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Green Productivity In Water Efficiency & Treatment

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Abstract: - As a result of liberalisation of the industrial policy, a number of multi-national companies are being established in the country. With the varying nature of these industries, they generate more wastes resulting in the lower overall productivity. Gradually lot of approaches have been adopted in various countries to minimise the waste generation and protect the environment. The approaches like Waste Minimisation and Cleaner Production emphasise on the pollution reduction at source along with improving the efficiency of the production process. In the recent past, the emphasis has been laid on resources' conservation and pollution control together in order to sustain the development. A sustainable development has been a key term for overall socio-economic development without creating negative impacts on the environment. Green Productivity (GP) signifies a new paradigm on socio-economic development aimed at the pursuit of economic and productivity growth while protecting the environment. The concept, methodology and tools &techniques are applicable for evolving water efficiency in the industrial sectors as well as in the domestic wastewater treatment for the recycle and reuse of treated water and achieving Zero Liquid Discharge (ZLD) in the industrial unit/industrial cluster/industrial estate/Industrial Pak.

Keywords: - Green Productivity, Water Efficiency, Wastewater Treatment, Industrial sector

1.0 Introduction

The concept of GP is integrating with socio-economic aspirations and a framed tool to harmonize economic development and environmental protection. It plays an important role to enhance the quality of life of the people through sustainable development. Improvement in quality of life is often associated with an increase in demand for goods and services. Production of these goods and services often lead to negative impact on environment [1]. The two major negative aspects are- firstly, it depletes the natural resource base; secondly, it generates wastes/pollution which if dumped/discharged into natural bodies causes environmental

damage. The socio-economic development, therefore, seems to defeat its own basic purpose, as there cannot be a better quality of life in polluted and degraded environment. Uncontrolled exploitation of scarce and natural resources may soon result in extinction of the same. Indiscriminate dumping of wastes and pollutants in the atmosphere or water bodies or even land has already degraded them. In several cases, these have been rendered unfit for human use and are beyond regeneration levels [2,3]. In some cases, production of goods and services has involved techniques, which use and/or discharge toxic and hazardous substances thus posing great risks to the society. Such techniques may sometimes be economically attractive but are not sustainable on ground of potential threats to the society.

Conventional productivity improvement techniques have not paid due attention to such environmental aspects. The environmental cost has been conspicuous by absence in the generally accepted production-cost accounting systems [4]. Wastes have been considered as valueless with, at best, a nuisance value for getting rid of.

GP looks at these wastes as potential resources. Wastes are manifestation of lost resources. The long-forgotten axiom of 'Higher wastes means lower productivity needs to be re-emphasised. Lower productivity obviously means lower profitability'. However, the performance of a manufacturing enterprise can no longer be evaluated on the basis of economic parameter alone [5]. It needs to be integrated along with environmental performance. Poor environmental performance means adverse impact on the environment due to higher levels of wastes and pollution generation. Such a situation is not sustainable since a manufacturing enterprise, which does not tighten its belt and strives for continuous improvement of environmental performance should not be allowed to operate in the long run. Apart from the economic competitiveness due to loss of resources, poor environmental performance also causes loss of social acceptability. Such a situation can only be tackled by application of GP techniques. GP aims at simultaneous improvement in economic as well as environmental performance of a company [6].

2.0 Green Productivity

With the support of the GP approach, the overall productivity of socioeconomic development and environmental performance can be improved. Actually, GP is a good application for productivity and environmental management strategies, techniques, and technology that help organisations reduce the environmental impact of their activities, commodities, and services [6,7].

An attractive feature of GP is that it is a strategy that leads to gain in profitability through improvements in productivity and environmental performance. Excessive use of resources or generation of pollution is indicative of low productivity as well as poor environmental performance. In fact, pollution is the inefficiency of the production process which has to be improved. To improve the situation, GP pursues a strategy based on technical and managerial interventions. It is a process of continuous improvement [6].

2.1 Environmental Compliance

The heart of GP is environmental protection, the first step for which is compliance. It is today one of the most challenging tasks industries are facing, which can be achieved through the practice of GP by pollution prevention and resource reduction. The residues should be viewed as a resource, which can be a raw material in another process, or valuable products can be recovered. Whatever the remainder is End-of-pipe treatment methods will be necessary to manage it. While reaching environmental compliance, GP's distinctive feature is that productivity will improve as well. These methods may result in a situation that goes beyond compliance in terms of assuring quality of life [7,8].

2.2 Productivity Improvement

Productivity enhancement is the other half of the GP coin. The continuous improvement strategy of Kaizen serves as the foundation. This must be done in tandem with environmental conservation. The notion of continuous improvement, which is achieved by following the concepts of the PDCA (Plan, Do, Check, and Act) cycle, aims to ensure not just productivity improvement but also environmental improvement, as opposed to traditional productivity improvement initiatives. This is an iterative and dynamic process [5,8].

2.3 Integrated People-Based Approach

Worker involvement and a team-based approach are two of GP's strengths. Its people-cantered approach encompasses topics like as improving the working environment, worker health and safety, non-discrimination, and other social welfare concerns. The methodology-based approach is being used, and it includes multi-stakeholder participation [3,6]. This allows for a step-by-step approach, systematic production of options and solutions, and participation in the GP process by all members of an organisation. Transparency and accountability are also ensured by involving people. In other words, GP can yield many benefits, which includes:

- Increase profitability due to: reduced operation, waste management costs greater competitive advantage and reduced liability risks
- Protection of public health and the environment
- Enhancement of the public image of an enterprise
- Resultant compliance with regulations
- Improvement of the employee’s morale, his participation, and the quality of his work life.

In nutshell, Green Productivity is a way of life. It is not simply a business strategy. It is a philosophy, which has to become the guiding beacon of all the companies. It is an endless process and the more one gets into it, the higher returns one gets. A successful Green Productivity Programme can be accomplished only by continuous involvement of all the stake-holders at all levels in an enterprise. Green Productivity is the surer and long sustaining way of carrying out economic activities be it agricultural, manufacturing or services with long term

effectiveness. The implementation of Green Productivity approach would lead towards the sustainable development in the long run [9,10].

3.0 Concept of Green Productivity

The concept of green productivity is drawn from the integration of two important developmental strategies: productivity improvement; and environmental protection.

Productivity provides the framework for continuous improvement. Environmental Protection provides the foundation for sustainable development. Sustainability is the vision or driving force for GP [6].

4.0 Green Productivity Methodology

The methodology of green productivity is depicted in figure 1 with its six steps [6].

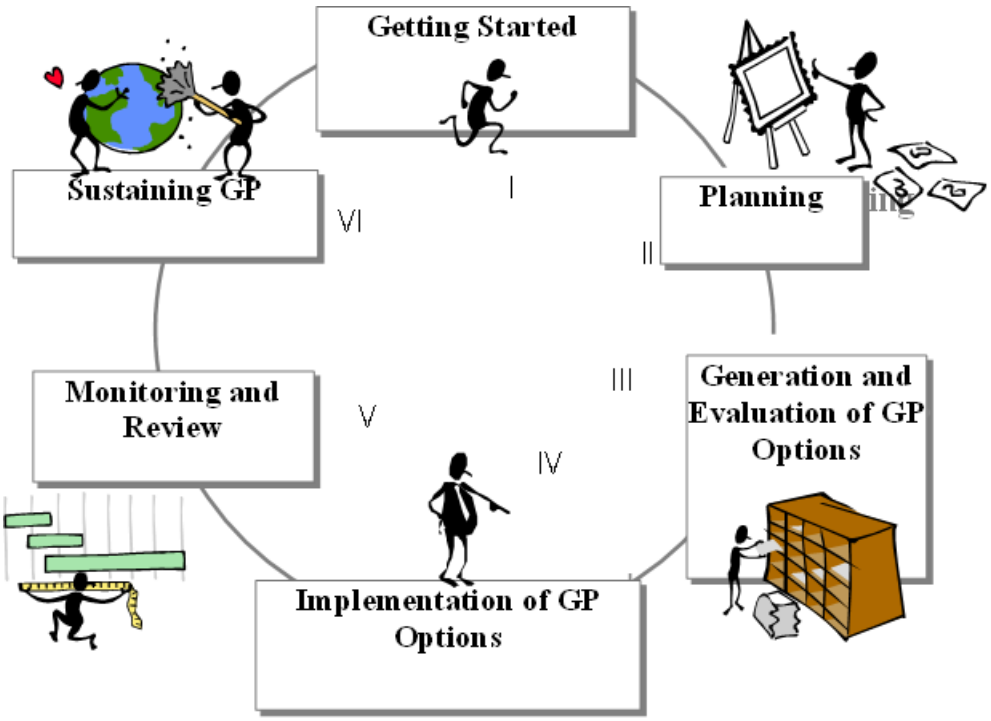

Figure1: Six steps of green productivity methodology

5.0 Overview of Water Efficiency

In India, according to National Commission for Integrated Water Resources Development (NCIWRD)[2], the total water demand in 2010 was 710 Billion Cubic Meter (BCM). Out of that, 78% share of total water demand is in agriculture sector, followed by industrial (8%) and domestic (6%) sectors. NCIWRD has projected that total water demand in India will rise up to 1,180 BCM by 2050, which will be more than the total available water in the country, i.e. 1,123

BCM. To overcome the situation, it is important to adopt water efficiency in each sector [10,11].

The importance of water efficiency in Indian condition is very much required as the India comes under Water stressed Country. The Average water availability per person (as on 2019) is 1,400-1,500 m3 per year and is projected to fall even more in the next 30 years[4]. As per the Falken mark Index [5], if the amount of water in a country is below 1,700 m^3 per person per year, the country is said to be water stressed; below 1000 m^3, the condition is said to be water scarce.

The water is being utilized at three stages:

1. Pre-consumption level
2. Consumption Level
3. Post Consumption (Pre disposal level)

The major opportunities for water efficiency are through treating the wastewater generated (at post consumption level) for recycle and reuse and achieving ZLD and through efficient practices at consumption level through adoption of Green Productivity Approach [8-11].

The major water intensive units are[6]:

- Thermal Power Plant
- Textile
- Pulp & Paper
- Iron & Steel
- Petro-chemicals
- Distillery
- Dye & Dye Intermediates
- Tannery

The water efficiency potential based on the studies conducted in the various water intensive sectors is in the average range of 40% is shown in table 1.

Table 1: water consumption in industrial sector

Industrial sector	Production (tonnes)	Specific water consumption (m^3/ tonne)	Water consumption (BCM)	Assuming 40% water saving potential (BCM)*
Textile	7,859,849	200 – 250	1.57 – 1.96	0.6-0.8
Pulp and Paper	4,217,000	100 – 175	0.42 – 0.74	0.2 – 0.3

Iron and Steel	106,560,000	37 – 52	3.94 – 5.54	1.2 – 2.2
Dye and Dye Intermediates	296,520	100 – 500	0.03 – 0.15	0.01 – 0.06

The scope of water efficiency in Industrial sector is achieved through:

- Process Optimization
- Monitoring of Water losses
- Technology Up-gradation
- Good Housekeeping.

It is further improved and the demand of fresh water reduces through proper treatment of wastewater through the following stages of treatment [3]:

- Preliminary treatment
- Primary and secondary treatment
- Tertiary Treatment
- Advance treatment (for reuse of treated wastewater).

6.0 IMPLEMENTATION OF WATER EFFICIENCY PROJECTS

The implementation of water efficiency projects could be made through the six steps methodology (figure 1) adopted by the Asian Productivity Organization (APO)-Japan. The assessment of Green Productivity Opportunities could be made by the industries In-house by forming a GP Team or through the External Consultant having wider knowledge in the industrial sectors.

The implementation of feasible options could be done through Engineering-Procurement-Construction (EPC), Design-Build-OWN-Operate-Transfer (DBOOT), Design-Build-OWN-Operate (DBOO), or Performance guaranteed mode [5,7].

7.0 Applicability of the Water Efficiency Concept

The water efficiency is very much applicable for all water intensive units to minimise their fresh water consumption and meeting the environmental compliance requirement for achieving Zero Liquid Discharge. It is applicable of individual industrial unit level or in the industrial clusters to treat the combined wastewater in Common Effluent Treatment Plant (CETP). It is also applicable to the Municipalities or Urban Local Bodies (ULBs) to treat the domestic effluent generated in their town/cities in the Sewage Treatment Plant (STP) and utilizing the treated water in the agriculture purpose or supplying to the nearby industry (located within 50 km radius) [11] for further treatment and utilizing it for industrial purpose. The Sewage Treatment capacity has increased from 11,787 million litres/day in 2009 to 26,066.31 million litres/day in 2018 (as of July 2018) [7].

8.0 National Water Mission and National Water Policy

Through integrated water resource development and management, the National Water Mission aims to save water, reduce waste, and ensure more fair distribution among and within States.

- A comprehensive water data base in the public domain and an assessment of the impact of climate change on water resources
- Promotion of citizen and state action for water conservation, augmentation, and preservation • Focused attention on vulnerable areas, including over-exploited areas • A 20 percent increase in water use efficiency
- Encouragement of basin-wide coordinated water resource management

The National Water Policy was developed as part of the Mission to optimize water usage by increasing water use efficiency by 20% through regulatory mechanisms [8].
Emphasis on the need for a national water framework law, comprehensive legislation for optimum development of inter-State rivers and river valleys

- System to evolve benchmarks for water uses for different purposes, i.e., water footprints, and water auditing be developed to ensure efficient use of water
- Setting up of Water Regulatory Authority has been recommended
- Incentivization of recycle and re-use has been recommended

9.0 Financing of Industrial Wastewater Treatment Projects

The Government of India had announced funding for the implementation of Wastewater Treatment Projects time to time. Ministry of Environment & Forests and Climate Change had given financial assistance for the installation of Common Effluent Treatment Plant (CETPs) in the industrial area/industrial estate. Similarly, Central & State government are financing through the scheme for Micro & Small Enterprises under Cluster Development Programme (MSE-CDP). The Department of Industrial Promotion & Policy (DIPP), Ministry of Industry & Commerce had provided financial assistance under Modified Industrial Infrastructure Upgradation Scheme (MIIUS) [8,10].

In addition, the nationalized banks, private banks, international funding agencies are also financing for the wastewater treatment projects.

JICA has provided funding support for sewerage and industrial wastewater treatment in India. In FY 2017-18, the committed amount was US$3.68 billion, out of that US$2.45 billion disbursed.

10.0 Conclusion

In the study of green productivity and the water policy of national and international it is concluded that if the waste water is treated for recycling, then uses of water can be optimized in industry and other sector. Government and other sectors are helping in terms of financing to set up the plant for the treatment of industrial water for reuse. Water efficiency is improved if

the fresh water consumption can be minimized and meeting the environmental compliance requirement for achieving Zero Liquid Discharge

References

[1] Green Productivity Training Manual by Asian Productivity Organization, Japan; ISBN: 92-833-2350-5
[2] National Commission for Integrated Water Resource Development (NCIWRD).
[3] Metcalf & Eddy, Book on "Wastewater Engineering Treatment and Reuse", Tata McGraw-Hill ISBN-13:978-0-07-049539-5 (2003).
[4] Reassessment of water availability in India using space inputs, CWC, 2019.
[5] Falken mark Index
[6] Pollution Control Acts, Rules and Notifications issued thereunder by Central Pollution Control Board, June,2010; Pollution Control Law Series: PCLS/02/2010.
[7] Sewage Treatment market in India 2018, India Infrastructure Report.
[8] Japan-India Friendship: Activities of JICA in India, Presented by Takema Sakamoto in Ahmedabad Management Association, 13 april,2018.
[9] National Water Mission (2008)
[10] National Water Policy (2012)
[11] Policy for reuse of treated water, Government of Gujarat.