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From The Desk of the Editor-in-chief...

Taking one more step ahead by carrying our legacy forward towards continuous learning, greater academic excellence and with the blessings from our Founder President **Dr. Ashok K. Chauhan** and inspiration from our Chancellor **Dr. Atul Chauhan**, I take pleasure in presenting you the inaugural issue of **Amity Journal of Energy and Environment Studies** brainchild of **Sh.B.P.S.Chauhan**. He is peer heading the energy and power initiatives of Amity as Executive Director of Amity Energy & Environment and Amity Power Management.

We at Amity University believe that this journal fills a unique gap as it represents deliberations of academic and practitioner's discourse under the broad umbrella of energy & environment studies. The journal focuses on studies and publications related to human interaction with the energy & environment including natural energy & environment, built energy & environment, and the sets of relationships between them to understand complex problems. In other words the journal revolves around the basic principles of ecology, energy and environmental science, as well as associated subjects such as ethics, policy, politics, law, economics, philosophy, Energy & Environmental sociology, planning, pollution control and natural resource management making it **interdisciplinary** in nature. This edition has been the resultant of hard work by Editor **Dr. Chandranshu Sinha** and Associate Editor **Dr. Ambrina Sardar Khan**

Amity Journal of Energy and Environment Studies (AJEES), to be published bi-annually, is a double-blind peer reviewed journal. The selection process is independent and solely merit-based, with the objective of identifying the best research in the field. The Journal proposes to bring together influential strategists, practitioners, policy-makers and students who share their views on the most challenging issues falling under the broad domain of Energy & Environment studies. The mission of AJEES is to provide a quality research platform for academicians and practitioners from academia and the industry. The journal is to be a forum for scholarly dialogue regarding the most important emerging issues in the field and advance the knowledge on issues and best practices related to energy and environmental studies which get reflected in the three pronged objectives of this Journal. The first objective is to meet the quality and integrity requirements of journal evaluation organizations. The second is the editorial staff and reviewers will work with authors to develop and improve submissions providing constructive commentary and evaluation to improve the submission and the author's writing capabilities. Finally the third objective is to work towards getting the journal listed and indexed in reputed databases. To achieve these objectives, much of the journal will be devoted to the publication of original empirical articles (including theoretical and applied research investigations), articles, book reviews, and case study. Integrative reviews of the evidence regarding energy & environment studies will be considered for publication.

We are committed to keeping the journal relevant and useful to academicians, practitioners, researchers, and policy makers. Our aim is to continually increase the journal's profile and impact factor, with a focus on significantly advancing scholarship in the field.

Our inaugural issue comprises of seven articles and the titles of the manuscripts cover a range of issues under the broad umbrella of energy and environmental studies. In the first article titled: 'Review of Green Building Guidelines: A Comparison between LEED 2011& LEED 2014' the author has attempted to identify the major differences between India's LEED NC 2011 (Leadership in Energy and Environmental Design- New Construction) rating system with LEED New Building Rating System 2014 signaling the arrival of green rating of buildings in India. In the second article titled: 'Depletion of water quality and quantity in Kuttanad, Kerala', the author has attempted to focus on the depletion of water bodies in Alleppey region of Kerala. The study talks of how it has led to the declining trend in agriculture its consequences and suggests remedial measures. The third article is titled:

'Energy Savings Performance Contracting: An Important Resource in India's Pursuit of Sustainable Development', the authors have reviewed and critiqued energy performance contracting (EPC) is a

demonstrated and globally accepted means for reducing the operating costs and environmental impacts. The fourth article is titled: 'Comparative Studies on Downstream Processing and Fermentative Production of Itaconic Acid Using Aspergillus terreus' and in the study the authors have attempted to demonstrate the comparison of production of itaconic acid by cheap raw materials and also the use of inexpensive method for purification which will be helpful in decreasing the process economics. The fifth article is titled: Role of Fuel Economy in Automobiles towards Conservation of Energy & Environment and in the study the author has attempted to bring out ways by which the consumption of fuel in automobiles can be reduced. The sixth article is titled: 'Remote sensing and Urban land use' and in this study the authors have attempted to critique the uncontrollable urbanization which has been responsible for many of the problems, our cities face today, resulting in substandard living environment, acute problems of drinking water, noise and air pollution, disposal of waste, traffic congestion etc. The paper further suggests that how The modern technology of remote sensing allow collecting lots of physical data, with speed and on repetitive basis, and together with GIS helps analyzing the data spatially. This development offers possibilities of generating various options (modeling), thereby optimizing the whole planning process. The seventh article titled: 'Effects of Climate Change on Agriculture' and in the study the authors have attempted to critique the effects of climate change and indicates the need to formulate of appropriate adaptation and mitigation strategies for responding to the challenge of climate change.

Please know that we always welcome your feedback on content, structure, and topical issues that could advance the journal and the field of Energy & Environment Studies. Please send all questions, comments, and inquiries to ajees@amity.edu.

Finally, it gives us enormous pleasure to officially launch the inaugural edition of **Amity Journal of Energy & Environment Studies**. Enjoy reading!

Sanjeev Bansal
Editor-in-chief
Amity Journal of Energy & Environment Studies

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Review of Green Building Guidelines: A Comparison between LEED 2011& LEED 2014

Rachna Dhingra*

The construction industry is one of the largest economic activities contributing to India's development. But, due to this growth and development at a rapid pace an enormous pressure is seen on the resource demand - like energy, water, materials etc. A lot of turbulence is seen in the environment and it is getting impacted to a very large extent. To resolve the environmental problems one way is to adopt a path towards sustainability and green buildings. Green building practices aim to reduce the environmental impact of buildings through environmentally friendly construction practices. The idea of green rating of buildings has taken roots in India. The design and construction industry has gradually accepted LEED (Leadership in Energy and Environmental Design) rating system in mainstream practice as evidenced through growth of LEED-New Construction (NC) certified projects over the past few years (LEED, 2005). This paper is an attempt to identify the major differences between LEED NC 2011(INDIA) and LEED New Building Rating System 2014.

Keywords : Sustainability, Green Buildings, Green Building guidelines, LEED rating system

INTRODUCTION

The construction industry is one of the largest economic activities contributing to India's development. India has been witnessing tremendous growth in building and construction sector in the past recent years. But, due to this growth and development at a rapid pace an enormous pressure is seen on the resource demand - like energy, water, materials etc. A lot of turbulence is seen in the environment and it is getting impacted to a very large extent. To resolve the environmental problems one way is to adopt a path towards sustainability and green buildings.

A sustainable building, or green building is an outcome of a design philosophy which focuses on increasing the efficiency of resource use energy, water, and materials while reducing building impacts on human health and environment during the building's lifecycle, through better sitting, design, construction, operation, maintenance, and removal. (U.S. Environmental Protection Agency, 2009)

"A green building is one which uses less water, optimizes energy efficiency, conserves natural resources, generates less waste and provides healthier spaces for occupants, as compared to a conventional building." (IGBC, 2008)

The related concepts of sustainable development and sustainability are integral to green building. Effective green building can lead to: reduced operating costs by increasing productivity and using less energy and water, improved public and occupant health due to improved indoor air quality and reduced environmental impacts. Green building practices aim to reduce the environmental impact of buildings through environmentally friendly construction practices.

Green Building Guidelines are developed to provide a series of guidelines and benchmarks to those interested in construction of a sustainable and green building. It was understood that in order to develop a proper understanding of the elements of a green building and to then construct it, a comprehensive set of guidelines would be required to direct the interested party in appropriate techniques and processes towards building a green building.

The idea of green rating of buildings has taken roots in India. This is in line with the global trend in which the rating tools set benchmarks for green measures for constructing and using buildings to make them sustainable and to reduce their negative impacts on

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environment. Globally, large numbers of rating tools have evolved in a number of regions that are influencing property markets towards more sustainable practices. A wide range of rating systems have evolved in different regions of the world based on local climates and geographical conditions.

A green building rating system is an evaluation tool that measures environmental performance of a building through its life cycle. It comprised of a set of criteria covering various parameters related to design, construction and operation of a green building. A project is awarded points once it fulfills the rating criteria. The points are added up and the final rating of a project is decided. Globally, green building rating systems are largely voluntary in nature and have been instrumental in raising awareness and popularizing green building designs. Each criterion has pre-assigned points and sets performance benchmarks and goals that are largely quantifiable

Leadership in Energy and Environmental Design (LEED) is an internationally recognized green building certification system, providing third-party verification that a building or community was designed and built using strategies aimed at improving performance across all the metrics that matter most: energy savings, water efficiency, CO2 emissions reduction, improved indoor environmental quality, stewardship of resources and sensitivity to their impacts.

LEED Green Building Rating System, developed by United States Green Building Council (USGBC) is one of the most widely accepted rating systems in countries such as China, India, and Canada (LEED, 2005). The design and construction industry has gradually accepted the LEED rating system in mainstream practice as evidenced through growth of LEED-New Construction (NC) certified projects over the past few years (LEED, 2005). The increase in LEED-NC certified project represents a steady and growing interest in green buildings (Syal, 2007).

These rating systems serve two functions; of promoting high performance buildings, and creating the demand for sustainable construction. One of the most significant indicators of the shift towards green design and construction practices in the past few years is the growing number of LEED-NC certified buildings in the United States (USGBC, 2006).

LEED- INDIA

Following in the footsteps of the United States Green Building Council, the India Green Building Council has been promoting green buildings in India for many years now. The IGBC has developed an internationally accepted India-specific rating program called the LEED-INDIA Green Building Rating System in 2007, making it easy for Indian buildings to go green. In India, there are 2,007 Registered Buildings and 357 Green Rated Buildings having a Green Building Footprint of 1.4 Billion Sq.ft (IGBC, 2013). So, it is seen clearly that the green building sector is growing in India and more companies are adopting this concept.

The USGBC had instituted the LEED rating, which covers various project types detailed as follows: LEED is a "National-consensus based, market driven building rating system designed to accelerate the development and implementation of Green Building practices". LEED takes into account all the project types including: New Construction, Existing Buildings, Commercial Interiors, Core& Shell, Homes and neighbourhood development.

LEED for New Construction is a one time event, designed to guide and distinguish high-performance commercial and institutional projects, with a focus on office buildings.

The LEED India rating system was formally launched by the IGBC in order to indigenize LEED US to suit Indian requirements. It adopts several Indian codes and standards such as the National Building Code, guidelines of the Environment and Forests Ministry, Central Pollution Control Board norms and the Energy Conservation Building Codes of the Bureau of Energy Efficiency. From January 2007 onwards LEED-India started registering projects under the Green Building New Construction (NC) system.

LEED-INDIA provides building owners, architects, consultants, developers, facility managers and project managers the tools they need to design, construct and operate green buildings. It promotes a whole-building approach to sustainability by recognizing performance in the following five key areas:

- Sustainable site development
- Water savings
- Energy efficiency
- Materials selection and
- Indoor environmental quality

The intent is to promote healthful, durable, affordable, and environmentally sound practices in building design and construction. LEED-INDIA rating system provides a roadmap for measuring and documenting success for every building type and phase of a building lifecycle.

LEED NC 2011 FOR INDIA

The first LEED India rating programme, referred to as LEED India Version 1.0, was launched during the Green Building Congress Conference in October 2006. The latest rating system is now called the LEED 2011 for India - New Commercial Construction and Major Renovations or LEED 2011 for India - NC. The Indian Green Building Council launched version of LEED India, LEED 2011 for India. The new projects will are register under the new rating system beginning 20th October 2011. LEED India 2011 focuses on reduction of energy usage & carbon di oxide emission

Features of LEED India

The LEED 2011 for India Green Building Rating System is a voluntary, consensus based, market-driven building rating system based on existing proven technology. It evaluates environmental performance from a whole building perspective over a building's life cycle, providing a definitive standard for what constitutes a "green building".

LEED India for 2011 is a measurement system designed for rating new and existing commercial, institutional and residential buildings. It is based on accepted energy, environmental principles and strikes a balance between known established practices and emerging concepts. It is a performance-oriented system where credits are earned for satisfying criterion designed to address specific environmental impacts inherent in the design and construction. Different levels of green building certification are awarded based on the total credits earned. The system is designed to be comprehensive in scope, yet simple in operation.

Review of LEED-NC - Credit List (2011)

- 7 major categories
- 8 mandatory prerequisite
- 49 credits and sub credits
- 100 possible points under 5 categories + 10 bonus points in 2 categories = 110 points in 7 categories
- Categories are not equally based

From the above figure it can be seen that all the categories have different weightage. The most important category is energy and atmosphere as its weightage is 35%. The second most important category is sustainable site (26%). The other categories are indoor environmental quality (15%), Materials and Resources (14%) and water efficiency (10%).

- Points not equal benefit

Figure 1: Major categories in LEED 2011 credit list

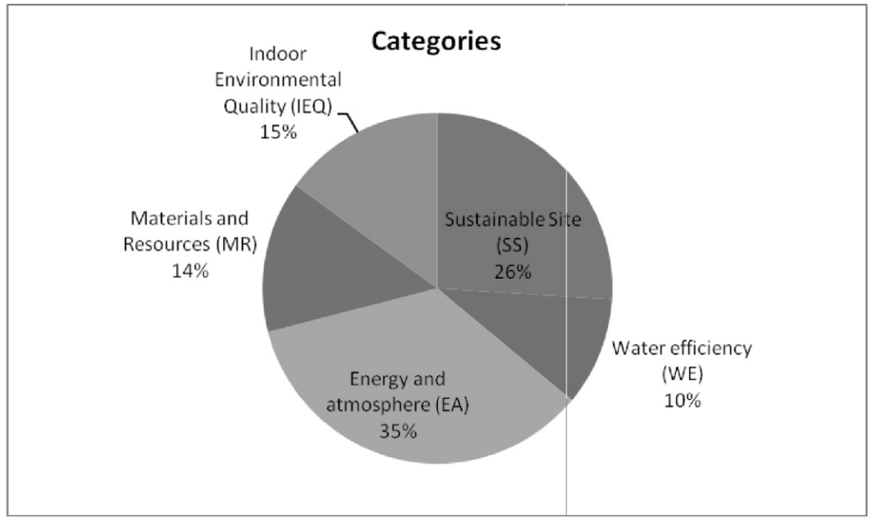
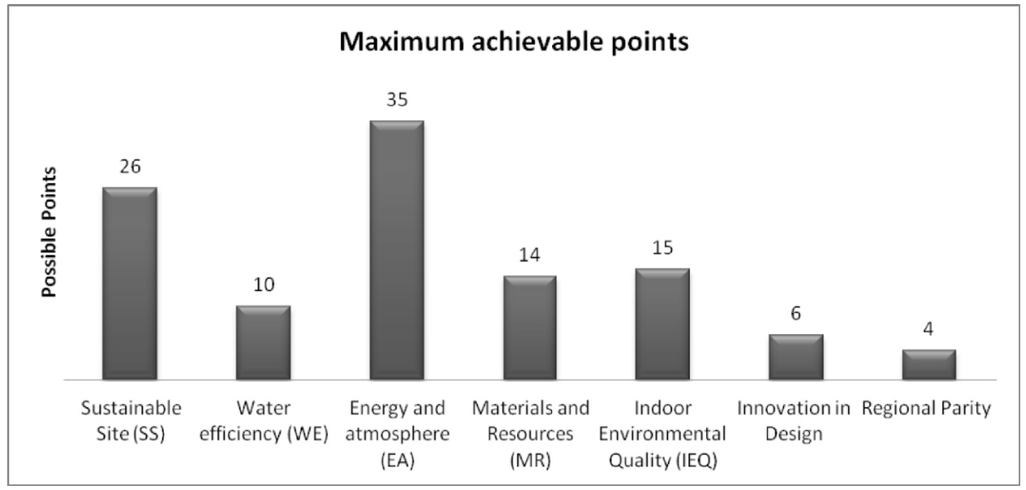


Table 1: Total credits and possible points in LEED 2011

Categories	Possible Points	Prerequisite	Credits & Sub-credits	Total Credits
Sustainable Site (SS)	26	1	14	15
Water efficiency (WE)	10	1	3	4
Energy and atmosphere (EA)	35	3	6	9
Materials and Resources (MR)	14	1	8	9
Indoor Environmental Quality (IEQ)	15	2	15	17
Innovation in Design	6	0	2	2
Regional Parity	4	0	1	1
Total	110	8	49	57

Figure 2: Maximum achievable points in each category



As it can be seen from the above figure, maximum possible points (35) can be achieved in energy and atmosphere, 26 points can be achieved in sustainable site, 15 points in indoor environmental quality, 14 points in materials and resources, 10 points in water efficiency, 6 points in innovation in design and 4 points in regional parity. It can be revealed that all the categories provide scope to a constructor for achievement.

Certification Levels

Table 2: Level of certification (LEED-2011)

Certification	Points Achieved
Certified	40–49 points
Silver	50–59 points
Gold	60–79 points
Platinum	80 and above

There are four different levels for achieving certification for a building i.e. certified, silver, gold and platinum.

LEED 2014 FOR INDIA - New Building Rating Systems

The building sector in India is growing at a rapid pace and contributing immensely to the growth of the economy. This augurs well for the country and there is now an imminent need to introduce green concepts and techniques in this sector, which can aid growth in a sustainable manner.

The green concepts and techniques in the building sector can help address national issues like water efficiency, energy efficiency, reduction in fossil fuel use for commuting, handling of consumer waste and conserving natural resources. Most importantly, these concepts can enhance occupant health, productivity and well-being.

Against this background, the Indian Green Building Council (IGBC) has launched 'IGBC Green New Buildings Rating System®' to address the national priorities. This rating programme is a tool which enables the designer to apply green concepts and reduce environmental impacts that are measurable. The rating programme covers methodologies to cover diverse climatic zones and changing lifestyles. (IGBC, 2014)

Announcing the launching of the three systems at the CII Green Building Congress 2014, Prem C Jain, Chairman of IGBC, said the New Building Rating System comes in the backdrop of IGBC and US Green Building Council parting ways on the LEED certification programme. "All these years, the US LEED certification was followed in rating new buildings. However, we have decided now to part ways and decided to have our own rating system for new buildings. We have adopted this approach as we believe India could become a next big Green Building base in the world," he said. A portal has also been created to facilitate online interface on green building rating systems.

National Priorities Addressed in the Rating System

The IGBC Green New Buildings rating system addresses the most important national priorities which include water conservation, handling waste, energy efficiency, reduced use of fossil fuels, lesser dependence on usage of virgin materials and health & well-being of occupants. The rating system requires the application of National standards and codes such as the NBC, ECBC, MoEF guidelines, CPCB guidelines, and several others. The overarching objective is to better the national standards so as to create new benchmarks.

- **Water Conservation:** Most of the Asian countries are water stressed and in countries like India, the water table has reduced drastically over the last decade. IGBC Green New Buildings rating system encourages use of water in a self-sustainable manner through reduce, recycle and reuse strategies. By adopting this rating programme, green new buildings can save potable water to an extent of 30 50%.
- **Handling of Consumer Waste:** Handling of waste in buildings is extremely difficult as most of the waste generated is not segregated at source and has a high probability of going to landfills. This continues to be a challenge to the municipalities which needs to be addressed. The rating system intends to address this by encouraging buildings to segregate the building waste.
- **Energy Efficiency:** The building sector is a large consumer of electrical energy. Through IGBC Green New Buildings rating system, buildings can reduce energy consumption through energy efficient building envelope, lighting, air conditioning systems, etc., The energy savings that can be realised by adopting this rating programme can be to the tune of 20 30%.
- **Reduced Use of Fossil Fuels:** Fossil fuel is a slowly depleting resource, the world over. The use of fossil fuel for transportation has been a major source of pollution. The rating system encourages the use of alternate fuel vehicles for transportation.
- **Reduced Dependency on Virgin Materials:** The rating system encourages projects to use recycled & reused material and discourages the use of virgin materials, thereby, addressing environmental impacts associated with extraction and processing of scare natural resources.
- **Health and Well-being of Occupants:** Health and well-being of occupants are the most important aspect of IGBC Green New Buildings rating system. The rating system ensures adequate ventilation, daylight and occupant well-being facilities which are essential in a building. The rating system also recognises measures to minimise indoor air pollutants. (IGBC, 2014).

FEATURES

IGBC Green New Building rating system is designed primarily for new buildings, both for air-conditioned and non air-conditioned buildings. New Buildings include (but are not limited to) offices, IT parks, banks, shopping malls, hotels, hospitals, airports, stadiums, convention centers, educational institutions (colleges, universities), libraries, museums, etc., Building types such as residential, factory buildings, schools, integrated townships will be covered under other IGBC rating programmes. It is broadly classified into two types:

1) Owner-occupied buildings are those wherein 51% or more of the building's built-up area is occupied by the owner.
2) Tenant-occupied buildings are those wherein more than 51% or more of the building's built-up area is occupied by the tenants. Based on the scope of work, projects can choose any of the above options.

It is a voluntary and consensus based programme.

The rating system has been developed based on materials and technologies that are presently available. The objective of this rating system is to facilitate a holistic approach to create environment friendly buildings, through architectural design, water efficiency, effective handling of waste, energy efficiency, sustainable buildings, and focus on occupant comfort & well-being. The rating system is evolved so as to be comprehensive and at the same time user-friendly. The programme is fundamentally designed to address national priorities and quality of life for occupants.

Some of the unique aspects addressed in this rating system are as follows:

- Recognition for architectural excellence through integrated design approach.
- Recognition for passive architectural features.
- Structural design optimisation with regard to steel and cement. This is developmental credit. Projects are encouraged to attempt this credit, so as to help IGBC in developing baselines for future use.
- Water use reduction for construction. This is also a developmental credit.
- Based on the feedback from green building proponents, use of certified green products will be encouraged. IGBC has launched a new initiative to certify green products to transform markets. Products would be evaluated right from extraction to disposal.
- Handholding from IGBC Counsellors will now be available for the projects.
- A site visit and audit is proposed before award of the rating.
- Projects are encouraged to report energy and water consumption data on an annual basis, to facilitate research in this area.

Review of LEED-NC Credit List (2014)

- 7 categories
- Divided into two categories: Owner occupied and tenant occupied
- 10 mandatory prerequisite
- 42 credits
- No sub-credits
- 88 possible points under 5 categories + 12 bonus points in 2 categories = 100 points
- Categories not equally based

As it can be seen that maximum weightage (28% - owner occupied and 27% - tenant occupied) is given to energy efficiency. The second most important weightage (18% - owner occupied and 19% - tenant occupied) is given to water conservation. 16% and 14% weightage is given to building materials and resources and site selection and planning respectively. Other categories has a weightage of indoor environmental quality (12%), innovation and development (7%) and sustainable architecture and design (5%). Each category has a different weightage and it provides the constructor a scope for working accordingly.

- Points not equal benefit

Figure 3: Major categories in LEED 2014 credit list (Owner and Tenant Occupied Buildings)

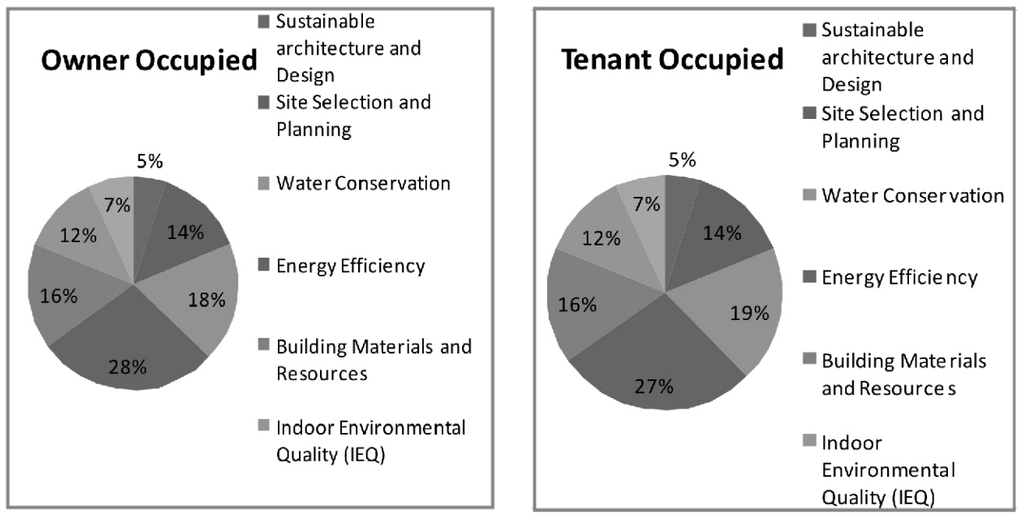
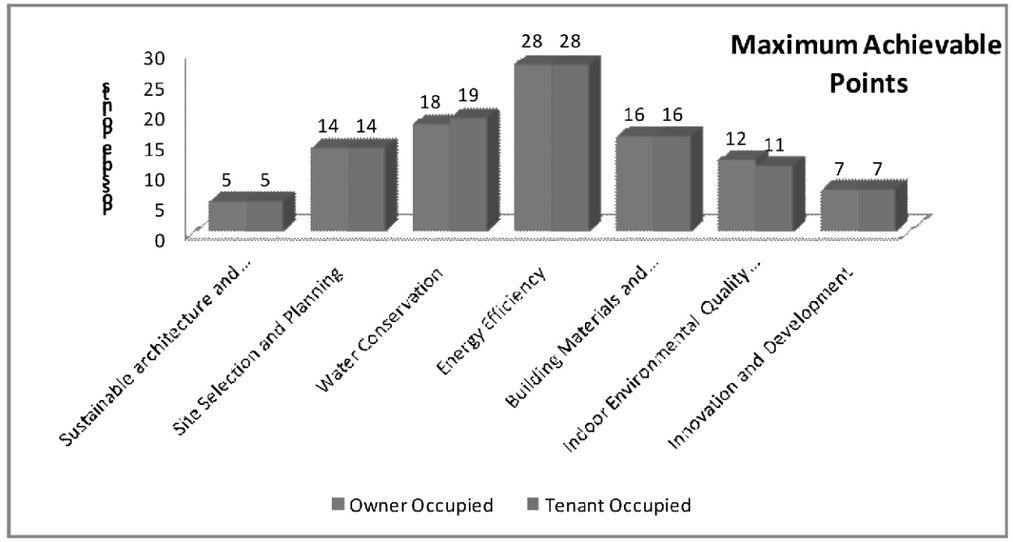


Table 3: Total credits and possible points in LEED 2014

Categories	Possible Points		Prerequisite	Credits	Total Credits in each category
	Owner Occupied	Tenant Occupied			
Sustainable architecture and Design	5	5	0	3	3
Site Selection and Planning	14	14	2	11	13
Water Conservation	18	19	2	6	8
Energy Efficiency	28	28	3	6	9
Building Materials and Resources	16	16	1	4	5
Indoor Environmental Quality (IEQ)	12	11	2	8	10
Innovation and Development	7	7	0	4	4
Total	**100**	**100**	**10**	**42**	**52**

Figure 4: Maximum achievable points in each category



Maximum achievable points are 28 in the category of energy efficiency. For water conservation (18 points - owner occupied, 19 point tenant occupied) and IEQ (12 points owner occupied and 11 points tenant occupied). Other categories have same points in both owner occupied and tenant occupied buildings. The points are: Building materials and resources (16 points), site selection and planning (14 points), innovation and development (7 points) and sustainable architecture and design (5 points).

Level of certification

The threshold criteria for certification levels are as under:

Table 4: Level of certification (LEED-2014)

Certification Level	Owner – Occupied Buildings	Tenant – Occupied Buildings	Recognition
Certified	50 - 59 points	50 - 59 points	Good Practices
Silver	60 - 69 points	60 - 69 points	Best Practices
Gold	70 - 79 points	70 -79 points	Outstanding Performance
Platinum	80 - 89 points	80 - 89 points	National Excellence
Super Platinum	90 - 100 points	90 - 100 points	Global Leadership

There are five level of certification for achieving rating for a building i.e. certified, silver, gold, platinum and super-platinum.

COMPARISON OF RATING SYSTEMS

Table VI: Entrepreneurial Activities Pursued by Rural Women Entrepreneurs in the Informal Sectors

<table>
<tr><th>Comparison</th><th>2011</th><th>2014</th></tr>
<tr><td>Categories</td><td>7 (regional parity included)</td><td>7 (sustainable architecture and design – new category, regional parity removed)</td></tr>
<tr><td>Sub-Categories</td><td>No divisions</td><td>Owner and tenant occupied buildings</td></tr>
<tr><td>Prerequisites</td><td>8</td><td>10</td></tr>
<tr><td>Credits and Sub credits</td><td>49</td><td>42, no sub - credits</td></tr>
<tr><td>Possible Points</td><td>100 possible points under 5 categories + 10 bonus points in 2 categories = 110 points in 7 categories</td><td>88 possible points under 5 categories + 12 bonus points in 2 categories = 100 points</td></tr>
<tr><td>Weightage Given to different categories</td><td><table><tr><td>Category
Sustainable site</td><td>Percentage
26%</td></tr><tr><td>Water efficiency</td><td>10%</td></tr><tr><td>Energy and atmosphere</td><td>35%</td></tr><tr><td>Materials and resources</td><td>14%</td></tr><tr><td>Indoor environmental quality</td><td>15%</td></tr><tr><td>Innovation in Design</td><td>6%</td></tr><tr><td>Regional Parity</td><td>4%</td></tr></table></td><td><table><tr><th>Category</th><th>Owner Occupied</th><th>Tenant Occupied</th></tr><tr><td>Sustainable architecture and design</td><td>5%</td><td>5%</td></tr><tr><td>Site selection and planning</td><td>14%</td><td>14%</td></tr><tr><td>Water conservation</td><td>18%</td><td>19%</td></tr><tr><td>Energy efficiency</td><td>28%</td><td>27%</td></tr><tr><td>Building materials and resources</td><td>16%</td><td>16%</td></tr><tr><td>Indoor Environmental quality</td><td>12%</td><td>12%</td></tr><tr><td>Innovation and development</td><td>7%</td><td>7%</td></tr></table></td></tr>
<tr><td>Highest Certification Level</td><td>Platinum</td><td>Super Platinum</td></tr>
<tr><td>Certified</td><td>40-49 points</td><td>50-59 points</td></tr>
<tr><td>Silver</td><td>50-59 points</td><td>60-69 points</td></tr>
<tr><td>Gold</td><td>60-79 points</td><td>70 - 79 points</td></tr>
<tr><td>Platinum</td><td>80 and above</td><td>80-89 points</td></tr>
<tr><td>Super platinum</td><td>No category</td><td>90 – 100 points</td></tr>
<tr><td>Recognition</td><td>No such criteria</td><td>Different levels of recognition for each certification level in terms of practices</td></tr>
</table>

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Depletion of water quality and quantity in Kuttanad, Kerala

Sarath Syamaprasad*, Ambrina S. Khan & Madhuri Kumari*****

The major occupation of rural people in Alleppey district is agriculture and fishing. These activities demand water which is made available from network of canals and rivers in this region. Apart from this, the well-knit network of canal is used for inland navigation and daily water requirement of the local people. However, many distribution channels are being blocked by filling mud or local materials for construction of road. With the blockade in flow of water and decreasing use of waterways the water stagnation and pollution is reported in many canals. Thus canals away from the main waterways are clogged with hyacinth and weeds. This is degrading the water quality leading to scarcity of potable water in vicinity. The environmental problem such as bacteriological pollution, anaerobic conditions and eutrophication is impacting the health conditions of people, water-borne disease being more prevalent. Also, it is hindering inland navigation and affecting the water tourism.

The study focuses on the depletion of water bodies and how it has led to the declining trend in agriculture in Alleppey region. The water samples are collected from canals and rivers of the region and it is tested for various water quality parameters. An analysis is done on the degradation of the water quality. Further, the consequences of poor water quality are studied and suggestions are made for restoring its quality.

Keywords: Water resource, Inland waterways, Canal, Water quality, Alleppey

INTRODUCTION

The quality of water influences our lives in many ways more than just drinking. The physio-chemical parameters of water used for domestic purposes like cooking, washing, bathingand irrigation purposes have a direct or indirect impact on health condition of people (Khan & Srivastava 2012). The human intervention and increased development often led to the poor surface water flow and increased concentration of pollutants in aquatic body (Cao 1989). The daily requirement of water is served from various sources like well, tapping ground water, and inland canals.

In areas with well-knit network of rivers and canals, the water in these water bodies is used for agriculture and other domestic activities apart from navigation. The inland water ways are one of the very prominent means of transport in such areas (Sriraman 2009 and Rangaraj & Raghuram 2007). However, in some region the canals are being blocked because of mud fillings done during construction of road. This causes growth of hyacinth and weeds and degradation of water quality in stagnant water bodies. In addition to it the waste water the domestic houses contribute a lot in the organic content of the water bodies (NEPA 1996). The growth of aquatic weeds, algal blooms and other aquatic microorganism get triggered with the augmented organic content, responsible to a poor water quality to a great deal (Carmichael, 1992 & 1994, Gopalan 1981). The excessive growth of weeds is also responsible for secretion of various toxins making the water unfit for the domestic use (Harada et al., 1996). The study of quality of water and its far reaching consequences is stated through this paper.

Good quality of water has the potential to maximize yield of agriculture. With poor quality of water, problems like salinity, soil contamination has to be dealt with. Contaminated water can act as breeding places and can encourage the growth of bacteria leading to water borne diseases. Degraded water quality at many places becomes a ground of many water borne diseases and epidemics (World Bank 1992 & Meinhardt 2002). Being the home of remarkable water bodies and unique ecosystem there is a drastic need to save the Kuttanad region (Thampatti & Padmakumar1999, Sabu etal. 2001 and Alexander et al. 2010). With the growing urbanization and human impact the Kuttanad region has been under severe and ever-increasing threat. Due to which the flora and fauna as well as the livelihood of the people of Kuttanad have seriously and negatively affected. There is a

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significant loss of fish population affecting the socio-economic life of local people. The eutrophic water bodies have aggravated the leaching of nitrate and phosphate resulting into high level of pollution with organic, inorganic and toxic components. The situation has become worse with the poor drainage system due to stagnant and blocked water ways. The crisis of potable water and emergence of water borne parasites and diseases have made the region more susceptible to poor quality of life. However, various mitigation strategies were planned time to time to cope up with the socio-economical and environmental crisis in Kuttanad (Swaminathan, 2007). Sustainable water management like effective rainwater harvesting systems in Kuttanad would also solve the problems associated with water to some extent (Christina Tang 2009).

This study gives an insight about the quality of water in a small region of Allepey district of Kerala and its effects on local people. An attempt has been made to analyse the cause of degrading water quality and provide possible solutions to restore the water quality which can lead to sustainable development.

Study Region

Alleppeyalso known as Alappuzha is one of the 14 districts of Kerala which is known for well-knit networks of rivers, canal and backwaters. The Kuttanad region characterized by a low-lying land measuring about 25 km east-west and 60 km north-south on the west coast of Kerala (Census, 2001). This boundary is spread over the three districts of Alappuzha, Kottayam, and Pathanamthitta (Kurein 1978). In another study it has been reported that the boundaries of Kuttanad is not distinctly defined and is redefined several times, today it is comprised of 79 revenue villages, 10 Taluks and 3 Districts (Dwivedi, 2011).

Alleppey district is a major part of Kuttanad region which is well known for vast paddy fields and geographical peculiarities. The farming is carried out below sea level in Kuttanad region. Rapid modernization with less focus on sustainable development is creating an imbalance in the intricate ecosystem of this region. Three of its large lagoons, Vembanad, Ashtamudi and Shasthanamkota, have been declared Ramsar sites, wetlands of environmental significance. Engineers and contractors have done the most damage to network of inland canals and water bodies, cheered on by local residents looking for a shortcut to modernity.

Till 1970s farmers used to have only one crop a year, but with the introduction of new fertilizers and pesticides and also by constructing barrage (bund), that would cease the saline water, farmers successfully enacted the plan of two crops a year. The farmer enthusiastically embraced a two-crop regime and pumped in the prescribed quantum of chemical inputs into their fields, and flushed these toxic contaminants into the river system. According to the department of agriculture, Kuttanad uses twice the amount of pesticides per tonne of rice than the rest of the state. The overuse of pesticides has altered the nutrient parameters of soil affecting the agricultural yield and will risk the life of local community. Studies have reported that pesticides have emerged as one of the biggest risk to human life. Health ailments like skin allergy and headache were quite prominent in Kuttanad region. (Dinham 1993, Rakhesh 1999, Krishna 2001 & Indira 2007). As time progressed, farm incomes declined and development in educational sector led to changes in Kuttanad's employment sector.

The recent studies indicate that the larger percentage of local people in Kuttanad region have shifted their occupation from the past natural choice of occupation as farming and fishing which were entirely dependent on water. Although in recent past it has been observed that with the increased intrusion of human into the backwater of Kuttanad there is the significant decline in the fish population (Nair 1991). The ever increased dumping of industrial, agricultural and domestic waste into the backwater has significantly damaged the aquatic life of Kuttanad region (Gopalan 1981 & Devalatha 1994). This shift needs an investigation. Many water ways are now covered with hyacinths and is not advisable for domestic uses and is rarely available for local transportation. Extensive construction of roads has resulted in increased bus services and boat services gradually decreased. Roads were constructed over river and canal beds affecting the water flow. Roads have increased the monetary value of the land. More and more people supported the construction of roads even when the basic conditions were violated. Ignorance towards sustainable development has thus resulted in the present condition of depleting and stagnant water bodies in Kuttanad (Meera & Nandan 2010).

Canals and tributaries away from the main rivers are clogged with hyacinth and weeds. People who are engaged in the traditional activities of farming and fishing are in trouble. Clogging and pollution have also made the canals useless for many other domestic purposes. Consumption patterns have altered and people throw plastics and non-biodegradable waste into the water. The solid waste dumped into the water 15 years ago was organic and therefore did not have the same impact. All these factors contributed to the degrading quality of stagnant water bodies which has become a breeding place for most of the parasites causing severe health problems. The raised river bed too has affected flow, with two monsoons a year adding about 3,000 mm annually, 38 rivers generously flowing through it, and over 1,500 km of waterways afforded by the lagoon, lakes, estuary, rivers and canals, water that does not flow properly is a serious problem. What remains are the famed houseboats, the boat races, the idyllic waters, the emerald green paddy fields, the carelessly strewn banana plants attract tourists who laze on boat decks.

Study area in focus

To study the water quality parameters Alleppey-Changanacherry canal is selected. According to a report by Padmakumar, B. in 2010, 70% of the total waterborne diseases in Alleppey is diagnosedin thepeople residing in vicinity of this canal. More than 500 families reside along the banks of the canal and are directly or indirectly affected by the degrading water quality of the canal. The canal is used intensively for agricultural purposes. Along the canal, there is a road which connects two districts. This has led to decreased attention of government towards maintenance of the canal.

Methodology

Water samples were collected from 10 different sites in the study area of which 4 samples were taken from flowing water and 6 samples were taken from stagnant water. Figure 1 shows 8 sample collection site, flowing water sites are marked in yellow colour and stagnant water sites are marked in red colour. Water samples were collected from the surface of canals and tributaries. The samples have been collected from boat jetty and along the road, closer to the bank depending upon the existence of jetties. The samples were collected in pre-cleaned polythene bottles and were packed intact for transportation to the laboratory in Noida. The geographical coordinates of sampling sites were found using a Garmin GPS tracker. Table 1 provides the details of sample collection sites and Figure 2 displays the collected water sample. Flowing water samples are named as F1, F2, F3, F4 and stagnant water samples are designated as S1, S2, S3, S4, S5 and S6.

Water samples were tested for various physio-chemical parameters like temperature, turbidity, colour, pH, total dissolved solids, dissolved oxygen, alkanity, nitrate and phosphate (Khan & Srivastava 2012). To understand the extent of biological contamination and source of many water borne diseases, E. coli test was conducted. To study the variation in the groundwater level and quality of the study area in focus, data was acquired from Central Groundwater Board (CGWB).

Figure I: Study area in focus with water sampling sites (source: Google earth)

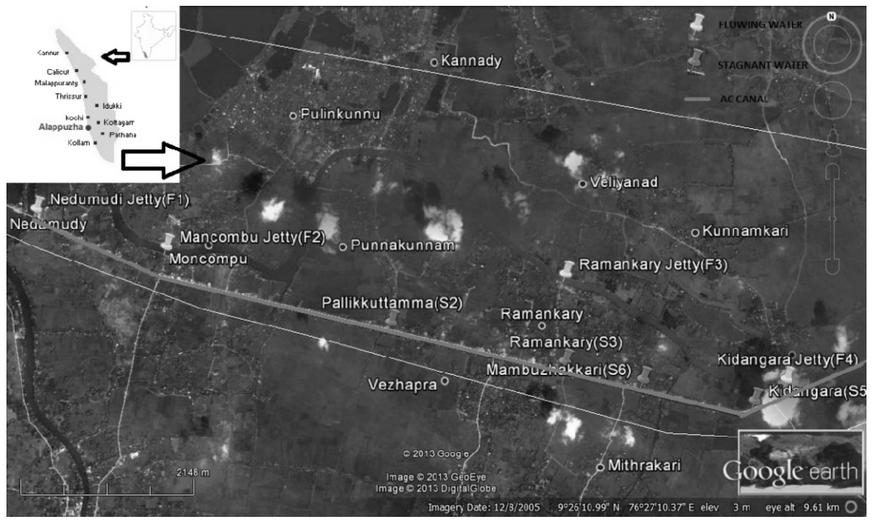


Table I. Geographical coordinates of water sampling sites

PLACE	STATION	LATITUDE	LONGITUDE
NEDUMUDI JETTY	F1	9° 26' 35"	76° 24' 18"
MANCOMBU JETTY	F2	9° 26' 17"	76° 25' 14"
RAMANKARY JETTY	F3	9° 25' 59"	76° 28' 3"
KIDANGARA JETTY	F4	9° 25' 13"	76° 29 '33"
ALAPPUZHA BOAT JETTY	S1	9° 30' 3"	76° 20' 43"
PALLIKKUTTAMMA	S2	9° 25' 42"	76° 26' 49"
RAMANKARY	S3	9 °25' 23"	76 °28' 1"
MANAKKACHRA	S4	9° 26'	76° 32' 6"
KIDANDARA	S5	9° 25' 5"	76° 29' 19"
MAMBUZHAKKARI	S6	9 °25' 15"	76° 28' 32"

Figure II. Water samples collected from sampling sites.

Results and Discussions

Water Quality of Surface water

The physio-chemical parameters of water quality was tested for samples collected from flowing water and stagnant water and the values of these parameters were compared. The physical parameters collected for the samples were temperature, turbidity and colour. The chemical properties of water samples like pH, total alkalinity, dissolved oxygen, total hardness; nitrate and phosphate were tested in laboratory. The results are tabulated in Table 2. The bar chart in Figure 4 shows the comparison of average values of chemical properties of water samples collected from sites with flowing water and stagnant water respectively.

Most of the values of water samples are well within the permissible limits of drinking water provided by Bureau of Indian Standards (BIS: IS 105000) and Central Pollution Control Board (CPCB). However, considerable degradation of water quality is observed in the stagnant water samples as compared to flowing water samples.

Temperature

The temperature ranges from 26 to 33 Degree Celsius. The water samples F3, S2, S3, S4, S5, and S6 were collected at around 4 pm and the rest of the samples were collected at noon time, the next day. The temperature is close to the average temperature of 33 Degree Celsius in Alleppey district. The temperature is crucial as dissolved oxygen levels decrease with increase in temperature.

Turbidity

Turbidity of water samples were categorised as less, medium and high. Water samples collected from flowing water had less turbidity, whereas the samples collected from stagnant water had high turbidity. The amount of undissolved minerals and waste products dumped into the water bodies contribute to the high turbidity.

Colour

The water samples collected from the flowing water were colourless. Samples S1and S6 was little brownish clearly illustrating the degrading water quality and the lack of decomposition of wastes dumped into it. Sample S1 which was collected from Alleppey boat jetty outside the study region in focus showed dirty yellow colour. The outlets provided in Alleppey boat jetty are inadequate when compared to the number of boats parked in the station. The obstruction caused in the flow of water affects the quality of water.

Potential of Hydrogen (pH)

The pH values of water collected from stagnant water is slightly acidic and is falling out of the potable water standards. On the other hand, the water samples collected from flowing water is found to be within the limits of various standards issued by BIS and WHO. The slight acidity of the water samples S2, S3, S4, S5 and S6 is explained by the leaching effect of soils from agricultural fields, mainly paddy. The effect of leachates on the flowing water is temporary since the self-purification process of water regenerates its original quality.

Table II. Results of water quality tests

STATION	TEMPERATURE (° C)	TURBIDITY	COLOUR	pH	TOTAL ALKALINITY (mg/L)	DISSOLVED OXYGEN (mg/L)	TOTAL HARDNESS (mg/L)	NITRATE (mg/L)	PHOSPHATE (mg/L)
F1	31	medium	Colourless	6.15	40	4.48	57.14	1.32	0.04
F2	31	less	Colourless	6.47	20	5.04	42.85	2.4	0.08
F3	26	less	Colourless	6.41	30	5.6	32.14	1.62	0.06
F4	31	less	Colourless	6.33	20	5.2	50	2.5	0.01
S1	33	medium	Dirty yellow	7.06	70	2.32	285.71	28.5	9.4
S2	27	high	Pale yellow	6.03	40	3.6	82.14	17.6	5.4
S3	27	high	Colourless	6.09	10	3.84	85.17	18.4	6.6
S4	27	high	Colourless	6.08	20	3.2	121.42	22.4	8.5
S5	27	high	Colourless	5.64	20	3.52	78.57	23.5	8.8
S6	26	high	Pale brown	5.61	30	3.68	89.28	20.6	7.9

Alkalinity

The Total alkalinity of water samples was very low. There wasn't much variation between the flowing and stagnant water samples for alkalinity. The low values show the absence of carbonates and hydroxides in the water samples. Only bicarbonates are present in the water collected, thus the ability to neutralise acidity of these water samples is very low. Alkalinity of sample S1 was found to be relatively high when compared to the other samples.

Dissolved Oxygen (DO)

The Dissolved oxygen level for stagnant water was found to be about 3mg/l. Meanwhile, the water samples collected from flowing water samples had DO of 5mg/l. The dissolved oxygen levels for stagnant water is very low as the minimum DO content for the survival of fish is 4mg/l. As mentioned earlier the water after irrigation activities are pumped back into the AC canal, thus the water is rich in pesticides and fertilizers. The nutrient rich water is left stagnant and favours the growth of hyacinth and other weeds. This process has culminated into the process of eutrophication. The dissolved oxygen content of S1 in particular was found to be very low.

Total hardness

The hardness of water samples indicates the foaming ability of water. The flowing and the stagnant water samples were collected from sites where they are used extensively for domestic purposes like washing of clothes, utensils, bathing etc. The water samples collected from stagnant water samples showed that the water in the AC canal (stagnant) was ranging from moderately hard to medium hard. On the other hand the flowing water has values showing it to be soft and on the lower side of moderate hardness. Samples S1 and S4 had high value of hardness which makes it unusable for any domestic activities.

Nitrate

The nitrate content of flowing water is observed to be lesser than the stagnant water and the self-purification process of water replenishes the water quality in the flowing water. Water resources are used extensively for agriculture purposes in the study area and thus the flushing out of water after irrigation will have significant amount of nitrates. Thus the higher values of nitrate in AC is can be explained by the poor flow of water. Nitrate content exceeding 10 mg/L is not advisable for use, especially for children as it may lead to blue baby syndrome.

Phosphate

The phosphate level is similar to the nitrate levels. The increase in the phosphate levels in stagnant water can be explained by the runoff from agricultural fields and domestic wastes dumped into the canal.

Biological contamination

To determine the extent of biological contamination E.coli test was conducted on samples F4, S1, S4, and S6.from visual observation the E.coli could not be counted as the bacteria concentration used for culture was added in excess. However, it was found that there was algae formation in samples S4 and S6. The intensity of orange colour indicating the presence of E.coli was relatively low in sample F4. The environmental problem such as bacteriological pollution, anaerobic conditions and eutrophication is impacting the health conditions of people, water-borne disease being more prevalent

Figure II. Water samples collected from sampling sites.

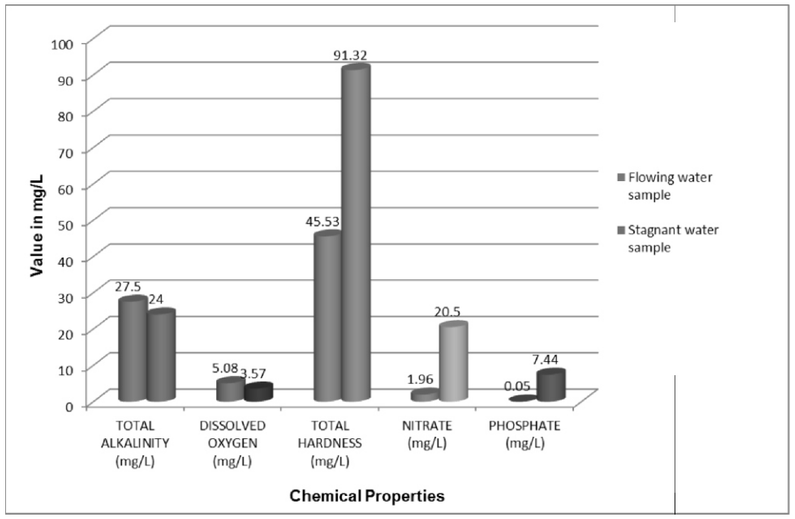
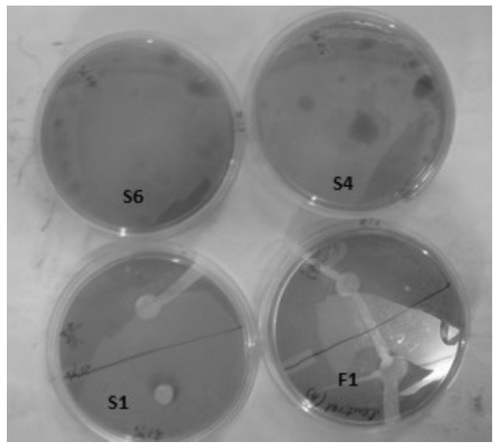


Figure IV. Result of E.coli test



Significance of Water Quality Analysis

Water samples are collected from flowing and stagnant water. Stagnant water is collected from AC canal and this area is specifically selected, because 70% of the total waterborne diseases in Alleppey region are concentrated to the region surrounding the AC canal (www.thehindubusinessline.in./bline). The canal receives its water from a tributary of river pampa and at its inlet and outlet water quality is relatively pure. The water quality at inlet and outlet is given by samples F1 and F4 respectively. Water flow has a good velocity at these points to carry out their self-purification process. The problem thus is the insufficient amount of small canal outlets in this entire path. It is further observed that the blockade caused by landfilling has affected the flow from inlet to outlet.

Kuttanad is famous for its lush green paddy fields and scenic beauty and is a potential site of tourism. The results of this study indicate that there is a degradation of water chemical properties in the stagnant water which is a topic of concern. If the same condition of stagnation persists in future then the projection of the existing results indicates a serious problem in water quality leading to lots of problems associated directly or indirectly with bad water quality.

Ground Water Quality and Level

The water quality parameters for groundwater is analysed from the data acquired from central groundwater board. Each parameter is compared with the Bureau of Indian Standards limits for drinking water.

Groundwater or subsurface water is the major source of water used for drinking and cooking purposes (Khan & Srivastava 2012). The data collected clearly depicts the extent of groundwater pollution. The rise of pH, carbonate and fluoride content is alarming and remedial measures should be taken for replenishing its quality.

The Places selected for the study of water level is a part of the study area in focus. The groundwater level has shown an all-time low value of 0.35 in Nedumudi. Ramankary had its ground water level depleted to 0.29m in the year 2010, however it has improved to 0.68 in 2011.The depletion of water table is illustrated in the graphs below and from the declining trend we must conclude that the potable water resources are getting depleted in the study region.

Table III. Groundwater Quality of Study area in focus (source: cgwb.gov.in)

PROPERTIES	YEAR 2007	YEAR 2008	YEAR 2011	BIS LIMITS
Ph	7.65	8.47	8.94	6.5-8.5
Mg	6.24	5.8	5	30
Nitrate	22	3.3	0.4	45
Phosphate	2.4	5.6	4.9	10
Sulphate	134	4.8	15	200
Carbonate	0	4.8	7.2	75
Bicarbonate	659	115	37	30
Chloride	45	40	43	250
Fluoride	0.11	0.17	0.18	1

Table IV. Average water level in m (source: cgwb.gov.in)

PLACE	YEAR 2007	YEAR 2008	YEAR 2009	YEAR 2010	YEAR 2011
RAMANKARY	0.72	0.45	0.44	0.29	0.68
NEDUMUDI	1.33	0.38	0.4	0.74	0.35

Figure V. Trend of water level in Ramankary

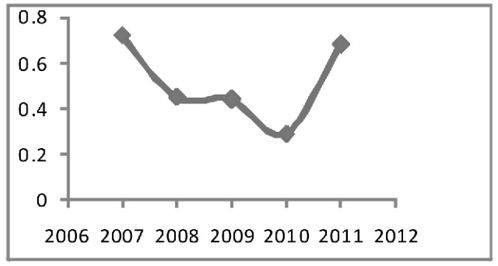
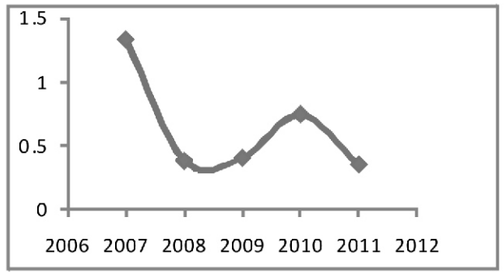


Figure VI.Trend of water level in Nedumudi



Depletion of Wetlands and Water resources

There is a rapid decrease in the water spread area of Kuttanad region in Kerala. A case study of water spread area of Vembanad kayal and its backwater showed a decline of 4.93% during 1983-1992. Similarly the depth of water bodies is also decreasing (MSSRF Report, 2007). Survey at certain points in Vembanad kayal over 50 years showed that water bodies are getting filled and becoming shallower. Furthermore the water carrying capacity of Vembanad kayal has reduced to 78%.Wetlands are very important from environmental aspects and the declaration of three sites as Ramsar sites speaks of the agrarian distress of Kuttanad region. Vembanad kayal is one of the Ramsar sites and its reduction in depth and water spread area endangers the biological diversity in Kuttanad.

Paddy fields can be termed as a manmade wetland and its depletion directly affects the productivity of rice, the staple food of Kerala. The variation in the land use pattern combined with the distress of water quality can be coined as one of the reasons for the decline in agricultural sector. It should be understood that agriculture and all forms of life are affected by the degrading water quality in one way or another.

Suggestions for Improving the Water Quality in the Study Region

Inspection and site survey of the study area in focus has resulted in the finding of number of canals and tributaries that links AC canal to the tributary of river Pampa.These linking canals are indicated in yellow colour line in the Figure 9. According to the local people in the area, these narrow canals of width 4 to 5 m were once used for inland navigation. The decline in the inland water transport has led to the negligence of water resources and has led to its depletion. The google earth image shows the number of small canals in yellow colour which need to be revived immediately, so that it can act as an outlet to improve the quality of water. The revival of canals can provide a short term relief to the existing problems due to degrading water quality. To improve the quality further, blockade of water flow caused by the landfill (red colour line in Figure 9) and bridges (yellow colour place marks in Figure 9) needs to be eliminated.

CONCLUSION

The present study on the water quality of the study area in Allepey district and part of Kuttanad region has certain limitations due the non-availability of information on the epidemic outbreaks. Unscientific and unsustainable constructions of roads and bridges arresting the water flow cause the formation of large pools of stagnant and contaminate water which becomes breeding ground for bacteria and mosquitoes. It is also to be noted that the quality of water standards when entering the AC canal is within the limits and along the course of the AC canal its quality depletes. The water used for

Figure VII. Decline in the water spread area of Vembanad kayal (Source: MSSRF Report, 2007)

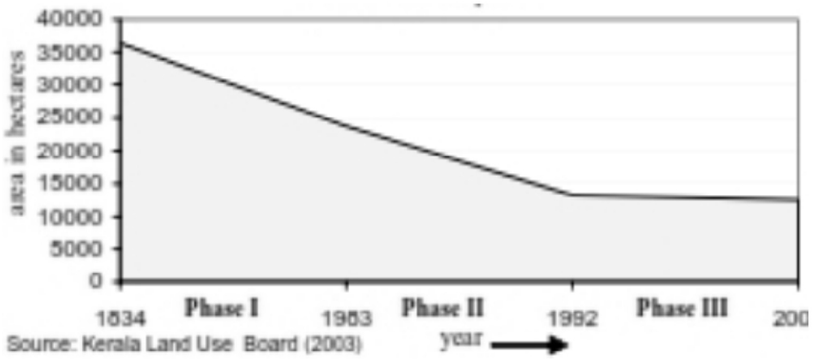


Figure VII. Decline in the water spread area of Vembanad kayal (Source: MSSRF Report, 2007)

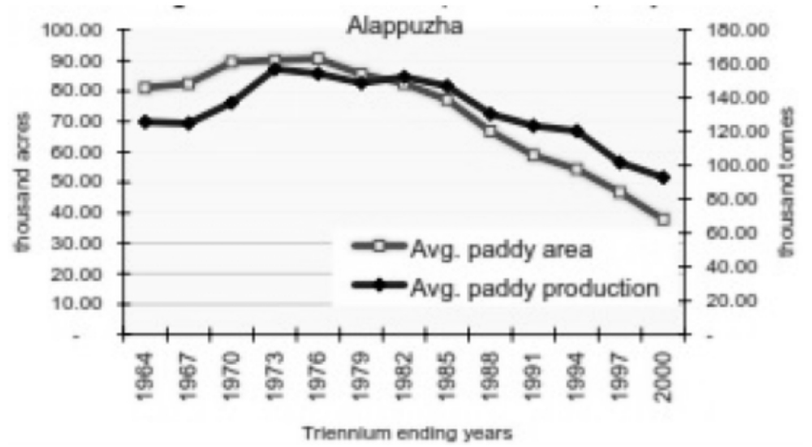


Figure IX. Study area in focus with suggestions to improve the water quality (source: Google earth)

agriculture is the same water which was flushed out in the previous season due to the absence of flow. This process has affected the agriculture sector dearly and immediate actions need to be taken.

Water transport was once the integral part of people in Kuttanad region including Allepey district. The advent of roads and motor vehicles has changed their lifestyles drastically. State water transport department has cancelled their services over the years due to low clearance provided by the bridges and thick vegetation in water which hamper the movement of vessels. The lack of advancement in the water transport in the Kuttanad region has further added to the cause of negligence of water resources. In today's scenario of rising prices, attending to smart use of inland water for navigation will be a step towards a cheaper sustainable alterative of transportation mode and will be much appreciated by the people. Apart from conveyance, once functional the water courses will have many advantages in terms of economic and environmental perspective.

In conclusion, water resources are directly linked to the people's lives in Kuttanad. The revival of many canals in different regions of Kuttanad region will affect the agricultural sector positively and will result in the social upliftment of people in Kuttanad.

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Energy Savings Performance Contracting: An Important Resource in India's Pursuit of Sustainable Development

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Energy efficiency is a key, economical resource for India's pursuit for sustainable development and Environment protection. Significant energy and cost savings can be achieved through the energy management of on hand systems. The implementation of fresh energy proficient technology in equipment and practices can help facilities to accomplish enhancement in productivity, environmental emissions, and quality of service. Energy Performance Contracting (EPC) or Energy Savings Contracting System (ESCS) is a modern financing technique that utilizes cost savings from reduced energy consumption to repay the cost of installing energy conservation measures. Thus, Energy performance contracting (EPC) is a demonstrated and globally accepted means for reducing the operating costs and environmental impacts. EPCs are provided by Energy Service Companies (ESCOs). Until now in spite of government support for EPC, India's ESCO industry is still in juvenile state.

INTRODUCTION

Every class of energy use, assume the four fundamental ways to reduce energy cost:

a) Decrease the price of the purchased energy

b) Decrease operating hours of the energy using equipment

c) Decrease the load or the need for energy

d) Raise in the operating efficiency of the energy using equipment

Energy Savings Performance Contracting (ESPC) is a contracting process in which a private service provider (typically called an energy services company or ESCO) assesses, designs, finances, acquires, installs, and maintains energy-saving equipment/systems for a client and receives compensation based on the energy consumption / cost savings performance of those equipment / systems. The investment in new equipment is reimbursed with the increasing savings in energy, water, and energy related cost savings (Turner and Wayne, 2001).

The Directive 2006/32/EC of the European Parliament and of the Council of 5 April 2006 on Energy End-use Efficiency and Energy Services (Energy Services Directive) established the following terminology (Marino et al, 2010):

- "Energy Performance Contracting" (EPC): a contractual arrangement between the beneficiary and the provider (normally an ESCO) of an energy efficiency improvement measure, where investments in that measure are paid for in relation to a contractually agreed level of energy efficiency improvement;
- "Energy Service Company" (ESCO): a natural or legal person that delivers energy services and/or other energy efficiency improvement measures in a user's facility or premises, and accepts some degree of financial risk in so doing. The payment for the services delivered is based (either wholly or in part) on the achievement of energy efficiency improvements and on the meeting of the other agreed performance criteria;

Potential equipment/system retrofit projects engage lighting, HVAC systems, automatic controls, building envelope enhancements, water preservation measures, and alternative fuel systems. Such contracts can be signed for time up to 25 years. In particular when small or no domestic financial support is presented, ESPC can be a successful medium by which energy conservation measures can be implemented (U.S. Navy, 1994).

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Such kind of contracting provides an efficient substitute for implementing energy saving projects when installation resources such as manpower, technical expertise and/or domestic funding are in short supply or merely not presented (Buckley and Chapman, 1997; VINE E. 2005).

Connection between energy conservation programs and environment protection

The prime relationship between energy conservation programs and environmental initiatives is the advantage to the environment of a decline in energy consumption. When electricity is generated, three principle pollutants are released from the power plant: sulfur dioxide, nitrogen oxides, and carbon dioxide.

When sulfur dioxide and nitrogen oxides are emitted by power plants and automobiles, they mix with water vapor, turn into sulfuric and nitric acids, and fall to the ground in the form of rain, snow, fog, or acidic particles. "Acid rain" damages buildings, trees, and other vegetation and can harm aquatic life.

Smog is caused by various pollutants. Nitrogen oxides are a primary ingredient in this corrosive mixture that is harmful to humans. At best, smog irritates the eyes and lungs. At worst, it can intensify respiratory ailments, including asthma and bronchitis. (Herring and Roy, 2007).

Advantages of Energy Savings Performance Contracting

Energy Savings Performance Contracting has following advantages (A Best Practice Guide to Energy Performance Contracts, 2000):

- ESPC will offer better, safer functioning and living environment.
- Contracts assure energy operation and maintenance price savings.
- Reduce the GHG (green-house gas) emissions; at the same time as also reduce costs and increases competitiveness along with improved energy efficiency.
- Reduces of operating costs;
- Facility improvement;
- Potential to focus on improving the quality of the indoor environmentindoor air quality (IAQ);
- Environmental benefits.
- Training and implementation of sustainable energy practices.

The Energy Performance Contracting (EPC) market has numerous key drivers that include the following:

- Savings Mandates EPC may act as the evasion method for implementing energy efficiency projects in those governments which are progressively mandating insistent energy savings goals for public facilities however, are not providing extended capital budgets to pay for energy efficiency improvements.
- Facility Modernization Those market facilities that in general lack for capital and maintenance budget may use EPC projects to obtain the needed facility progression. The measures in an EPC project improve building performance as well as saves energy. Lighting, temperature conditions and ventilation are all improved, which also has a considerable effect on the productivity of building occupants, whether they are workers or students.
- Green Buildings "Energy Efficiency Pays for Green," which this focus in mind the facility owners who intend to "Green" their buildings/structures often implement EPC projects. The green measures finance the installation of renewable energy measures through a long-term EPC contract. Thus, the savings obtained from energy efficiency measures helps to finance the renewable measures.
- Climate Change The organizations that are trying to meet state mandates for GHG (Green House Gas) reductions keep energy efficiency as their primary choice. Further, the revenues that will be attached to carbon trade regimes are expected to deliver more widespread EPC projects that involve renewable technologies, because these carbon trading income are over and above the energy savings revenues that today finance comprehensive energy efficiency EPC projects. The development of supplementary revenue flow creates different project economics that can support the use of more costly technologies like renewable energy.
- Utility and ISO/RTO Capacity Programs EPC projects, which can be self-financed through energy savings, are an attractive alternative for the State regulators that face utility applications to build a new generation of power plants. So,

they are increasingly looking to large-scale energy efficiency programs as an alternative.

CONCLUSIONS

EPC projects focus at the deployment of comprehensive solutions for improving energy efficiency. This type of contract would help to overcome financial constraints to energy efficiency investments by paying off initial costs through the future energy cost savings resulting from reduced energy consumption. ESCOs have long been likely to have an significant role in encouraging energy efficiency. While the concept of ESCOs is very popular in the western countries, the growth of the ESCO industry in India has not taken place in spite of constant efforts by the Government. One of the Government reports highlights deficiency of knowledge from building owners on the performance contracting route for energy efficiency improvements, high transaction costs in preparing documents for bid requests and a lack of true ESCO's who identify with the ESCO concept and who can fetch in third-party financing for the projects as barriers to immature markets of EPC in India. In India most of the ESCOs are often equipment companies that focus on sales of a single technology, rather than a group of energy conservation measures. Lack of technical expertise in these ESCOs to undertake comprehensive energy efficiency measure is a major barrier to EPC in India. However, enormous growth potential for ESCO activity in India has been estimated given financial and policy support.

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Comparative Studies on Downstream Processing and Fermentative Production of Itaconic Acid Using Aspergillus terreus

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In this study, a systematic process optimization was performed with an Aspergillus terreus MTCC 479. In the present study, cheap raw materials like Maize flour, Waste potatoes and Corn starch were used. Acid and Enzymatic hydrolysis was carried out by production of amylase (enzyme activity 126U/ml) using Aspergillus oryzae MTCC 645. Itaconic acid production was 15.5g/l from control (with pure glucose), 10.3g/l from corn starch, 6.5g/l from maize flour and 5.8g/l from waste potatoes at 120hr. After purification by Solvent extraction method by using n-Butanol as solvent , Itaconic acid concentration was increased 2-3 times i.e. 40.80g/l for control ,35.75g/l for corn starch,22.75g/l for maize flour and 17.55g/l for waste potatoes respectively using 1:3 aqueous to organic phase ratio. So this study shows the comparison of production of itaconic acid by cheap raw materials and also the use of inexpensive method for purification which will be helpful in decreasing the process economics.Keywords: Aspergillus terreus, Itaconic acid, Aspergillus oryzae, Bromination, Solvent extraction method.

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INTRODUCTION

Itaconic acid (2-methylidenebutanedioic acid) is an unsaturated di-carboxylic acid. It has a broad application spectrum in the industrial production of resins and is also used as a building block for acrylic plastics, acrylate latexes, super-absorbents, and anti-scaling agents [1-3]. The Itaconic acid derived Bis-pyrrolidone-type monomers are also used in preparation of Biopolymers [4]. Since the 1960s the production of itaconic acid is achieved by the fermentation with Aspergillus terreus on sugar containing media [1]. Although also other microorganisms like Ustilago zeae [5], U. maydis, Candida sp. [6], Rhodotorula sp. [7] Aspergillus flavus [21] were found to produce itaconic acid, A. terreus is still the dominant production host for production of Itaconic acid. [2; 8].The studies on biosynthesis of Itaconic acid reveals that it is derived via one of the intermediate of Tri carboxylic Acid (TCA) Cycle; cis aconitic Acid. During Biosynthesis the cis aconitic acid is converted to Itaconic acid via decarboxylation reaction performed through enzyme cis aconitate decarboxylase. Recent studies indicates that Macrophages as a immune response, expresses high levels of immunoresponsive gene 1 (IRG1) under inflammatory conditions as an enzyme that catalyses the production of Itaconic acid by decarboxylation of the Krebs cycle intermediate cis-aconitate.[9]. The optimal conditions for Itaconic acid clearly differ from conditions optimal for citric- and oxalic acid production [10]. The highest IA yield is achieved when glucose is used as the substrate, but crystalline glucose is too expensive to use as a raw material for the commercial production of IA. Therefore, other raw materials that are cheaper than crystalline glucose, such as starch [19], molasses, hydrolysates of corn syrup or wood, and other combinations, were also tested. The most frequently used substrates are beet or sugarcane molasses [11], which are pretreated by ion exchange or ferrocyanide [12] and increases the process economics. The present study demonstrates the production of itaconic acid utilizing Maize flour, the Corn starch and waste potatoes which are much cheaper than glucose helps in controlling the process economics. For purification, Solvent Extraction method is used which is inexpensive method than other methods like Liquid chromatograph. Also it is easy to scale up and permits continuous steady state operation.

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MATERIALS AND METHODS

Strain and Chemicals

Aspergillus terreus MTCC NO.479 and Aspergillus oryzae MTCC NO.645 were procured from Microbial Type Culture Collection (MTCC), Institute of Microbial Technology (IMTECH), Chandigarh, India. Maize flour, waste potatoes and corn starch were obtained locally, Iso butanol was received from Fischer scientific (Mumbai) and all other chemicals were of analytical reagent grade.

Culture Media

Aspergillus terreus was grown on Czepak Dox medium containing (gl^{-1}) of Sucrose,30 ;Yeast extract,5; K_2HPO_4,1; $NaNO_3$,300; $MgSO_4.7H_2O$,50; KCl,50; $FeSO_4.7H_2O$,1; Agar15 .Aspergillus oryzae was propagated on Potato dextrose Agar (Hi-Media) with gl-1of PDA 24, pH-5.1.Slants were grown at 30^0 C for 5 days and stored at 4^0C

Acid Hydrolysis

Starch estimation in raw materials was done by anthrone method [13] and determination of reducing sugars was done by DNS method [14].Hydrolysis was performed by acid as well as by amylase enzyme produced from Aspergillus oryzae[17]. Acid hydrolysis of three different starchy materials was done by using the hydrochloric acid. Optimization of acid hydrolysis was done by varying the concentration of Hydrochloric acid as well as by varying the concentration of Substrate.

Enzymatic hydrolysis

Hydrolysis was done by production of amylase from Aspergillus oryzae [17, 18]. To the 5 days old culture slants, 5ml of 0.9% saline solution along with the 0.1%Tween-80 was added. Spores were dislodged using inoculation loop under sterile conditions. Inoculum was prepared by adding these spores into Potato dextrose broth and keeping this Broth at 30^0C under shaking conditions for 24 hours. This inoculum was further used for production of amylase enzyme in amylase production media(g/l);Corn starch,24g; Yeast extract,36g; Na_2HPO_4,47g; KCl,0.2g; $MgCl_2$,0.2g; $CaCl_2$,1g.

Effect of incubation period

Effect of incubation period on amylase production was studied by measuring enzyme activity after every 24 hrs. Culture filtrate was harvested and enzyme assays was performed up to 120hrs. After maximum production, whole broth was centrifuged at 15000rpm for 30 minutes to extract the enzyme.

Optimization of hydrolysis conditions

Effect of substrate concentration (5%, 10%, 15%) as well as time period (4, 8, 12, 16, 20, 24 hrs.) at 500C was studied to get maximum hydrolysis of substrates. After maximum hydrolysis, Centrifugation was done at 10000 rpm for 30 minutes to extract glucose. The glucose obtained by this method was further used for Itaconic acid production.

Enzyme assay

The reaction mixture consisted of 1.25 mL of 1% soluble starch (Merck) solution, 0.25 mL of 0.1 M sodium acetate buffer (pH 5.0), 0.25 mL of distilled water, and 0.25 mL of properly diluted crude enzyme extract. After 10 min of incubation at 50°C, the liberated reducing sugars (glucose equivalent) were estimated by the dinitrosalicylic acid method of Miller .One unit of amylase is defined as the amount of enzyme releasing 1µ mol. of glucose equivalent/min under the assay conditions.

Enzyme activity (U/ml) = Concentration obtained from standard graph× Dilution factor ×1000/Time for enzyme incubation× 1g mole of substrate

Culture conditions for Itaconic acid production

Conidiospores from 7 day old culture slants were suspended in 5ml sterile 0.05 mol/l phosphate buffer (pH 6.5) containing 0.1% Tween-80 and used to inoculate 500ml conical flasks containing 100 ml sterile Czepak Dox medium to give a high spore concentration. After incubation on rotary shaker at 200 rev/min for 24 hours at 350C, fractions of 10 ml were used to inoculate 90ml sterile production medium (l^{-1}) Glucose,100g; Ammonium sulphate, 2.36g; KH_2PO_4,0.11g; $MgSO_4.7H_2O$,2.1g; $CaCl_2.2H_2O$,0.13g; NaCl,0.074mg; $CuSO_4.5H_2O$,0.2mg; $FeSO_4.7H_2O$,5.5mg; $MnCl_2.4H_2O$,0.7mg; $ZnSO_4.7H_2O$,1.3 mg in 500 ml conical flasks. Cultures were then incubated for 6 days under the same conditions as above. Samples were taken after every 12 hrs till 6 days, diluted with deionized water to solubilize the itaconic acid and filtered through 0.2 µm whatmann discs .This sample was analysed for itaconic acid production by Bromination method [15].

Itaconic acid purification

Itaconic acid was purified by Solvent extraction method [20] by using n-butanol as solvent. Itaconic acid broth was filtered through whatman (0.2µm) filter discs. Aqueous itaconic acid solution was prepared by dissolving itaconic acid in equal amount of deionized water. Then again filtration was done by using whatman (0.2µm) syringe filter. The saturated solution of itaconic acid was mixed with organic solvent (n-Butanol) in different ratios i.e.(1:1,1:2,1:3,1:4) to optimize the volume of extractant for maximum purification. Solutions were mixed properly for 45 minutes by using magnetic stirrer. The mixture was transferred to separating funnel (500ml) and allowed to settle for 1 hour .Two stable phases were formed depending upon the density difference between aqueous phase and organic phase. After the phase separation volume of aqueous as well as organic phase was measured. The aqueous and organic phases were analyzed for determination of itaconic acid concentration by titration method in different ratios of n-butanol. Degree of extraction (%E) was calculated [16].

RESULT AND DISCUSSION

Overall 95% starch content in Corn starch, 75% starch content in maize flour and 16% starch content was determined in waste potatoes by anthrone method. The starch content was found to be less in waste potatoes as compared to maize flour and corn starch. This may be due to more amounts of dietry fibres, fat content as well as more moisture content .Waste potatoes may also be affected by environmental conditions as well as certain different microorganisms due to which starch content was decreased.

Effect of substrate concentration on acid hydrolysis

Substrate concentration was varied from 5% to 20%. Yield of reducing sugars and hydrolysis % (Table 1) was calculated by using standard graph of glucose. It was observed that Substrate concentration affects the hydrolysis of raw materials in affective way. The table 1 showed that yield of reducing as well as hydrolysis percentage varied with substrate concentration. It was observed that for maize flour maximum yield of reducing sugars was 60 and hydrolysis was 80% with 10% substrate .For Corn starch maximum yield of reducing sugars 42.5 and 57% hydrolysis for 10% substrate was observed. While in case of waste potatoes, maximum yield of reducing sugars 17.5 and 73% hydrolysis for 15 % substrate was observed.

Effect of acid concentration on acid hydrolysis

Acid concentration was also varied in the ratio 1:0.5 to 1:5 for the same substrate concentration in which we got the maximum hydrolysis % (Table 1). Yield of reducing sugars and hydrolysis %(Table2) was calculated by using standard graph of Glucose. It was observed that acid concentration has significant effect on yield of reducing sugars as well as hydrolysis percentage. Table 1 shows effect of acid concentration on yield of reducing sugars as well as percentage hydrolysis. It was observed that for 10% maize flour, maximum yield of reducing sugars was 60 and hydrolysis was 80% with substrate to acid ratio 1:1. For 10% Corn starch, maximum yield of reducing sugars 42 and 56% hydrolysis with 1:1 substrate to acid ratio was observed. Likewise in case of 15% waste potatoes, maximum yield of reducing sugars 17 and 72% hydrolysis with 1:1 substrate to acid ratio was observed. In case of all the starch materials, significant effect up to a certain concentration of acid (1:1) i.e. when acid concentration equivalent to the substrate concentration was observed .After this equivalent ratio, as the acid concentration increased more than that of the substrate, yield of reducing sugars as well as hydrolysis got decreased for all raw materials. This might be due to the fact that high concentration of acid caused the reducing sugar degradation. The soft hydrolysis conditions led to a sugar-rich prehydrolysate. When using harsh pretreatment conditions, sugar recovery in raw materials decreased.

Effect of Incubation period on amylase production

The effect of incubation time for production of enzyme was also observed by varying the time period for production of amylase from 1st to 6th days. Enzyme activity was maximum on 4th day which was found to be 126 U/ml. (data not shown) The enzyme activity first increased with increasing time period i.e.it increased up to 4th day and then start decreasing till 6th day.The incubation period is directly related with the production of enzyme and other metabolic process up to a certain extent. Then after, production of enzyme started decreasing which might be due to the depletion of nutrients in

the medium which stressed the fungal physiology resulting in the inactivation of secretary machinery of the enzyme.

Optimization conditions for hydrolysis by amylase

After the production, the amylase enzyme was extracted from fermentation broth by centrifugation and used for further hydrolysis of maize flour, Corn starch and waste potatoes (Figure 2).The glucose produced by this hydrolysis method was further used for production of itaconic acid.

Figure 1 shows that for all three substrates, hydrolysis percentage was highest at 20th hour for 10% substrate. Maximum hydrolysis was found to be in case of maize flour i.e. 96%.In corn starch hydrolysis was found to be 67% while in case of waste potatoes hydrolysis was found to be 94% . For every substrate yield of reducing sugars and hydrolysis increased up to 20th hour then it became stable. This may be due to the reason that 20th hour time period was sufficient for all the substrate to get hydrolyzed. Further no substrate was left to be converted into glucose so 20th hour time period is optimized for hydrolysis of starch into glucose.10% substrate was found to be optimized to get the maximum hydrolysis for all the three starchy materials.Stable glucose production after 10% substrate might be due to enzyme inhibition by the presence of impurities. Moreover, high concentration of substrate might reduce the water content in reaction mixture which lowered pentose yield and also lowered the rate of hydrolysis as shown in hydrolysis progress in Figure 1.

Comparison of Itaconic acid Production

The glucose released after hydrolysis of three starchy materials was used for the production of Itaconic acid. All the ingredients were added which are necessary for the growth of A.terreus and production of itaconic acid. Pure glucose was used in control instead of glucose released after hydrolysis, to compare the production of itaconic acid. Samples were taken after every 24 hours and analysis of itaconic acid was done by Bromination method. Table 3 shows that maximum production of itaconic acid was at 120 hours for all three materials. For control, maximum production of itaconic acid was 15.5 g/l. For maize flour, production of itaconic acid was 6.5g/l while in case of waste potatoes and corn starch production was 5.8g/l and 10.3g/l respectively. Production of itaconic acid was increasing with time period from 24 hours to 120 hours for all raw materials.

Maximum production of itaconic acid was in control in which pure glucose was used as raw material. Besides that considerable production was found to be in case of corn starch i.e.10.3g/l which may be due to amylolytic activity shown by A.terreus. As corn starch got completely liquefied after autoclaving of medium, so A.terreus shown more amylolytic activity in case of liquefied corn starch and hydrolyzed rest of starch also. So production of itaconic acid was more in corn starch.

Purification of itaconic acid by solvent extraction method

Purification of Itaconic acid from broth was done by using n-butanol as an extractant with the help of separating funnel. Effect of Volume ratio between organic and the aqueous phase was investigated to get the maximum purification from broth. Initial itaconic acid concentration and organic-to aqueous volume ratio appears to have positive effect on the degree of extraction (Table 4). Bromination method was performed for aqueous phase as well as organic phase to find out the concentration of itaconic acid after purification. Degree of extraction was calculated by using formulae. Degree of Itaconic acid extraction was found to increase significantly when the higher volume ratio between n-Butanol and starting aqueous solution was used in the process. At aqueous to organic ratio of 1:3, degree of extraction was highest and after that degree of extraction decreased. Consequently, extraction of itaconic acid with n-butanol should be carried out with properly selected organic-to-aqueous volume ratio.

Comparison of Itaconic acid production and purification for all substrates

As shown in Table 4, for control, Itaconic acid concentration after purification was 40.8g/l. While for corn starch, itaconic acid concentration was found to be 35.75 g/l after purification. Likewise in case of maize flour, concentration was 22.75 g/l and for waste potatoes concentration of itaconic acid was 17.55g/l. It was observed that purification by solvent extraction was found to be very successful method for purification because as shown in Figure 2, After purification by solvent extraction method, concentration of itaconic acid was almost two or three times of the concentration after production for every raw materials.

CONCLUSION

An efficient and low cost process can be established by production of itaconic acid utilizing cheap raw materials that can be helpful in decreasing the process economics more efficiently while used at pilot scale. Similarly other cheap materilas can also be used. Itaconic acid concentration was increased up to 2-3 times after purification by solvent extraction method which is inexpensive method for purification and also can be used for large scale operations. Other conditions like pH and temperature can also be optimized to increase the feasibility of the method.

Figure 1: Optimization of time period and substrate concentration for hydrolysis by amylase

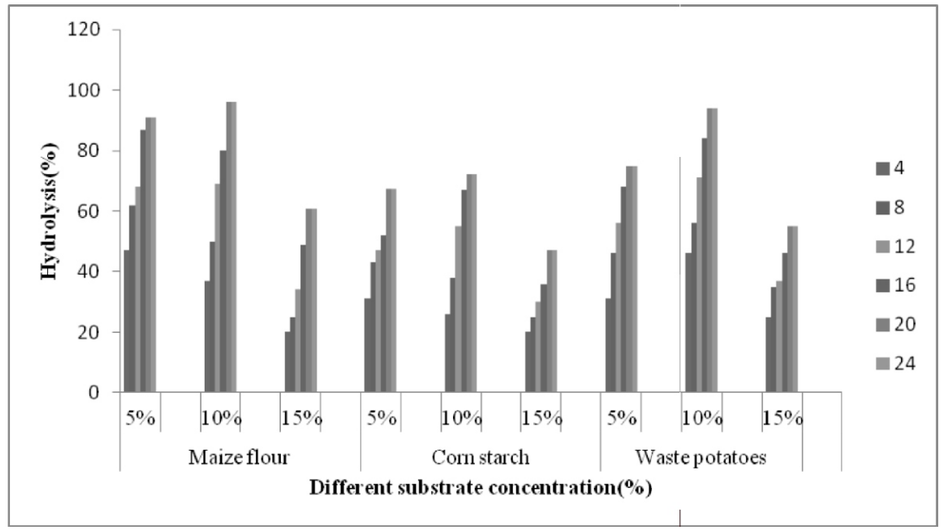

Figure 2: Comparison of Itaconic acid production and purification

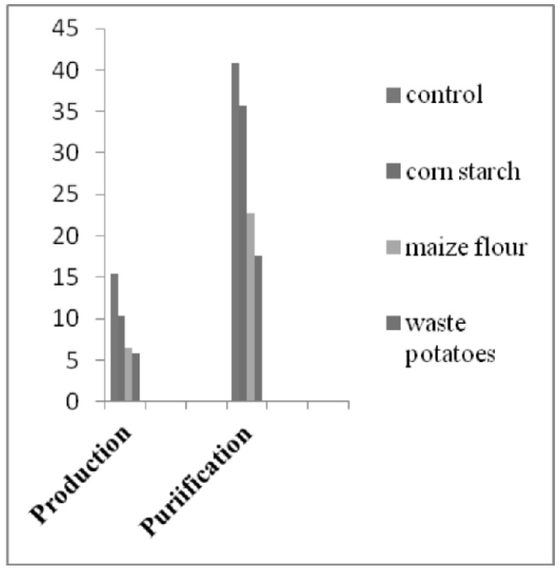

Figure 3: Optimization of time period and substrate concentration for hydrolysis by amylase

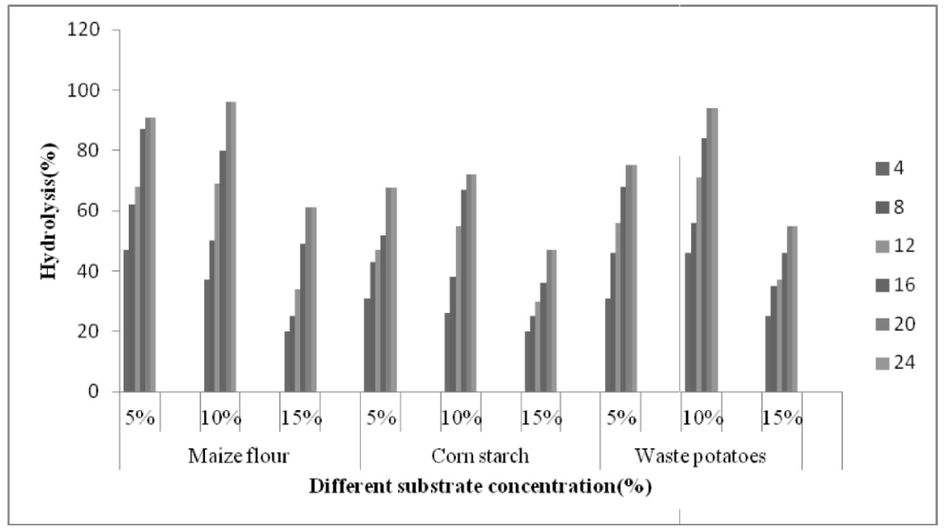

Figure 4: Comparison of Itaconic acid production and purification

Table1: Effect of substrate concentration on yield of reducing sugars as well as Hydrolysis (%)

Substrate	Substrate concentration (%)	Absorbance (540nm)	yield of reducing sugars	Hydrolysis (%)
Maize flour	5	0.51	21.5	58
	10	**1.41**	**60**	**80**
	15	1.32	55	50
	20	1.25	52.5	35
Corn starch	5	0.45	20	47
	10	**1.01**	**42.5**	**57**
	15	0.76	32.5	30
	20	0.70	30	20
Waste potatoes	5	0.1	5	62
	10	0.24	11	68
	15	**0.41**	**17.5**	**73**
	20	0.35	15.5	49

Table 2: Effect of Acid concentration on yield of reducing sugars as well as Hydrolysis (%)

Substrate	HCl concentration (S:A Ratio)	Absorbance (540nm)	yield of reducing sugar	Hydrolysis (%)
Maize flour	1:0.5	0.98	42	56
	1:1	**1.41**	**60**	**80**
	1:3	1.01	55	73
	1:5	1.1	47.5	63
Corn starch	1:0.5	0.82	34	35
	1:1	**1.21**	**42**	**56**
	1:3	0.9	38	40
	1:5	0.85	35	37
Waste potatoes	1:0.5	0.25	12.5	52
	1:1	**0.41**	**17**	**72**
	1:3	0.34	15	63
	1:5	0.29	13	53

Table 3 Comparison of Itaconic acid production as estimated by Bromination method

Time(hour)	Itaconic acid production(g/l)			
	Control	Maize flour	Corn starch	Waste potatoes
24	0.52	0.23	0.48	0.12
48	1.32	0.96	1.2	0.85
72	6.53	3.39	5.42	2.4
96	11.3	5.8	9.6	4.9
120	15.5	6.5	10.3	5.8
144	14.6	5.9	9.52	4.5
168	13.24	4.52	8.35	3.69

Table 4: Degree of itaconic acid extraction as a function of organic to aqueous volume ratio

Substrate	Initial phase Volume(ml)		Equilibrium phase Volume(ml)		Equlibrium Concentration(M)		Degree of Extraction
	aqueous	butanol	aqueous	butanol	aqueous	butanol	
Corn Starch	10	10	9.5	10.5	3.25	24.37	74.28
	10	20	8	22	2.5	27.62	85.49
	10	**30**	**7**	**33**	**1.96**	**35.75**	**91.95**
	10	40	5	45	3.1	29.25	90.64
Maize flour	10	10	7	13	1.1	15.6	37.96
	10	20	5	25	0.6	16.9	40.3
	10	**30**	**3**	**37**	**0.1**	**22.75**	**42.05**
	10	40	2	48	0.9	21.12	41.08
Waste Potatoes	10	10	6	14	0.6	11.05	31.55
	10	20	5	25	0.2	14.3	33.06
	10	**30**	**4**	**36**	**0**	**17.55**	**33.64**
	10	40	3	47	0.2	15.92	33.29
Control	10	10	9	18	12.1	30.13	72.85
	10	20	8	22	11.7	35.01	95.17
	10	**30**	**8**	**32**	**11.5**	**40.8**	**97.65**
	10	40	7.8	42.2	12.5	38.4	89.12

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Role of Fuel Economy in Automobiles towards Conservation of Energy & Environment

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INTRODUCTION

Terrorism and Global warming are the two major threats in today's world. The two are independent of each other and therefore need to be dealt separately. Global warming is directly related to environment that is directly connected with energy and its utilization.

Energy is required for creation, sustenance and growth of everything that we see around us. Major sources of energy today are coal and products made out of petroleum crude (fossil fuels). It is also being obtained from solar, nuclear, hydrostatic and wind sources. Bio Fuel, CNG, LPG and Hydrogen are some other sources of energy. Requirement of energy is going up at a very high rate. No development or advancement is possible without availability of energy.

Environment is affected by production and utilization of energy in most cases. Global warming and contamination of air and water are directly affected by the rate of utilization of energy. While solar, nuclear, hydrostatic, electrical, wind sources, Bio Fuel, CNG, LPG and Hydrogen sources (also called 'clean energy') hardly cause harm to the environment, Coal and fossil fuels are extremely harmful for the environment. Efforts are being made to produce more & more clean energy not only to help the environment but also because the reserves of coal and fossil fuels are limited. However, there is a tough competition between ever growing requirement of energy and production of clean energy. We are still largely dependent on coal and fossil fuels to meet our energy requirements. Also, there are practical difficulties/limitations in production and utilization of clean energies.

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Some of the alarming statistics pertaining to India about use of fossil fuels is as following:-

- India is 5th largest emitter of CO2 in the world after USA (5800MT), China (4732 MT), Russia (1529 MT) & Japan (1215 MT).
- 70% of Diesel & 99.6% of petrol is used by transport industry.
- 90 % of total pollution is caused by automobiles.

- Most of the automobile pollution is at breathing level.

- In spite of Bio diesel, CNG, LPG, Hydrogen coming up as alternative fuels and use of electric vehicles as well as increase in public transport

specially in the form of electric trains, the dependence on diesel & petrol driven vehicles continues. It is mainly due to ever increasing need of transportation by road.

- India consumes petroleum products worth Rs 4 lakh Crores per annum!!!
- Both diesel and petrol are major source of pollution. Diesel as compared to petrol is quantitatively less harmful but it is more harmful qualitatively.
- There are continuous efforts to cut down the harmful effects of vehicle exhaust by improving the design of vehicles.
- Consumption of fuel by vehicles is almost directly proportional to the quantum of pollution being spread by them.
- Reduction of 2 - 2.5 % in the fuel consumption of automobiles would result into a saving of Rs. 8,000 10,000 crores per year!!!

This article is aimed at bringing out ways by which the consumption of fuel in automobiles can be reduced. Improved driving, vehicle maintenance and allied considerations are the major efforts for cutting down fuel consumption. Reduction in fuel consumption will not only result in saving precious foreign exchange but will also help in conservation of environment.

There are some design constraints which cannot be overcome e.g. fuel consumption of an Ambassador car cannot be improved to compete with a Maruti 800 cc Car. Similarly, Bullet 350cc Motorcycle cannot match Hero Honda 100 cc. However, it is possible to improve fuel efficiency of every vehicle to its optimum level by various measures which are given in succeeding paragraphs.

Driving style has direct bearing on fuel economy. It has been found that if 100 drivers run a vehicle under identical conditions and their fuel consumptions are recorded in an ascending order, the average consumption of first five will be 10% lower than that of remaining 95. Appendix "A" shows the percentage of drivers in whom various driving flaws were observed before training. It is important to note that most of the flaws by themselves may have limited effect but their cumulative effect becomes significant. Economic driving calls for anticipation and concentration. Anticipation is the key to economical driving. If you anticipate a green signal turning red before you reach it, ease the pressure on accelerator pedal and gently roll your vehicle to halt, instead of slamming brakes at the last minute.

Fuel consumption of a vehicle is very high when it is moved from stand still. Frequent braking means frequent starting. One sudden application of brakes results in loss of 650 meters of vehicle movement at 60 kmph. Braking should be done sparingly. Driving in correct gear will reduce frequent braking. Your first pressure on brake pedal should be light but continue with increasing firmness so that that the vehicle slows down gradually. Shifting into lower gear while braking helps in reducing braking distance and it also reduces marching time after the vehicle has retarded/stopped. Every vehicle has a cruising speed for which the fuel consumption is least. For most of the vehicles it is between 45 & 55 Kmph. This speed can be around 65 Kmph when the vehicle is moving in overdrive. High-speed driving increases fuel consumption & increases chances of accident. It really does not save much time as felt by some people. For same amount of fuel, distance covered at 40 kmph is about 40 % more than that at 80 kmph. Braking distance at 60 kmph is nearly 4 times that at 30 kmph, which indicates that chances of accident go up almost exponentially with increase in speed. Single foremost quality of a good driver is minimum application of brakes.

Shifting into higher gear as soon as possible results in fuel economy. However, driving in high gear below a certain vehicle speed can cause stalling and becomes harmful for engine. Driving in wrong gear can increase fuel bill by 20%. It pays to maintain speed than frequent accelerations. Recently introduced 'Driver information System (DIS)' in upper segment cars are step in that direction only. Tachometer (RPM meter) helps in fuel economy by running the engine at fuel efficient speed. However, it would need understanding & practice.

While driving up hill use low gear. This increases mechanical advantage, makes acceleration smoother and hence low fuel consumption. Gear for going down hill should be same as for going up hill for safety reasons.

Climbing up hill from stand still should be done with the help of hand brakes which should be released gradually with simultaneous increase in throttle opening to avoid excessive opening of latter thus reducing fuel wastage.

Vehicle Maintenance Aspects

Spark Plug Condition indicates the combustion efficiency, which has a direct bearing on fuel consumption. Always use spark plug as specified by manufacturers unless otherwise advised by an expert.

Self-Starter and Battery. Do not use starter in short bursts and also do not keep it engaged for long. Give a gap of about 45 sec between starts. If engine does not start in three attempts, find out what is wrong. A week battery may increase fuel consumption due to repeated cranking for starting engine. In case a vehicle has not been used for some time, try to crank the engine without starting it for proper lubrication of engine. Battery should be maintained as per instructions of manufacturers.

Clutch. There should be no slippages of clutch due to less free play in clutch pedal, inferior quality/worn-out clutch liner, warp age in the metallic frame of clutch plate and inadequate pressure being exerted by pressure plate. When the vehicle speed does not increase with increase in engine speed, it indicates a poor clutch performance, which will increase fuel consumption. Clutch riding wastes fuel besides damaging clutch disc & linkages.

Carburetor choke should be fully open when the knob on the dashboard is pushed in completely. When required, pull out the choke at the start and return it progressively as the engine warms up. Never use choke in a warm engine. Set slow running only when the engine has warmed up. However, Carburetors are left in old model vehicles only. Presently, MPFI system is used in most of petrol vehicles. It is marginally fuel efficient, maintenance free and more environment friendly.

Fuel System Cleaning or changing of fuel filters should be done as specified. Choked air filters will not only increase fuel consumption but will create highly toxic exhaust. Leakage of fuel if existing can cause a lot of wastage of fuel.

Brakes. The brakes should be free of dirt, which on accumulation increases the rolling resistance. Hand brakes should also be checked for any sticking tendency specifically in old vehicles.

Wheels and Tyres. Radial tyres have less rolling resistance than cross ply tyres and are good for fuel economy (3 % to 7%). Little over inflated tyres in a fully loaded vehicle will reduce fuel consumption. Wheel alignment should be correct to avoid extra rolling resistance. It is easier to adjust air pressure in cold tyres as the readings tend to vary in tyres after vehicle has moved some distance.

Aerodynamics of a vehicle should not be disturbed by fitting a roof rack which will disturb air flow over the vehicle, increase the drag and adversely affect the stability of vehicle also. Whenever rack is used, the luggage should be carefully selected and properly stowed. A badly packed roof rack can increase the fuel consumption significantly. When not in use, roof rack should be taken off because an empty roof rack alone can increase fuel consumption by 5%. Open windows create wind turbulence. On long fast drives, it is economical to roll up the windows and switch on A/c.

Fitment of Additional Gadgets. All such gadgets will not only increase fuel consumption on account of current drawn (electrical gadgets only) but also due to increase in total weight of vehicle. Point to be clearly understood in petrol/diesel is the only of energy in an automobiles and any extra energy spent will demand more fuel.

Turbochargers are being fitted in most of diesel vehicles these days. It is important that after starting, engine should idle for approx. 1 min before accelerating it. Similarly, idling should continue for I min before switching off the engine. This will save turbocharger from sudden damage and will also avoid wastage of additional fuel supplied by FIP to turbocharged engines.

Other Considerations

(a) Engine overhaul should not be unduly delayed. Poor acceleration, black smoke and noisy tappets should be rectified whenever noticed.

(b) Clutch pedal should be pressed while starting engine in cold weather.

(c) Vehicle should be marched smoothly using lowest gear. Avoid idle running of engine for warming up. Instead, move off in lower gear.

(d) Idle running of engine should be avoided as for as possible. At a red lights, switch off engine if the waiting is more than 30 sec. Delhi alone burns petrol/diesel worth Rs. 994 Crores per annum at traffic red lights. Hundreds of vehicles in stating condition can be seen at all the busy crossings wasting fuel and creating unnecessary air pollution and noise pollution. Idling costs 2 ltrs per hour and long idling may damage engine also due to low oil pressure. Instead, switch off engine & start again. Slow running should be adjusted only after the engine has warmed up.

(e) Avoid city rush-hour traffic, which can increase your fuel bill by 100%. In most cases, a long route through a main road may prove to be economical as well as time saving.

(f) Vehicle should be parked in the shade wherever possible.

(g) 'Users hand book' should be read carefully before operating any vehicle/equipment to know its full potential, peculiarities and other useful information. It should also be consulted in case of any difficulty before going for repairs.

(h) 'Cleaning of parts with costly petrol/diesel' should not be done. Instead inexpensive solvents should be utilized. Boiling hot water can also be used for cleaning of motor parts.

(i) Quality and Quantity of fuel: Both are very important for fuel economy. In the present era of high fuel cost and enforcement not being what it should be, lack of quality and quantity are quite common. Fuel should normally be purchased from selected outlets only after ascertaining their genuineness. It is better to learn from other's experience.

(j) Wasteful driving not only increases cost to owner in terms of fuel, repairs and maintenance but also causes congestion, pollution and accidents of vehicles affecting entire society.

(k) Car pooling and use of public transport can cut down the fuel consumption in a big way. Vehicles running on non conventional sources of energy should also be used as much as possible. Bicycle is a very good substitute for motor vehicles in certain places/occasions. It has large number of benefits and should be encouraged..

CONCLUSION

Vehicle owners themselves can apply most of the measures mentioned above. However, some of them may need an expert for diagnosing as well as for rectification. There is no doubt that every vehicle can be brought to its optimum performance by these measures. Fuel consumption claimed by manufacturers under 'Ideal conditions' should not be mistaken as under 'heavenly conditions' and therefore not achievable at all.

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User's Handbooks & operators manuals.

Appendix 'A'

Percentage of Drivers in whom various Flaws were noticed before Training

1.	Over speeding	42
2.	Rash & Rough driving	39
3.	Sudden acceleration	30
4.	Jack Rabbit starting	12
5.	Violent & sudden braking due to poor anticipation	37
6.	Gear change without double declutching - Diesel vehicle only	39
7.	Improper gear selection	30
8.	Use of clutch to hold the vehicle on a gradient	123
9.	Clutch riding	27
10.	Unnecessary idling	12

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Remote sensing and Urban Land Use

Maya Kumari* and Richa Sharma**

Urbanization is inevitable, when pressure on land is high, agriculture incomes are low and population increases are excessive, as is the case in most of the developing countries of the world. Urbanization has been both one of the principal manifestation as well as an engine of change, and it has been the 20th century which has been the century of urban transition for human society. In a way urbanization is desirable for human development. However, uncontrolled urbanization has been responsible for many of the problems, our cities face today, resulting in substandard living environment, acute problems of drinking water, noise and air pollution, disposal of waste, traffic congestion etc. To improve these environmental degradations in and around the cities, the technological development in related fields have to address to these problems caused by rapid urbanization, only then the fruits of development will percolate to the most deprived ones. The modern technology of remote sensing which includes both aerial as well as satellite based systems, allow us to collect lot of physical data rather easily, with speed and on repetitive basis, and together with GIS helps us to analyze the data spatially, offering possibilities of generating various options (modeling), thereby optimizing the whole planning process. These information systems also offer interpretation of physical (spatial) data with other socio-economic data, and thereby providing an important linkage in the total planning process and making it more effective and meaningful.

INTRODUCTION

Expansion of urban area due to increase in population and migration from rural areas and the impact is bound to have on urban areas in terms of infrastructure, environment, water supply and other vital resources. Urbanization is considered as the most influential drivers of land use and land cover change associated with growth of populations and economy. Rapid urban development ensuing dramatic changes in the landscape have been recently witnessed in many developing countries as a result of fast economic advancements (Yeh and Li, 2001).

Since urbanization is an unavoidable process, efforts can be made to direct it in the most proper way by urban land use planning so as to protect the natural resources and the needs and rights of the people (Soffianian et al., 2010). Hence, accurate mapping of urban environments and monitoring urban growth is becoming increasingly important at the global level (Guindon and Zhang, 2009). Urbanization is inevitable, when pressure on land is high, agriculture incomes is low and population increases are excessive, as is the case of most developing countries of the world.

During the last fifty years the population of India has grown two and a half times, but urban India has increased nearly five times. In 2001, 306.9 million Indians (30.5%) were living in nearly 3,700 towns and cities spread across the country, and it is expected to increase to over 400million and 533 million by 2011 and 2021 respectively.

The majority of the world's population now resides in urban environments and information on the internal composition and dynamics of these environments is essential to enable maintenance of certain standards of living. The availability of urban land cover data is critical to policy makers, particularly for town planners, because of their ability to monitor impact of planning policies, the direction of urban growth and the development progress.

Remote sensing can provide an important source of

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data for urban land use/land cover mapping and environmental monitoring. Urban land cover/use mapping has received an increasing amount of attention from urban planners and scientists including geographers. A numbers of significant studies were made for environmental quality management. Thus, various techniques have been applied for mapping urban land use/land cover. It helps in encroaching urban problems even of very small magnitude and dire.

In order to prepare urban development plan, the planners need detailed information on the distribution of land and its use in city and its surroundings. Urban planners use these techniques in survey, analysis, planning, implementation and monitoring stages of the planning process.

REMOTE SENSING AND GIS APPLICATIONS IN URBAN PLANNING

Application of Remote Sensing technology leads to innovation in the planning process in various ways:

1. Digitization of planning base maps and various layout plans has facilitated updating of base maps wherever changes have taken place in terms of development.
2. Digital maps provide flexibility as digital maps are scale free information and maps are available in digital format, correlating various layers of information about a feature from satellite imagery.
3. Remote Sensing techniques are extremely useful for change detection analysis and selection of sites for specific facilities, such as hospital, restaurants, solid waste disposal and industry.

Aerial photographs have long been employed as a tool in urban analysis. In India, city planning has been largely confined to aerial photography. Various types of cameras and sensors black and white, colour, colour infrared are used for aerial photography.

For obtaining accurate land use data the following points should be considered:

(i) Characteristics of imagery: scale of the photography, geometric fidelity, contrast, sharpness, and resolving power of film etc., waveband used, photographic or digital format.

(ii) Characteristics of land use: consistency of the relationship between form and function, degree of multiple uses, the amount of ground control, and change since imagery was obtained.

(iii) Characteristics of user: interpretation skill, use of stereoscopic techniques etc.

Urban Land Use Classification Criteria

Classification is an activity of sub-dividing a group of objects in two or more groups, i.e. to arrange objects into classes according to some system or principle.

i) The classification system should be applicable over a large area covering both city core and its surroundings.

ii) Classification should be suitable for using remotely sensed data obtained at different time periods.

iii) The minimum interpretation accuracy and reliability in the identification of land use should be about 85 percent subject to level of classification of different land uses.

iv) The nomenclature, definition and framework to the extent possible should be compatible with existing terminologies adopted in planning agencies.

v) Classification should be easier to understand and flexible.

vi) Aggregation of similar or multiple land use classes should be possible at different levels of requirement.

vii) The classes must be mutually exclusive, i.e. any geographical individual can only fall into one class.

viii) Wherever possible, it must be based upon quantitative criteria. Comprehensive Urban Land Use Classification (Gautam and Narayan 1982)

URBAN LAND USE DELINEATION

There are different perspectives in the classification process, and the process itself tends to be subjective, even when an objective numerical approach is used.

PROBLEMS WHILE URBAN PLANNING

When remote sensing is used data many problems arise during interpretation of different urban land use/land cover features, in which cloud patches on satellite data is important one. Another problem in remote sensing data depending upon urban building size and spectral contrast with the surrounding area is that some buildings in urban area may be identified, while others may not.

The following urban issues are analyzed by using this technology:

- Urban Land Use Inventory.
- Study of Urban Sprawl and Growth Trends
- Space Use in the Core Area
- Travel Route Pattern
- Urban Environment Analysis
- Site Suitability Analysis
- Social Infrastructure

CONCLUSION

In Urban and Regional planning field, IRS products are widely used for urban sprawl and land use/land cover mapping, Utility planning and management, Infrastructure planning and location of major industrial, recreational, institutional facility in context to the Region. Satellite remote sensing with repetitive and synoptic viewing capabilities, as well as multispectral capabilities, is a powerful tool for mapping and monitoring the ecological changes in the urban core and in the peripheral land use planning, will help to reduce unplanned urban sprawl and the associated loss of natural surrounding and biodiversity. Rapid development in city poses several challenges including problems associated with urbanization for urban managers and policy makers. Meeting these challenges requires access to timely and reliable information.

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Effects of Climate Change on Agriculture

Richa Sharma* and Maya Kumari**

INTRODUCTION

Climate is a complex phenomenon described in simply as the average weather conditions at a place that vary with time. Temperature, wind direction and speed, water vapor content in the air, atmospheric composition, pressure and density are the parameters that define the state of the atmosphere at a place. Atmosphere continuously interacts with the underlying surface of the earth like the oceans, land and ice and this interaction is termed as the climate system. Measurements through the direct and the indirect methods of the past variations in the earth's climate validate that there has been a significant variation in the climate on a wide range of time scale. This variation has been termed the global climate change by the group of scientists and policy makers all over the world.

Climate change refers to a statistically significant variation in either the mean state of the climate or in its variability, persisting for an extended period (typically decades or longer). Climate change may be due to natural internal processes or external forcings, or persistent anthropogenic changes in the composition of the atmosphere or in land use. This change in the climate is a continuous phenomenon, and is happening since the pre-historic times. Various reasons that were attributed to its cause in pre-industrial era were changes in the earth's orbit and the sun's intensity. Volcanic eruptions also emitted aerosols and carbon dioxide into the atmosphere. Changes in ocean currents are caused by the heating and cooling of the earth, which are responsible for distribution of heat on the earth's surface. There are periods of stability as well as periods of rapid change. Interglacial climate (such as the present) is more stable than cooler glacial climate. Rapid climate changes usually occur in between the glacial and interglacial periods. Any geological period in which long-term cooling takes place and ice sheets and glaciers exist is described by the scientists as ice age or glacial age. An ice age or glacial age is a long interval of time when global temperatures are relatively low and large areas of the Earth are covered by continental ice sheets and glaciers. There are multiple shorter-term periods of warmer temperatures within an ice age when glaciers retreat (called interglacials or interglacial cycles) and colder temperatures when glaciers advance (called glacials or glacial cycles).

Since the industrial revolution, human activities have increased at a very rapid rate which is causing atmospheric, temperature, and precipitation and sea level changes. Anthropogenic activities like the burning of fossil fuels, agriculture and land-use changes like deforestation has notable contribution to climate change. These activities result in the emissions of carbon dioxide (CO2), the main gas responsible for climate change, as well as of other 'greenhouse' gases.

The increasing green house gas concentrations raise the temperature of the earth, influence precipitation patterns, and sea level changes. The main driver of climate change in the future would be the concentrations of the green house gases and how long these gases would persist in the atmosphere. Accelerated melting of glaciers, sea level rise, submergence of islands or coastal areas and deviant rainfall patterns are one of the most common outcomes of increase in the green house gas emissions (IPCC, 2007).

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Climate and agriculture

The primary determinant of agricultural productivity is the climate of a place. Plausible climate change scenarios include elevated temperatures, changes in the rainfall patterns, and higher atmospheric carbon dioxide concentrations. Crop production, hydrologic balances, livestock, soil processes and other components of agricultural systems are expected to be influenced by climate change. The nature and magnitude of the impacts of climate change on these components is complex and uncertain.

Crop response to climate change

Changes in climatic factors such as temperature, rainfall patterns and the frequency and severity of extreme events such as droughts, floods, and wind storms directly affect the crop production. It is expected that warmer temperatures will cause crops to grow faster, but it could also reduce yields. On the same hand, faster growth could reduce the amount of time that seeds require to grow and mature fully. Therefore, the effect of temperature increase will ultimately depend on the optimal temperature of a crop required for its growth and reproduction. Plant growth fundamentally depends on carbon dioxide. Rising concentrations of carbon dioxide have the potential to enhance the crop yield. However, yield increases may be reduced or reversed by some factors that may counteract the increases in yield. For example, if the temperature surpasses a crop's optimal temperature range or if adequate water and soil nutrients are unavailable. Increased temperatures, humid climates, and elevated carbon dioxide levels favor the proliferation and spread of pathogens, parasites, weeds, pests and diseases. This would lead to increased financial burden on the farmers for the use of pesticides and fungicides which will indirectly affect human health negatively.

Dealing with extreme events such as floods and drought could become a challenge in areas where summer temperatures are projected to increase and precipitation is projected to be erratic. It may be more difficult to meet water demands for agriculture, as water supplies are reduced and water quality is compromised. Droughts will increase the soil water deficit significantly and impact the availability and timing of irrigation water supplies. Floods lead to inundation of a large area of agricultural land as a result which there will be huge crop loss. This will result in shortage of food, and animal fodder. Floods may also affect the soil characteristics. The land may be rendered infertile due to erosion of top layer or may turn saline if sea water floods the area.

Livestock response to climate change

Climate change poses formidable risk to the livestock sector which is an important component of agricultural systems. The anticipated rise in temperature profile with erratic rainfall patterns resulting from climate change is likely to exacerbate heat stress in animals, affecting them both directly and indirectly. Heat stress directly induces behavioral and metabolic changes, which include reduced feed intake and metabolic activity and thereby a decline in their overall productivity. Reduced diet and slow metabolism indirectly causes increased vulnerability to disease, reduce fertility, and reduce milk production. Extreme events such as summer heat waves, winter storms, floods, droughts etc. can also result in the death of vulnerable animals. Drought may pose a threat to regular pasture, crop by-residues, and feed supplies for the animals. The amount of quality forage available to grazing livestock is also considerably reduced by droughts. Increased temperatures and humid climates may also affect the severity and distribution of livestock diseases and parasites. Increases in the atmospheric carbon dioxide (CO2) may step-up the yield of pastures quantitatively, but it may also drop-off their quality. As a result, cattle would need to feed more in quantity to obtain the same nutritional benefits qualitatively.

THE INDIAN CONTEXT

India, being an agrarian economy, is the most vulnerable to the impacts of climate change. Agriculture represents a core part of the Indian economy and provides food and livelihood activities to much of the Indian population. While the magnitude of impact depends on the region and its location, climate change is expected to impact adversely on agricultural productivity and shifting crop patterns. The key characteristics of Indian agriculture that could influence its vulnerability to climate change are high level of subsistence agriculture with small land holdings of farmers; majority of agriculture is rain-fed; frequent occurrence of extreme weather events such as droughts and cyclones; and the wide variation in agricultural productivity across the country.

Climate change directly affects food security and nutrition. Climate change will affect food security

through its impacts on all components of global, national and local food production systems, which is projected to affect all four dimensions of food security, namely food availability; stability of food supplies; access to food and; food utilization. It challenges the current efforts to protect the lives and livelihoods of the over 1 billion food vulnerable people and will increase the risk of hunger, malnutrition and poverty by an unprecedented scale within the next decades. People who are already vulnerable and food insecure are likely to be the first affected. Agriculture-based livelihood systems that are already vulnerable to food insecurity face immediate risk of increased crop failure, new patterns of pests and diseases, lack of appropriate seeds and planting material, and loss of livestock. People living on the coasts and flood plains and in mountains and dry lands are most at risk.

CONCLUSIONS

The agriculture sector represents 35% of India's Gross National Product (GNP) and as such plays a pivotal role in the development of the nation. Exposure to climate change poses an unprecedented challenge to agriculture in the next decades. Any adverse impacts in the agricultural sector also affect other downstream industries of agriculture that depend on agricultural goods and determine cross-effects in the economy of a country. Changing climatic and weather conditions affect crop yields and supply. Decline in supply will lead to higher and more volatile prices. Higher costs will affect the most vulnerable section of the society and will cause further malnutrition and poverty. Thus, the impacts slowly spread into the social fabric as the regular sources of income dwindle, food shortage, health reduction and loss of life, increased poverty, reduced quality of life and social unrest leading to migration. Therefore, formulation of appropriate adaptation and mitigation strategies is the need of the hour to respond to the challenge of climate change. Failure to identify agriculture as a priority sector for adopting adaptation and mitigation measures will lead to further aggravation of the potential damages from climate change to this sector.

Possible adaptations may include changes to the food security policy of the country to account for changes in the total crop produce as well as shifting boundaries for crops and crop acreage, and the rippling impact it will have on the food supply. Changes in the yield of the cash crops of the country will significantly affect the revenue generated by their exports. To accommodate such changes in the import/exports of the country, modifications to trade policy of the country would be a possible adaptation measure. With agriculture contributing significantly to GNP, it is vital that the policy also addresses the issues of loss of livelihood and the imparting of advanced set of skills to such people to cope with the changes. Water policy will also need to consider the implications for water demand of agricultural change due to climate change, since the impacts vary significantly according to whether crops are rain fed or irrigated. Policy-makers will also have to consider adaptive measures such as the introduction of the use of alternative crops, changes to cropping patterns, and promotion of water conservation and irrigation techniques to cope with changing agricultural patterns.

Therefore, there is an urgent need to harmonize the policies so that each policy acts as a compliment to one another. The policy implications for climate change impacts in agriculture are multi-disciplinary and cross-sectoral in nature. All mitigation and adaptation strategies should be reflected in the action of the nation's administration and it should be ensured that they are adequately internalized across the various sectors.

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