem^[8]. In Bangladesh, transportation sector is developing mainly under SME ownership. Other emitters are

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light engineering sector, furniture, plastic manufacturer, handloom etc. For example, Wooden furniture manufacturing process deals with many activities that are causing environmental degradation. Without a proper utilization and disposal system materials, such as paints, adhesive glues, stains, varnishes, polishes harm both the environment and the workers health and safety. Currently, the residues from the majority of the wood working operations, like sawdust and waste wood, are mostly disposed or open incinerated instead of energetically used although energy issue are vital for the SMEs. The continuous growth of the energy price are forcing the SME either to pass through the higher costs to the customer or to curtail operating costs. Since the consumers tends to react sensitive to increasing retail prices the first priority needs to be energy saving measures and an overall increase in energy efficiency in order to stay competitive.

Pollution of water is also a common phenomena in Bangladesh. Among the huge number of SMEs not all are polluting, but it is clear that many ecosystems are now under threat and the people in surrounding areas are being affected. Agriculture is main for eroding land quality by the heavy use of pesticides and fertilizers. Waste volume in all industrial units require more spaces for landfilling. As landfilling is not a available, traditional dumping is practiced which is also creating emissions. Energy requirement is increasing with higher production, but energy prices are also increasing. Low energy consumed technology can minimize some cost burden, but the effort for such initiatives are rarely observed. Another example is Light Engineering Sector (LES). The energy demand in LSE is much higher and the energy efficiency much lower than in other industry sectors. During manufacturing processes contaminated waste water are generated. Currently, the majority of the LES is not connected to an operating sewer grid system and thus discharging the waste water in nearby rivers with high pollution loads for the ground water reserves. In addition, hazardous chemicals like cyanide, acid, solvent, compressed gases, polishing compounds, solder etc are used without having sufficient precautions of the employees' operational health and safety. As a result, the LES are facing increasing economic burdens by increasing energy and waste disposal cost and imbearing a tremendous pressure on the environ-

ment.

Problems relating issues that have both direct or indirect impact on environment. Even the industry process, raw materials and finished products are not same, general problems regarding the assessment, examination and evaluation of process mechanism remains the same. The reason for such pollution by SMEs can be categorized as follows:

2.1.1. Lack of knowledge and awareness

This is not uneven to find out employees who is working for several years in an SME but does not know how much electricity the machine is consuming or how much fresh water is needed for washing the raw materials. Lack of education creates this problems. People are not concerned about the value of virgin resources used. Some times people think the underground water has an unlimited stock and they can consume as long they desire! Specific knowledge about resource and scarcity of resources are to be given to make the people know about the resource issues.

2.1.2. Lack of knowledge about potential benefits from eco-friendly way

Sound Environmental Management can bring financial benefit in the long run. Due low education rate and less media coverage, people are not concerned about the system that produce less waste, generates less emissions and produce efficiently. Thy tested system are generating more revenue in the long run.

2.1.3. Lack of Institutionalization of resource consumption

Resource consumption in Bangladesh is not under rule and regulation except few cases in big cities. For example, in Dhaka City Corporation area setting up deep tubewell is not allowed. But in other cities there are no rules for such set up. SMEs operating from outside capital or other big cities, are using ground water for all there water needs. There is no information and data about how much water is used everyday by each unit. The resources are not under institutional care to protect. Other than mining, as this is expensive to be extracted, other resources that are to be protected are still not getting proper care. Institutionalizing the resource consumption pattern is necessary to help region save resources and thereby environment.

2.1.4. Lack of technology

Developing countries are trying hard for basic needs of living—food, clothe and shelter—where environmental issues are not included. With primary demand of fundamental needs, fiscal budget lacks investment in technological improvement. Engineering universities are trying to develop new systems remaining in low budget for research and development. The researchers and academics who have vast experience in developed western world has the knowledge and expertise to implement technology; but as there is no technology, they are not able to apply their knowledge. This is also a reason for brain drain.

2.1.5. Lack of motivation

SMEs are, in most cases, family business. The ancestors started and the predecessors are running and expanding business. Even some emotional issues relates not to change the system (like-respecting father, grandfather by maintaining the same system, very common in Indian sub-continent), motivation is still lacking. One reason is the output of the changing system is not known. Another reason is ‘feeling of ok’.

2.1.6. Lack of government initiatives

For any sovereign nation, government is the body to implement policies for national short and long term development. Some laws that are actively operating in western world, notably in western Europe, are not yet in action in Bangladesh. Government initiatives are remarkable to some extent, but still it needs some up-to-date effort to encourage optimum resource consumption. Though Environmental Protection Act 1995 is in action to prevent pollution problem, the implementation requires more rigorous effort.

In addition to the more general problems described above, industry-specific problems relate unnecessary electricity consumption, water consumption, creating emissions through use of prohibited metals etc.

3. Material flow management (MFM) approach and its coverage

Material Flow Management (MFM) often misunderstood with resource management and/or environmental management. Resource Management comprises the analysis, planning and allocation, exploitation, and

upgrading of resources^[5]. From organization point of view, resource management refers to efficient and effective deployment of resources of any kind, like- financial, inventory, human, production, IT etc, when these are used or required. Similarly, environmental management refers to managing the environment while manufacturing product or generating services that has impact on either local and global environment due to process or disposal or any other causes. Material Flow Management refers to optimum use of resources so that input, unwanted output and waste as well as energy consumption remains the least possible, wanted output remains maximum and emission levels do not cross the international standard, so that ecology remains unaffected. Material Flow Management thus deals directly with the roots of the problem, since material flows and their impact are direct causes of ecological problems^[11]. MFM ensures three corners—economical, environmental and social issues—of sustainable development. Both from national level and/or company level the purposes are the same. MFM offers the opportunity to combine economic profit with regional added value and environmental protection. From manufacturer point of view, with regard to environmental protection “clean technologies” are preferred compared to “end of pipe” technologies.

MFM is a multi-disciplinary approach with specific options for individual situation. MFM deals primarily with risks and opportunities of a system ranging from raw material extraction till final disposal after consumption and tries to close the loop of ordinary linear economic model of input-process-output. Changing the current material flow to future material flow with high resources efficiency and added value is the goal of MFM strategies. MFM is linked with other discipline of business like-accounting, finance, management, marketing; environment like-environmental technology, environmental management; and engineering like-process technology, ecological engineering etc.

3.1 Tools for implementing MFM strategies

To achieve the objectives of documentation of energy and material flows, potentials to reduce operating cost and pollution, comparing investment cost for MFM and non-MFM strategies, corporate MFM approach uses several tools. Some are direct operational tools

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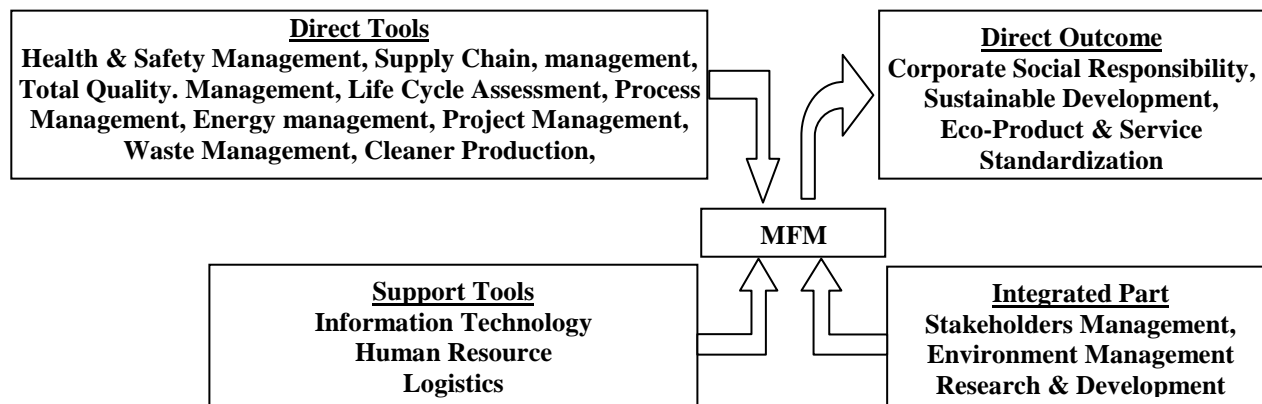


Figure 1: Tools and techniques for MFM outcome

and some are support tools, while few management approaches are fully integrated with MFM application. The final outcome comprises sustainable development along with other obvious benefits.

3.2. Implementation of MFM approach to SME

The scale of modern industrial activity, even today, when four fifth of the world is relatively non-industrialized, is great enough to have changed significantly the natural global cycles of carbon and nitrogen^[7]. Under such condition, Corporate MFM is the best options to take energy, emission and waste issues into consideration, simultaneously, at the same time by utilizing various tools and techniques of optimizing resource utilization. Particular tools, like end-of-pipe, cleaner production etc. have specific goals to achieve and in a single implementation might cover all the issues related to energy emission and waste of any form. MFM helps to keep the three issues together to attain sustainable development.

Material flow management combines many technical and planning tools in the field of resource and energy efficiency and applies them coordinated and tailor made to a company or a region, that can be easily replicated to SME units. Even the cost issue matters for the small SMEs, an alliance of similar industry can initiate the implementation of MFM that will reduce cost burden for each involved unit. Implementation of industrial MFM requires active and spontaneous involvement of all. A typical MFM strategy implementation steps for SMEs may take the following shape:

Team formation

The very first step is to develop a team consisting people both from inside and outside the organization with expertise in material flow management and understanding of issues relevant to MFM. The team's responsibilities will include :

- Assessment of inputs and outputs with clear distinction among material (both direct and indirect), energy and heat as well as fresh and processed water.
- Selecting the process steps of the entire production chain. Based on the system boundary of the project, from raw material extraction till final disposal after use may also be taken in to consideration.
- Identify the process steps that are wasting resources or not at all necessary for a good supply chain.

Process analysis

Based on the process identified in first step, this step focus further detail of the entire flow of resources and materials from starting point in the system boundary to the end of system boarder. The activities in this step are as follows:

- Analyze the process through a flow chart or material balance. Flow chart software can be used to develop the stream of the resources and wastes.
- Quantity of resources and wastes is to calculated identifying the waste stream.
- Identifying the causes of waste in the process.

Process Analysis involves implementation of various tools that are tested and proved effective in large industries. The basic and mostly used tools are described in following part.

Eco-efficiency application tool

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Eco-efficiency enables more production with better process while reducing resource consumption, waste, pollution and emissions. WBCSD focuses eco-efficiency benefits⁽¹⁾ Background Briefing on Eco-Efficiency, WBCSD, 16) as, “delivery of competitively priced goods and services... that bring quality of life, while progressively reducing ecological impacts and resource intensity throughout the life-cycle.” Eco-efficiency improves business and environmental performance, and helps companies to get out in front of market and regulatory trends, to reduce cost, to gain competitive advantage and to ensure long term profitability and sustainability^[12]. Seven elements for eco-efficiency improvement^[9] are :

- Reduced Material Intensity
- Reduced Energy Intensity
- Reduced Dispersion of Toxic Substances
- Enhanced Recyclability
- Maximized use of Renewables
- Extended Product Life
- Increased Service Intensity

Eco-efficiency tool box for successful application in companies comprises many tools-Environment Management System, Life Cycle Management and Assessment, Eco-innovation or Eco-design or Design for Environment, Environmental Supply Chain management, Cleaner Production etc.

Life cycle assessment

Life Cycle Assessment (LCA) is tool for analyzing the environmental impact of a particular product service starting from raw material preparation to after use disposal. The range of coverage for LCA is flexible. The impact a production process that has on environment varies from step to step. Some production process has higher impact during raw material extraction, whereas some products have during after use disposal or core production step. Common categories where LCA plays role and provides significant outcome are global warming issues, acidification, ozone layer depletion, eutrophication, depletion of minerals and fossils energy etc. If alternative processes are available, LCA help is comparing impacts and suggest which one is more eco-friendly. Proper assessment through LCA gives the producers ideas about which processes are more emitting in nature and where to focus to reduce

emissions to attain the goal of eco-design. For any process for production of goods and services LCA is equally helpful.

Material flow accounting

Material Flow Assessment or Accounting (MFA) is the tool for physical accounting of material (including primary and secondary raw material), production and manufacturing process, emission, waste and energy in regional level. Based on primary interest, basic accounting types are Problem-Specific Material Focused, where specific material is studied if it is relevant for creation of environmental impact. For example, CO can be studied as it is effecting global warming. And Volume-specific region Focused, where sustainability of a particular region is studied with the volume and structure of materials. For example, construction industry is studied with respect to their throughput of huge scrap of construction industry.

Input-output analysis

Broadly, Input-Output Analysis (IOA) is an accounting framework used for developing a holistic view of regional economy showing flows of materials and resources to and from industry and society (institutions). In company level, IOA can show how efficiently the inputs are transformed to become output. In addition to IOA, energy balance and emission level calculation will provide a picture of environmental impact for a given quantity of production.

Production integrated environment protection (PIUS)

Production Integrated Environmental Protection (German Acronym is PIUS) is an initiative of five companies, namely-Sonderabfall-Management-Gesellschaft Rheinland-Pfalz (SAM), Landesamt für Natur und Umwelt (LANU), Hessische Industriemüll Technologie GmbH (HIMTECH), ABAG-itm Gesellschaft für innovative Technologie- und Managementberatung mbH, Niedersächsische Gesellschaft zur Endablagerung von Sonderabfall mbH (NGS) for cleaner production system. It increases the competitiveness of companies, leads to cost reductions, efficient usage of raw materials and energy as well as contributes to the optimization of operative processes (www.pius-info.de)⁽²⁾ Illustrating operational experiences

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of procedures, technology and tried and tested measures online since April 2001 (Accessed on April 21, 2008, GMT 13.00)). Examples of PIUS initiatives lead to the following benefits-

- Substitutions of environmentally un-friendly auxiliary and industrial materials
- Application of efficient and innovative processes
- Usage of energy saving potential i.e. heating Internal circulation management of materials used
- Valuable utilization of unavoidable residues
- Awareness of pre and post stages of production processes
- Ecological product creation (Longevity, ease of repair, lower energy consumption, ease of recycling etc.),
- Usage of, as opposed to, sales of products (ecology leasing).

Suggestion for improvement

In this step, suggestions are to be made for the causes identified in the second step. With detailed examination of the process step, and with expert opinion, some suggestions are to be made for upgrading the existing system.

Analysis of proposed solution

The proposed solution is to be analyzed from sustainability point of view, where lies the concept of MFM. The suggested solution need to have three fold benefits-economic, environmental and social-in addition to technical feasibility of the solution. While deciding a solution from these four perspective (technical, economical, environmental and social), a balance can be made with some more benefits of one by offsetting some benefits of others; but at the end, it must have positive impact.

Implementation and monitoring

The last step is implementation of the desired solution to enjoy the whole benefits of industrial MFM strategies. Corporate MFM is not a final solution for resource management and/or sustainability. It needs continuous monitoring. With changes in technological development, industrial MFM reshapes its thinking and policies. So continuous monitoring is must even with better-than-before outcome from the system. With repeated assessment process can be optimized as and when required.

Benefits of MFM implementation

Successful implementation of MFM strategies will lead to following benefit irrespective of the type and size of SMEs:

- a. Improved efficiency in production by producing desired output with less input or by producing more output with given input comparing to similar other system.
- b. Higher profit margin by way of cost reduction; for example, less emissions to air and water and less waste will lead to lower disposal or treatment cost.
- c. Resource and energy conservation in a continuously increasing trend of resource prices
- d. Easy access to corporate loans as the financial institutions is becoming more and more conscious about environmental issue in production process. With positive image of environment friendly, producers have easier access to loans and development aid.
- e. As a response to market, companies can no longer survive in the near future without environmental log, like ISO, EMAS. With globalize business environment, access to export market of both developing and developed countries requires certain environmental features of the products. Voices for green energy, green product, eco-product and the like are rising and it gives more flexibility to the company with environmental standards to grab new and potential market.
- f. Good working environment and hygienic conditions for employees. By implementing cleaner production technology, toxicity and emissions are brought down and the direct effect enjoys by the workers in the process. This type of working conditions motivated workers to work well and job satisfaction of employees have implied impact for the growth of the company.
- g. Image of the company is developed and enjoys more attention of people as public awareness for environmental protection is growing day-by-day. Entire environmental profile of the company is important part of company reputation. Environmental regulations all over the world are becoming strengthened, so maintaining the level of environmental standards will give some added benefit of company marketing.

CONCLUSION

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Economic growth and environmental pollution in Bangladesh are going hand in hand; but it should not be. The process of economic development should not be mutually exclusive with pollution; rather these should be independent events both in policy formulation level and implementation level. Decoupling growth and environmental protection is the primary focus for a sustainable world for future generation. As SMEs are playing active and vital role for developing a strong economic base of Bangladesh, environmental issues are sometimes overlooked. Material flow management is the best approach to combat environment pollution created by the SMEs in Bangladesh. Sound application of MFM strategies will lead the SMEs consume less resources, generate less wastes, make independent chain of resource use among the different industries and finally reduce emission. As environment is vulnerable to production processes, it should be taken proper care so the future generations are no worse-off. Further on MFMs applicability on SME may focus on single units by doing financial feasibility study to get the real cost-benefit scenario.

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