The Role of Information Technology in Environmental Protection and Management for Sustainable Development: Profiling Turkana County, Kenya

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Abstract

This Research Paper evaluated the challenges related to application of IT for Environmental Protection and Management for Sustainable Development, studied advantages and disadvantages of Information Technology (IT) on Environment and understood the potential impacts of IT on Environmental Protection in Turkana County, Kenya. Based on the Literature review Conceptual Model was developed to show how IT & Environmental Department can impact conjointly in Developing Environmental Development and Sustainability. For the purpose of this study 25 small scale companies I Lodwar town were selected randomly. One University College was also selected to determine research developments in environmental sustainability that was being undertaken. Analysis Reveal that most of the companies were unsuccessful in implementation of IT in their Environmental Management system. The University College shared an implementation matrix of the different MoUs being implemented to conserve the environment and the research outputs. This might be because of advantage and benefits of IT are availed by corporate service institutions. Corporate have to face the huge Financial Crunch in short run for Implementation of

IT because of IT infrastructure limitations in developing countries. Even after many barriers almost one fourth of company have adopted Technology in running their businesses. That is the way ahead to look towards IT as the whole world is moving towards Digitalization. IT will definitely play a Major role in Environmental Protection and Management for sustainable development with its Advantages and Benefits. That will lead in more Cleaner, Greener and Environmental Sustainability World – wide by next few decades.

Keywords: Environmental Protection; Information Technology (IT); Environmental Sustainability; Environmental Management; Sustainable Development.

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1. Introduction

Sustainable development is one of the utmost important social challenges of the 21st century. One universal trend with major implications for sustainable development is the extremely rapid development and application of Information Technology (IT), typically referred to as the "IT revolution." As a result of the "IT revolution," there are several efforts to leverage IT for sustainable development, mainly in the context of empowering developing countries [1].

There is an excessive reliance on technology to resolve environmental difficulties around the world nowadays, thanks to a virtually universal reluctance by governments and those who guide them to create the social and political changes that may be necessary to cut back growth in production and consumption. However, the types of technological changes that may be necessary to stay up with and counter the growing environmental destruction caused by escalations in production and consumption would have to be honestly dramatic. The driving force of sustainable development, legislative measures, economic instruments, and customer pressures, are aimed at achieving technological changes like waste minimization, recycling, altered production processes, and replacement of materials, pollution control and well-organized usage of resources [2].

Technology that's additional to existing production processes to manage and cut back pollution. One off the option available to replace the end of the pipe technologies is by implement new generation 'clean' technologies that adjust manufacturing procedures, assistances to the products and process themselves so that, they're more environmentally friendly. Clean technologies are desirable to end-of-pipe technologies since they avoid the essential to extract and concentrate poisonous material from the waste stream and deal with it. Technologies must be used that need less water, energy and raw materials, and that decrease waste discharges. Also, raw material inputs and processes are modified so instance, solvent-free inks and paints, and heavy metal-free pigments are used. The end products can be redesigned to decrease environmental impact during both manufacture and use, and waste flows is reused within the production process rather than dumped. Cleaner technologies don't always exist and, even when they are available; corporate tend not to exchange their old technologies until they have run their useful life. Also, corporate opt to keep to a minimum the organizational changes that require to be made; they prefer to play it safe once it comes to investment in pollution management [3].

Most of substitute technologies aren't adopted since alternatives are more costly or less economical; there are typically other reasons, too. Even today several corporate aren't implementing technologies aimed towards waste reduction and minimization, in spite of their accessibility and cost savings. A universal trend with vital implications for sustainable development is the extremely speedy development and use of Information Technology (IT), often referred to as the "IT revolution." By significantly dropping the cost of information and communication, IT advances have had tremendous economic effects. By helping to motivate the globalization of markets and tributary to a larger knowledge intensity of economies, IT has inspired the "knowledge-based economy [4].

2. Review of Literature

The paper "The trend-setter role of technologies in waste management towards the sustainable development" Iona & Gheorghe (2014) presents the foremost significant IT technologies that have contributed to the identification and implementation of latest sorts of economic and social development that takes into account the assessment of the environmental impact of products throughout their life cycle [5]. Technologies such as Decision Support Systems (DSS), remote sensing and Geographical Information Systems (GIS), online web services, virtualization and cloud computing are examined in terms of the trend-setter role and of the impact on the sustainable development of society. This paper focuses on the problem of the waste management and the role of IT to support management activities. In the context of the sustainable waste prediction is of great interest to the businesses involved within the entire chain of waste management, to the local government in order to assess the expenses and establishing the budgets [6].

This paper debates the challenges for life cycle assessment arising from the difficulty of food systems, and endorses research urgencies for both scientific development and improvements in everyday implementation. The most challenges highlighted in analysis are associated to totally different methodological features. Firstly, there's a necessity to move beyond the humble rationale that more productivity per hectare is sufficient to ensure growing eco-efficiency. This advises a desire to search out a balance between quantities and qualities in addition as exploring prospect for implementation of semi-quantitative models in LCA. The goal must be to have comprehensive and scientifically sound measures [7]. The research conveyed here undertook a three-phase approach of choosing, analyzing, and synthesizing relevant literature to develop a holistic, Tran's disciplinary, integrative framework for IT-enabled corporate transformation. The attention on business transformation is since business is recognized as being a crucial contributor in realizing the challenges of environmental sustainability due to its potential capacity for revolution and change - locally, nationally, and globally. This research Paper also serves as a resource base for researchers to start to undertake vital information structures and multidisciplinary work toward the objective of environmental sustainability. Through selection and analysis of explanatory examples of current work from twelve academic disciplines across six core classes, the framework addresses the key problems of uncertainty: (1) what's meant by environmental sustainability? (2) What are its key challenges? (3) What's being done concerning these challenges? (4) What must be done?

3. Research Problem

Sustainable development represents a major universal challenge by imposing society to balance the need to prosper economically with the responsibility to safeguard continuing social development and environmental protection [8]. IT and development, positive as well as negative, need got to be well understood to see that problems can be efficiently addressed by means of IT, however IT tools can be used, and in what context must the technology be executed. Deepening "digital" and "knowledge" divides, over-reliance on IT as a cure-all to whole problems, and environmental rebound effects are between the dynamics that disturb a country's capability to implement effective IT policies for sustainable development. The word green IT is often used, notably in association with reducing energy usage in data center. However the term is taken into account misleading. Green IT is an oxymoron; it emphases attention on technology instead of its application; and there's "inherent lack of greenness within the technology [9].

4. Research Methodology

The study made usage of primary and secondary source were based entirely on the use of firms corporate website and annual report of choose companies in Goa and different applicable info was also collected supported on personal visit to government offices like IDC, Industrial development corporation, Director of industries trade and commerce, Goa state pollution control board and their official web-site. For the purpose of this study 25 manufacturing companies selected, out of Large and medium classes based on random sampling technics. This examination utilized the content analysis technique like percentage which is research methodology for making replicable and valid inferences form data. Primary date was collected through personal interview and Questioner, where secondary data has been gathered through intense Literature review of Journal Article, Research Paper, Thesis, Periodical, which has been Collected through various E- Resources Like Shodhganga, N- List, Science direct, University E - library, J-Stor Etc. This Literature has performed as the base Line in Conceptual Formation and Model Development during this Research article.

5. Objectives

5.1 To evaluate the challenges related to applications of IT for Environmental Protection and Management.
5.2 To study and understand potential impacts of IT on Environmental Protection.
5.3 To study Pros and cons of IT on Environment.

6. Conceptual Model and Framework

The terms technology, green IT, and environmental sustainability of IT warrant some clarification. Technology is stated to generically in many evaluative reports and research papers for its potential involvement to environmentally sustainable solutions. Certain specific technologies are identified for particular situations; for example, technology enabled contributions to decrease environmental degradation, including clean coal technologies, more efficient energy production, and transportation substitution. The technologies to be applied might be present or emerging; they could be enabling new chemical processes, waste processing, or video conferencing. At some stage, perhaps only for process coordination, management, monitoring, modelling, evaluation, and reporting purpose, it is greatly probable that IT will play a vital role. Environmental sustainability of IT refers to the role of IT in environmental

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sustainability as both problem and solution. The term is employed widely however lacks common and consistent meaning. The term is defined in this article holistically from the perspectives of IT producers and those seeking to use IT for environmental sustainability as activities to reduce the negative effects and maximize the positive effects of human behaviour on the environment through the planning, production, application, operation, and disposal of IT and IT enabled merchandises and services throughout their life cycle (Figure 1).
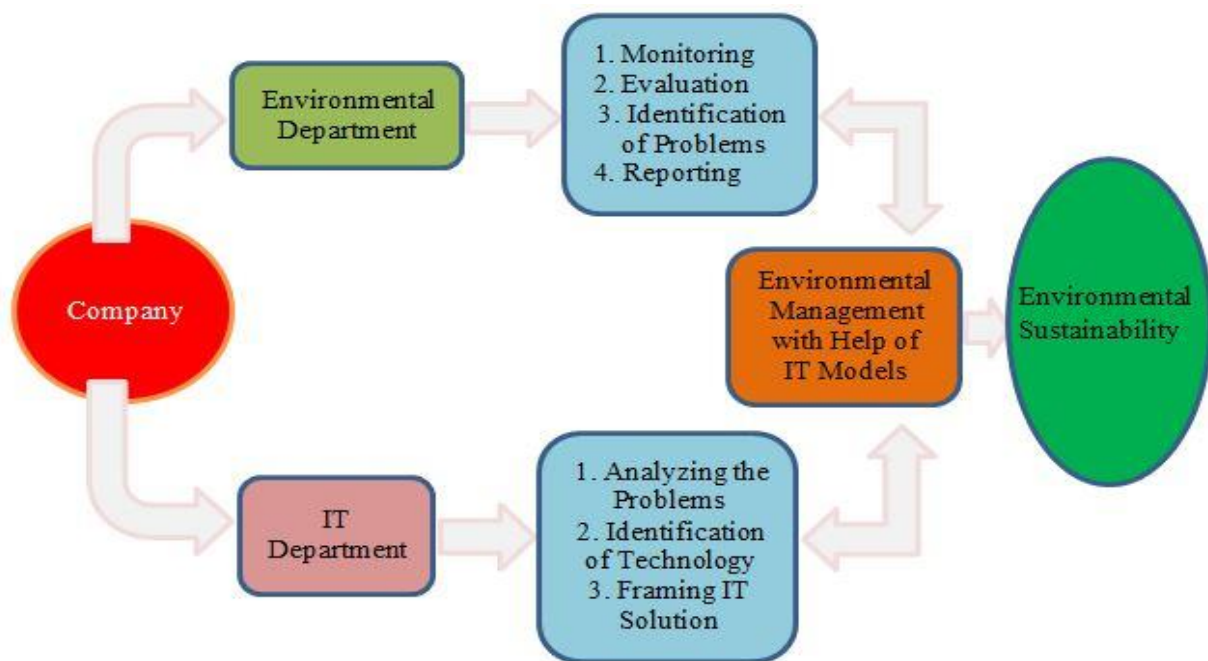

Figure: 1 Conceptual Model of the Impact of IT & Environmental Department on Environmental

7.Analysis
7.1 The Challenges Related to Applications of it for Environmental Protection and Management
Environmental technology solutions permit companies to go ahead of environmental regulations and establish a firmer footing with regard to environmental and products liabilities. They may permit industry to anticipate some regulations. They similarly permit some leading corporate to shape environmental regulations in line with their own internal policies. These corporate stand to gain competitive advantage over rivals. With of these potential advantages one wonders why lot of Corporate does not adopt environmental technologies quickly. There are numerous barriers to their adoption, including the following:

7.1.1 Costs of Developing Solutions: Technological solutions for several environmental issues are expensive to develop. They need new investigation, new technological info, new organizational arrangements, and generally new

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infrastructural services. Environmental technologies might increase up-front costs as a result of the essential for fresh designs, new setup costs, switchover costs from present procedures, and personnel training costs. But they can also reduce costs of operations, raw materials and energy, maintenance, waste disposal, pollution control, and environmental liabilities. Possibly the net result is that environmental technology investments have longer pay- back periods than conventional investments.

7.1.2 Lack of Knowledge and Environmental Information: In some environmental regions technological solutions are merely not available at this time. For instance, think about the global warming issue caused by excessive greenhouse gases with in the atmosphere. There are not any financially possible and politically acceptable solutions currently presently accessible. Every proposed solution has certain unintended negative effects. In such circumstances managers desire to take a wait-and-see attitude.

7.1.3 Implementing environmental technologies is organizational inaction: Organizations are comfortable to doing things in certain set ways. They obligate stable and ancient decision routines, standard procedures, and cultural habits for doing things. There's opposition to altering historical patterns of procedures and systems.

7.1.4 Contradictory Regulation: Contradictory regulation of environmental problems occasionally acts as a barrier to action. Managers tend to be confused regarding what's expected of them, and desire inaction. Even several Laws and Regulation have been violated every day due to no proper Guidelines has been specified when it comes to the Environmental Protection. Despite these and many more specific barriers in individual companies, environmental technologies are being adopted broadly and are collectively disturbing the competitive landscape. They enable corporate to remain competitive in world-wide markets, decrease costs and production periods, and improve strategic flexibility.

7.1.5 Potential Impacts of it on Environmental Protection: The most vital IT technologies that have contributed to the identification and implementation of recent methods of economic and social development that takes into consideration the assessment of the environmental impact of merchandises throughout their life cycle Technologies like a Decision Support Systems (DSS), remote sensing and Geographical Information Systems (GIS), online internet web services, virtualization and cloud computing are examined in terms of the innovator role and influence on the Environmental sustainability in society.

7.1.6 Types of Technology and Its Impact on Environmental Protection: The classification of environmental technologies is an essential first step in the process of characterizing an environmental technology group as a whole, monitoring changes, and assessing implications for performance. In fact, other research supports straighter - forward types for characterizing environmental technologies as fitting to three general classes: Pollution prevention, Management system, Pollution control. With the support of these classifications, we can categorize the allocation of resources across environmental technologies over time and project-by-project for over all Environmental Protection and Management.

7.1.7 Pollution prevention technology: These technologies decrease or eliminate pollutants by using cleaner alternatives than those presently in Place. Product adaptation encompasses all investments that considerably modify an existing product's design to decrease any negative influence on the environment throughout any stage of the product's manufacture, use, disposal, or reuse. Procedure adaptation refers to basic changes to the manufacturing

process that decrease any negative impact on the environment throughout material acquisition, production, or delivery. The ultimate rethinking of a product or manufacturing process conjointly places fewer constraints on the means of realizing environmental improvement, thereby providing larger prospect for innovation. All environmental technologies, by definition, have some positive impact. However, pollution prevention technologies are likely to significantly decrease the overall amount of harmful pollutants released into the atmosphere and disposed of. Pollutants don't seem to be simply transferred from one medium to a different (for instance, from the air to solid waste); instead, their generation is totally avoided.

7.1.8 Management systems: These environmental technologies are nothing but infrastructural investments that affect the way manufacturing is managed. They embody efforts to formalize procedures for evaluating environmental impacts throughout capital decision budgeting, to extend external stakeholder involvement in managing processes, to extend worker training for spill prevention and waste reduction, to regulate an environmental department, and to develop new procedures for cross-functional coordination. Monitoring, internal and external reporting, and connected compliance systems also are examples of management systems. Since these systems operate to both control and stop environmental degradation, no consistent result on performance is expected.

7.1.9 Pollution Control Technologies: A pollution prevention technology is structural investments. However, in distinction to prevention technologies, pollution control technologies recycle or dispose of impurities or harmful by-products at the finale stage of a manufacturing method, either instantly or later. To accomplish this, a plant necessarily adds operations or equipment to the end of an existing manufacturing process, thus leaving the original product and method nearly unaltered. Pollution control technologies can be more categorized as either rectification or end-of-pipe controls. Rectification refers to cleaning up environmental harm caused by crises or past practices, and it's usually driven by regulation or by improvement in scientific understanding of environmental harm. End- of-pipe controls state to using equipment that is added as a final method step to capture pollutants and wastes before their discharge. Any environmental advantage offered by pollution control technologies is restricted to reducing the risk connected with a specific contaminant, either transferring it from a less secure medium to a more safer one (for instance, from air emission to solid waste) or changing it to a more benign sub- stance. Thus, no important modification in the quantity of pollutants is predictable.

7.2 Pros and Cons of It on Environment
7.2.1 Disadvantages of IT on Environment: One of the foremost important harmful effects of IT on sustainable development can be generally categorized as "rebound effects." Associate environmental rebound impact is a trend that emerges to counteract the energy, resource, and pollution reductions gained by IT production or use. Harmful rebound effects possibly occur once the widespread consumption of those products result in harmful environmental impacts that offset the initial resource savings. These effects are typically classified as primary or secondary. Primary effects are direct environmental effects due to the manufacturing and usage of IT infrastructure. Secondary effects are environmental impacts that arise attributable to IT-induced changes in customer behavior:

7.2.1.1 Primary Effects
7.2.1.1.1 Waste: IT products appear to end in less production of waste than other traditional products. However, a better explore at the problem reveals that this is not forever the case. As a result of shorter innovation cycles, various IT products have shorter life spans, resulting in increasing amount of waste electrical and electronic equipment. IT

products contain substances that are dangerous to the environment and human health, like halogen organic compounds and heavy metals, and are troublesome to eliminate of, recycle, or reuse. Several of the older IT products are still largely burned or landfilled, and also the rest are largely recycled instead of reused.

7.2.1.1.2 Energy: There are doubtless important rebounds effects from energy consumption due to IT usage. One study on book purchasing in Japan found that B2C e-commerce consumes slightly extra energy than traditional retailing. Customers who shop online at home end up increasing their home energy intake. This interprets into growing demand for further equipment and later more energy to drive this equipment- this is another serious implication of IT that requires thoughtful attention.

7.2.1.2 Secondary Effects

7.2.1.2.1 Waste: The IT revolution has not lived up to its promise of making the "paperless workplace." In fact, IT advances have led to enlarged paper consumption. World-wide consumption amplified twenty-fold throughout the 20th century, and by an element of three just during the last three decades. One major aspect is that the inflated accessibility to printers, that fuel the demand for paper. Email additionally contributes to inflated consumption. According to one source, a corporation that uses email sees an average 40% increase in paper consumption as a outcome.

7.2.1.2.2 Transportation-Related Pollution: Although there are some ways in which IT may decrease the need for transportation, there are several IT-related services that could induce more transportation with worse-than-intended environmental consequences. E - Commerce has enlarged the demand for overnight shipping that has generated additional freight traffic, both within the air and on the road. Due to the easy accessibility of the Internet, there is similarly a growing trend towards world-wide shipping, resulting in geographically extended offer patterns. These new transportation demands have potential environmental implications that required to be assessed.

7.2.2 Advantages of IT on Environment

Environmental technologies request alignment of corporate technologies and businesses with the natural environment. Environmental technologies are a possible strategic resource since they effect on the value chain at multiple points. They're capable of providing corporate with unique and irreproducible advantages at every stage of the value chain. Integrating environmental technologies into strategic management offers several reasonable advantages; some of the advantages are as follows:

7.2.2.1 Cost Reduction: Environmental technologies provide the chance to drive down operating costs by exploiting ecological efficiencies. By reducing waste, conserving energy, reusing materials, and addressing life cycle costs, corporate can make large financial gains.

7.2.2.2 Revenue Enhancement: Environmental technologies produce prospects for revenue improvement in two ways. First, they permit entry into the growing marketplace for environmental products and technologies. There's an oversized and growing section of customers those want eco-friendly products and packaging in most industries. These 'green' products need environmental technology designs in production systems

7.2.2.3 Supplier Relations: Both producing for the environment and design for dismantling actively involve suppliers in company's decision making. They strengthen supplier ties. Stronger ties facilitate in guaranteeing higher

quality of incoming supplies. Corporate can influence suppliers to vary the planning specification of supplies, to scale back costs, and simplify manufacturing process.

7.2.2.4 Quality Improvement: Environmental technologies reinforce the overall quality controlling philosophy. TQEM supports total quality programs and encompasses them to environmental problems. Technology assessment permits quality considerations to be incorporated within the very early stages of selected product and production technologies.

7.2.2.5 Competitive Advantage: Competitive advantage ensues directly from cost declines and revenue enhancements prompted by environmental technologies. Environmental technologies also provide corporations the potential for making unique and irreproducible strategies. Corporations will distinguish themselves through these strategies and become environmental leaders.

7.2.2.6 Reduction of Liabilities: Environmental technologies are penetrating to long-term risks of resource depletion, changing energy costs, product liabilities, and pollution and waste. By introducing environmental technologies that consistently address these long-term problems early, corporations will become responsive to and manage these environmental risks.

7.2.2.7 Social and Health Benefits: Environmental technologies help the ecosystem and the environment of communities in which corporate operate. They effect in reduced community expenses on health impacts of industrial pollution.

7.2.2.8 Public Image: Environmental technologies are similarly good for public relations and corporate image. They assist corporate to establish a social presence in their markets, and gain social legitimacy. Environmental technologies deliver a way of fundamentally shifting the profitability dynamics of businesses. They have an effect on basic cost parameters of resource use, energy use, producing efficiency, waste disposal, and pollution reduction. They deliver new bases for crafting competitive advantage. They empower companies to produce new product markets, and alter customer demand in existing markets.

7.2.2.9 Impact of it in Environmental Management on Industries of Goa: Investigation has Identified that Industries in Goa Hardly Adopted the Technology in Environmental Protection and Management. As out of Select 25 Companies hardly one fourth of Company has agreed that they have started using Information Technology into their Environmental Management system. This will lead to Individual Benefits of corporate as well as in building Environmental Sustainability World-wide. This Picture also Highlight that Even after Information Technology having so much of advantages. Where whole world is moving in the Direction of Digitalization and IT oriented. Major Chunk of the Companies in Goa has Unsuccessful in implementation of IT in to their Environmental management system. That highlight Company has to rethink on their stand towards IT application. As well as Government also should Support the Company that have started implementing IT in EMS. Government should look forward in bring some Grant, Laws, Coniston, Award and Subsidies in support with Technology adoption. This will enhance in more Utilization of IT by corporates in their Environmental Management System (Figure 2).
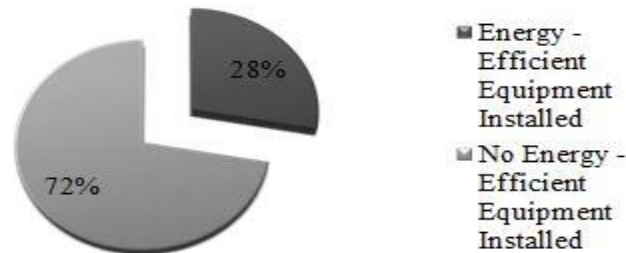
Figure 2: Industries in Goa adopting environmental friendly technology.

8. Conclusion

Environmental sustainability is one of the utmost important world-wide challenges of the 21st Century. Information systems are an important but ineffectively stood weapon in the arsenal of organizations in their environmental sustainability by permitting new practices processes in backing of belief formation, action formation, and outcome asses. Which also been highlighted in study as major chunk of company have not at adopted Technology in their Environmental Management system. That hint use as Barriers, Challenges and Disadvantages are right now completely over taking the Advantages and Benefits of Information Technology. This might be because of advantage and benefits of IT are availed by corporate at Long Run in the business. Corporate have to face the huge Financial Crunch in short run for Implementation of IT. As corporate have to bear with operating cost as Technology keeps on Updating. Even after many barriers almost one fourth of company have adopted Technology. That is the way ahead to look towards IT as whole world is moving towards Digitalization. IT will definitely play a Major role in Environmental Protection and Management with its Advantages and Benefits. That will lead in More Cleaner, Greener and Environmental Sustainable World-wide by next decade.

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