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Editorial

Energy and water have been the prime source of life on this planet. In the present age, energy has become all the more important in modern life. Can we have communication, transport, health, IT and so many other services without energy? It is the lifeline of modern age and therefore, it is not unnatural that energy issues are coming to the fore in the present century.

We discussed water at length in the April-June 2013 issue. The main focus of this issue is on ENERGY with its various aspects and applications. In the liberalized economies where we run after the GDP growth, we especially need ENERGY, cheaper energy in abundance to boost production and improve the living standards of people. To meet our energy needs we are dependent on depleting non-renewable resources which adversely impact the environment. Generating energy from renewable sources happens to be expensive and therefore, authorities shun the efforts in this direction. R & D efforts are also lacking in this field. In the southern part of the world which faces energy poverty, enough solar and wind power is available and sufficient quantity of energy can also be produced with available municipal solid waste. It may prove long lasting but it is still an elusive dream since it is yet to become a viable option. Even the energy rich countries like Nigeria, the largest oil producing country in Africa and Indonesia one of the largest coal exporters in Asia unfortunately fail to provide fuel or power to their people.

With all these presumptions and challenges Ramanathan Menon believes that renewable energy is a way forward for India's economic growth. Shankar Sharma also tells us that India can do without nuclear power. How the life style changes, alter the pattern of energy consumption in the neo-rich society is the theme of Sanjay Prakash and Gurneet's paper. Prateek takes us back to Vedic era to search for the primitive source of energy in Agni—the fire. Dr. Dinesh Goyal experimented in the field of solar water pumps and made it a model to replicate. Ramachandar a research scholar, explains how power can be generated from municipal solid waste. Papers on study of energy expenditure pattern, growth of e-commerce and green computing have also been included to promote research in the areas. A report on a consultation on Energy: Policies and Challenges organised by the IDM, has also been included in the issue. Dr. Vivek Agrawal and his co-authors tell us how economic development and solid waste generation go together in the developing world. In RTI section a case study of Jaipur Development Authority has been dealt with. In Gender section, Dr. Abha Sharma speaks about the unsafe abortions and maternal mortality in India. In institutional profile, Annakshetra Foundation working to save food, energy and the environment is being introduced.

The forthcoming issues of Oct-Dec 2013 and Jan-March 2014 will focus on Citizen Centric Governance and Language/Literature and Development respectively. The editorial team of JDM requests authors and researchers to contribute papers on these themes. Here again we reiterate that one of the purposes of the Journal is to encourage original research and promote dissenting views. These may generate purposeful debates which are essential for democracies. Your participation is solicited.

Arun Ojha

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Can We do without Nuclear Power in India?

Shankar Sharma

Abstract

The debate as to whether nuclear power is a safe, suitable and essential option for India has been going on for many decades. The proponents of the nuclear power have been offering many arguments in favour of the option. However, there are many contrary views expressed by those who feel it is not a credible solution to meet the legitimate electricity requirements of our society on a sustainable basis. Even if such a debate has been going on in other countries also, a densely populated and poor country like India should consider the nuclear option from the perspective of overall welfare of its communities.

Acronyms/Abbreviations

AEC: Atomic Energy Commission, AERB: Atomic Energy Regulatory Board, BEE: Bureau of Energy Efficiency, CBA: Costs and Benefits Analysis, CEA: Central Electrical Authority, CSP: Concentrated Solar Power, DAE: Department of Atomic Energy, GHGs: Green House Gases, IEP: Integrated Energy Policy, IISc: Indian Institute of Science, IPCC: Intergovernmental Panel on Climate Change, ISEC: Institute for Social and Economic Change, MNRE: Ministry of New and Renewable Energy, NPCIL: Nuclear Power Corporation of India Limited, PLF: Plant Load Factor, RAPS: Rajasthan Atomic Power Station, SRREN: Special Report on Renewable Energy Sources, T & D: Transmission and Distribution, USSR: Union of Soviet Socialist Republic

Overarching Principles on Societal Welfare

While the contentious issues on safety, sustainability and economics of nuclear power may not be settled in the near future, there is an urgent need to look at nuclear power from the perspective of Precautionary Principle as adopted by the UN Convention on Biological Diversity (1992), and as per the spirit of our Constitution. The Precautionary Principle is an approach to uncertainty, and provides for action to avoid serious or irreversible environmental harm in advance of scientific certainty of such harm. According to this principle, those activities which are likely to pose significant risk to nature shall be preceded by an exhaustive examination; their proponents shall demonstrate that the expected benefits outweigh potential damage to nature, and where potential adverse effects are not fully understood, the activities should not proceed. Since the economic costs and risks associated with nuclear power to our society is finite, and since many implications/consequences of a nuclear accident are not known, yet the basic need for additional nuclear power capacity can be and must be analysed objectively.

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Many concerns have been expressed from knowledgeable people from all over the world on the nuclear power technology. In view of the practical experience gained from all over the world the major issues of concern to our own communities can be listed as in the table below:

Major issues for the society with nuclear power technology

Economic Issues	Demands large tracts of forests and fertile land; huge capital and decommissioning costs; long term waste management costs; serious shortages of nuclear fuels in India; impact on food availability subsequent to accidents; true costs to society can be huge; massive costs to society subsequent to an accident
Social Issues	Peoples' displacement and health; long term health implications; genetic deformities; inter generational implications of nuclear waste
Environmental Issues	Mining related pollution; radiation emission during operation and from nuclear wastes for centuries ; radiation contamination of air, water and land; contamination of food products

In the overall context of the societal welfare some fundamental questions need to be raised. The primary objective of a nuclear power station is the production of electricity. There are many benign ways of producing the electricity. Has our society harnessed all the benign alternatives available for us to the maximum extent? What is the efficiency of the usage of the existing electricity infrastructure in the country? Is there a scope for meeting all the legitimate demand for electricity for our society by a combination of these benign alternatives? Can an objective analysis of Costs versus Benefits of a nuclear power project as compared to these benign options prove beyond reasonable doubt that it is in the best interest of our society?

Also, since the declared objective of nuclear power policy in the country is to meet the electricity demand of our communities, a dispassionate analysis of the very need for nuclear power and suitable alternatives in Indian context has become urgent. As of 31.1.2013 the nuclear power capacity in the country was 4,780 MW out of the total power capacity of 211,766 MW. Whereas this small percentage (2.25%) of nuclear power has been less than 5% of the total installed power capacity for decades, the time has come to rationally view the role of such a small percentage in the overall context of the power sector.

Central Electrical Authority (CEA) data reveals that for the year 2011-12 the electrical energy demand was 936,568 MU, whereas the demand met was 857,239 MU, which meant a shortfall of 8.5%. Similarly, for this period the peak power demand was 130,250 MW and the demand met was 115,847 MW with resultant shortfall of 11%. The contribution of nuclear power during this period was 32,287 MU (3.4% of the total).

Assuming 80% PLF and 10% auxiliary consumption the maximum power output by nuclear power sector during the peak demand period could be about 3,440 MW, though it could be much less if one or more reactors were not operating at that time. This works out to about 3% of the total power met during peak demand period.

With such a low share of electricity produced, how critical has the nuclear power to our society been?Between 2006-07 and 2011-12 the capacity utilisation factor of the nuclear power plants around the country has varied between 50% and 71% of the installed capacity as per Nuclear Power Corporation of India Limited (NPCIL) website data. Rajasthan Atomic Power Station (RAPS) units 1 and 2 have been de-rated to 100 MW and 200 MW respectively as compared to original designed capacity of 220 MW each.

Nuclear power authorities had promised a much larger share of nuclear power in the country. Dr. Homi J Bhabha had announced that there would be 8,000 MW of nuclear power in the country by 1980. By 1962, the prediction went up to 20,000 and 25,000 MW by 1987. By 1969 the AEC predicted that there would be 43,500 MW of nuclear generating capacity by Year 2000.

The reality has been quite different. The difficulties faced by the nuclear power sector in meeting its own capacity addition target since independence has to be kept in proper perspective before we plan for additional power plants. There have also been issues of reliability of supply of nuclear fuel. The Integrated Energy Policy (IEP) of the Planning Commission in 2006 had estimated that the Uranium reserve in the country can support only about 10,000 MW of nuclear power capacity. If the country were to rely on import of nuclear fuel and technology, the energy security would become a major issue.

The very nature of nuclear power makes it essential to be connected to a larger power network. In the event of power blackouts like the ones that happened recently the nuclear power plants are likely to be adversely affected, with the possibility of a radiation leakage, even though such chances are said to be low. A large size nuclear power plant such as the one proposed at Jaitapura (10,000 MW capacity) can even be a cause for a power blackout in the case of major trouble in the plant resulting in tripping of all the generating units in a short span of time.

A Department of Atomic Energy (DAE) document of 2008 "A Strategy for the Growth of Electricity in India", projects nuclear power capacity of 275,000 MW (as compared to 4,780 MW now) by 2050. Assuming an average power capacity of 500 MW for each nuclear reactor/generator this means about 550 reactors/generators. In view of the need for a large quantity of water to run these plants, it is natural to expect that they are located close to the coast. With the main land coast line of about 6,000 km this works out to approximately 11 km between two reactors. Even assuming that 2 or 4 reactors are placed in a straight line perpendicular to the coast, the distance between two nuclear power plants can only be between 22 to 44 km. Assuming a circular safe zone with a radius of 2 km around each reactor, 550 reactors would require a total of

approximately 7,000 Sq. km as safe zone. Can the diversion of such a large chunk of land be in the interest of a densely populated country?

When we look at the chronic power cuts of about 10-15% faced by our communities since year 2000, the huge investment that has gone into nuclear power sector even if its share is miniscule, and the huge scope for efficiency improvement feasible within the existing power infrastructure, the true relevance of the nuclear power can become suspect. Although a large amount of money is reported to have been spent on various activities associated with nuclear power research since independence, the contribution of the nuclear power to the total installed power capacity in India as of now can be termed as miniscule, and even negligible. If the huge budgetary support to nuclear power sector ever since independence is given to efficiency improvement measures and harnessing our renewable energy sources, it can transform the power sector with many other associated benefits.

Efficiency of Power Sector in India

It is a well known fact that the overall efficiency of the power sector in the country is one of the lowest in the world. T&D losses alone are reported to be about 25% against international best practice of 5%. A quick look at the efficiency levels within the power sector in India reveals that there is a huge scope for generating virtual additional power to the extent of 40% to 50% of what is currently being produced.

Power Sector Efficiency in India

Power Sector Area	Prevailing level of efficiency/ loss in India	Potential for improvement/ savings (percentage of total annual energy)
Generating capacity utilisation	50-60%	5-10%
Aggregate Technical & Commercial losses (AT&C)	35-40%	15-20%
End use efficiency in agriculture	45-50%	15-20%
End use efficiency in industries and commerce	50-60%	5-10%
End use efficiency in other areas (domestic, street lights and others)	40-50%	5-10%
Demand Side Management	Potential to reduce the effective demand by more than 20%	

(Source: Author's estimation based on IEP, National Electricity Policy, Annual reports of CEA and many other reports/article on Indian Power Sector)

Efficiency increase in the end use of electricity alone, whether in lighting, heating or motive power etc. is estimated to provide more than 20% of virtual additional power capacity at less than 25% of the cost of new nuclear power plant without any of the attendant risks.

Improving the overall efficiency of the power sector to international best practices alone can provide virtual additional power, which can be more than the planned nuclear power capacity by 2032. The real need for additional nuclear power capacity should be objectively considered in this context.

Costs and Benefits Analysis and Alternatives

It is an accepted practice worldwide to deploy the CBA, as an economic decision making tool, in order to determine the most suitable option in any project which can provide maximum benefits at least cost to the society. In the case of nuclear power technology in India such a CBA would reveal that there are many much benign options to meet the electricity demand of our masses at much less overall cost. Just to cite one example, the capital cost estimated for the proposed Jaitapura Nuclear power project in Maharashtra is estimated to be about ₹ 21 Crores per MW, whereas the capital cost for a coal based or dam based hydel project is reported to be in the range of ₹ 7 to 10 crores per MW. Even the solar power projects, which are generally termed as costly, are known to cost about ₹ 12-15 crores per MW.

The issues, which have been raised in a number of papers released within the country on the economics of nuclear industry, need to be fully appreciated and addressed. One such paper, by Dr. M V Ramana, formerly of ISEC, Bangalore, has established with reasonable amount of certainty that the real cost of a modern nuclear power station is clearly higher than that of a comparable size coal based power station. If we also take into objective account the long term storage costs of fuel spent and all the associated environmental and health costs, the nuclear power projects will be much costlier than the coal based power projects.

The life cycle cost of nuclear power including that of nuclear fuel mining, transportation, processing, decommissioning of reactors, and safeguarding nuclear wastes for hundreds of years (though not quantified so far), is projected to be many times more than that of other power generation technologies. Very sadly, these costs are not being accounted for in determining the cost of nuclear power to our society.

The direct and indirect costs to our densely populated and ill-prepared country in the unfortunate event of an accident such as the ones in Chernobyl and Fukushima can be horrendous. One major accident alone can negate all the electricity benefits from all the nuclear power plants in the country since independence.

An essential part of the CBA is the objective consideration of all feasible alternatives for a given project. If we consider the Jaitapura Nuclear power project in this context one can clearly see many credible alternatives to obtain the equivalent of net power/energy from that project. The net average output from the Jaitapura Nuclear power plant in a year can be expected to be about 6,300 MW of peak power and about 44,000 MU of annual energy (assuming 80% PLF, 10% auxiliary consumption and about 25% transmission and distribution losses in the Western Region). Credible alternatives to this project look highly attractive.

(a) T&D loss reduction from 25% to 5% in Western Region alone can yield about 6,400 MW & 47,000 MU (demand met was 32,100 MW and 233,000 MU in 2009-10 as per CEA).

(b) Using CFLs/LEDs in place of incandescent lamps and loss reduction techniques in IP sets within Western Region can yield about 6,400 MW and 47,000 MU of annual energy.

(c) PLF improvement in thermal power plants and loss reduction in domestic and commercial applications can yield about 6,300 MW and correspondingly high annual energy.

It should be noted that the capital cost of these alternative measures will be much lower than that of the proposed nuclear power plant, and the operational costs will be negligible. As per Bureau of Energy Efficiency (BEE) at the prevailing cost of additional energy generation, the cost of saving 1 unit of energy is $1/4^{th}$ that of producing it with new capacity. Additionally, the social and environmental costs of these efficiency improvement measures will be negligible as compared to the costs of a nuclear power plant.

True Relevance of Renewable Energy Sources

Being a tropical country, India is endowed with huge potential in new and renewable energy sources as shown in the table below:

Renewable Energy Potential in India

	Potential (Grid interactive power only)
Wind energy	50,000 MW (Onshore only) / **(100,000 MW as per WISE) / 748,000 to 976,000 MW as per a recent study in 2011)**
Small hydro	15,000 MW
Solar	Over 5,000 trillion kWH/year Potential (estimated to be many times more than the total energy needs of the country) / (**200,000 MW of CSP as per WISE)**
Bio-mass	> 50,000 MW
Ocean based Energy	With about 7,000 kM of coastal line potential should be huge, but no estimates available
Geo-thermal	Estimated to be considerable

(Primary Source: MNRE, Govt. of India)

The potential of renewable energy sources is huge and is capable of meeting most of the electricity requirements of the country. Effective deployment of such sources in a distributed mode such as roof top solar PV panels or community based bio-mass/ wind power units will provide much more benefits such as minimum T&D losses, accelerated rural electrification and development, and reduced expenditure to the State. Solar power alone is estimated to have the potential to meet the total energy needs of the country.

As per a simulation by Greenpeace International, India can meet around 65% of electricity and 50% of the Primary Energy demands from renewable energy sources by 2050. Being a poor and densely populated country, there is no alternative to India other than taking such rational approach. As per IPCC report 'Special Report on Renewable Energy Sources (SRREN)' renewable energy could account for almost 80% of the world's energy supply within four decades.

Safety, Social and Environmental Concerns

If resource rich, knowledgeable and quality/safety conscious countries (US, Russia and Japan) could not avert nuclear emergencies, can our densely populated and ill-prepared society ever hope to avert the possible human catastrophe from a nuclear mishap? It is unrealistic to expect a risk free nuclear power plant. However small the probability of a nuclear accident may be, the consequences for a densely populated country like India can be horrendous. In the case of a complex technology such as nuclear power, the true value and the credible risks to the entire society, including the flora and fauna and general environment should be determined objectively.

While more and more complex safety systems/redundancies are being designed and built for the overall safety of nuclear power stations, it should be noted that they are only increasing the number of sub-systems and the complexity. Such complex systems can result in increasing the risk of failure of individual sub-systems/ sub-components (because of unintended/ unexpected interaction between sub-systems), and increasing new accident modes. All these can result in an increase in the number of automatic shutdown of reactors or catastrophic failures. The rapidity at which a minor problem in the complex system of safety can escalate into a major disaster is great in a nuclear power station, as experienced at Chernobyl.

How safe is it for our communities to ignore the sane advices by Dr. A Gopala Krishnan (former Chairman, AERB), Dr. Balaram (Director, IISc), Mikhail Gorbachev (former president of USSR), Dr. Helen Caldicott (founder of Physicians for Social Responsibility), Naoto Kan (Former Japanese Prime Minister) and many others? The insistence of the nuclear reactor suppliers/builders to get a waiver for them on the nuclear damages liability and the refusal of any insurance agencies to provide insurance against nuclear accident are clear indications of the huge consequences of a nuclear accident.

Pro-nuclear advocates have started arguing that nuclear power is a good option against Global Warming since it does not emit GHGs in reactor operation. Observers are of the opinion that floundering nuclear establishments around the world have grabbed this second opportunity (of arguments w.r.t. Global Warming) and have made claims for massive state investments in the hope of resurrecting an industry that has largely collapsed due to its inability to provide clean, safe or cheap electricity. Two assumptions made by such pro-nuclear advocates are fundamentally flawed. One is that Global Warming can be contained without fundamentally changing the Western pattern of energy consumption; because nuclear energy is a small contributor to energy

mix world wide (hence, has no discernible impact on Global Warming). It is generally considered to be impossible to contain Global Warming through a particular power generation technology alone, without significantly reducing the overall energy consumption levels of Western/ developed countries.

Also, the aggregate of energy consumed in the entire nuclear fuel cycle from the stage of mining till the nuclear wastes are safely discarded after hundreds of years is estimated to be so huge that a nuclear power plant can be a net consumer of energy rather than a producer. Hence, its net impact on global warming seems to be negative in nature rather than being positive. It is also undeniable that the impact on the flora, fauna and the general environment during the mining and in the case of a nuclear accident is highly adverse.

Nuclear Power Scenario Around the World

Whereas the proponents have been saying that nuclear power is essential for the energy security, countries like Australia and New Zealand have managed their electrical power demand satisfactorily by consistently refusing to opt for nuclear power. Not a single reactor has been approved in US since Chernobyl disaster. Germany has decided to shut down all its reactors by 2022 and Japan has only 2 of its 54 reactors running now consequent to Fukushima disaster. Few other European countries have also shelved their plans to add reactors. It is worth noticing that the independent parliamentary panel of Japan, which studied Fukushima disaster, has termed it as a man made disaster.

In the background of all these issues, and keeping in view the low probability but huge consequence of a nuclear accident, the question to ask ourselves is how critical nuclear power stations are for the development of all sections of our society. The electricity industry experts say that there are enough non-nuclear power options, including measures such as efficiency improvement, Demand Side Management, energy conservation and renewable energy sources to meet our legitimate electricity demands on a sustainable basis.

Conclusions

The decision on Nuclear Power is too critical from the perspective of the overall welfare of our communities to be decided by few people in the nuclear establishment alone. It is necessary to have active participation of all the stake holders in making informed decision on the issue. In any such discussion on nuclear power in India a rational analysis of all the relevant issues shall be of critical importance.

Despite huge investment in the nuclear industry since 1950s, the nuclear power capacity has not lived up to the tall claims of its Captains. In the background of the fact that even known technological leaders like USA, USSR and Japan, very particular about high quality and safety issues, have failed to avert nuclear accidents, it is a challenging task for India to have safe/accident free operation of all the existing/proposed reactors.

We cannot say that the decision made by Germany and Japan to move away from the reliance on nuclear power is ill-conceived. We have the example of Australia and New Zealand who shunned nuclear power from the beginning and have not suffered from lack of quality electricity supply so far.

A comparative study is needed on the cost front as well. The projected cost at Jaitapur nuclear power park is about ₹ 21 crore per MW nuclear power while coal power comes to be about ₹ 7 Crore/MW hydro power at about ₹ 8 crores/MW or solar power about ₹ 15 crore /MW. We need to explore better options to bridge the gap between demand and supply of electricity in a densely populated country like India. It is crucial that we consider all the much benign options before we move to the nuclear power option, which has not gained popular acceptance even after 50 years of massive support.

Can we afford to accept the high risks (where 'risk'='probability of nuclear accident occurring' X 'consequences of such an accident') associated? No one will probably be ready to live near a nuclear power plant/ nuclear facility knowing well the credible threat of radiation leakage. In the background of three major nuclear accidents, and many near misses, we certainly cannot afford to ignore the "precautionary principle" as enunciated by the international convention on bio-diversity. Many reports/articles which have appeared in the media and by leading personalities such as Mikhail Gorbachev, UN Secretary General, physicians for Social Responsibility, Dr. A Gopala Krishnan, Dr. Balram and others have cautioned on this score.

One must also take into account the costs involved in safeguarding the nuclear waste for hundreds of years in future. Is it worth the price? The nuclear fuel cycle will perhaps consume more electricity than it can generate in its economic life cycle of about 40 years. In a poor country like India, we cannot forget all the direct and indirect costs of nuclear power as compared to the benefits it will bring to the society.Through an objective study of Costs & Benefits Analysis we can see beyond reasonable doubts that every nuclear power plant in the country has more costs than benefits to the society.

Can we convincingly say that none of the provisions of our Constitution and various Acts of our Parliament will be violated by persisting with the nuclear power policy? We need to have a serious introspection over the nuclear power issue and learn from the bitter experiences of nuclear establishments around the world.

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Agni[1] : The Principal Source of Energy in the Vedas

Prateek Goswami

Abstract

As the principal source of energy of the universe, Agni performs multiple functions. It infuses life-blood (prāna) in every celestial body, like Sun, Moon, Stars and Constellations (Grah-Nakshatras). It produces all existing four forces including the electromagnetic force, provides gravitation and rotation and controls movement of various galaxies, in establishing the famous Rita-principle(order of universe set by lord Prajapati).

As the chief purohit (Priest) of the shrishti-yagya (universal ritual of sacrifice) of Lord Prajapati, Agni is placed second to Kāl. (time) only, in the hierarchy of divinity. The smallest particle of our universe is covered, protected and energised by Agni since every atom contains in it the actual photo-print of the universe. Agni is potentially present in the lustre of every particle moving in our atmosphere and takes control of these particles (Vasus).

Introduction

Agni has been recognised in the Vedas as the principal source of energy in the universe, that is why it has been given the first place among all objects of this world "अग्निर्हव तं अग्नि " (that which is first). In addition to this, every atom of physical world is covered and fostered by Agni without which it has no existence.[2] Even the Sun, Moon, *grah* and *nakshatras* (constellations) are enlightened by the light and glory of *Agni*.

Our physical world, according to Vedas is activated by sixteen forces produced by *Agni*, whereas in modern science it is activated by only four physical forces, one of these forces is known as Electro-Magnetic force. In the Vedas as well as in modern physics, all these forces are engendered by the thrust of Agni or the Energy-Principle.

The smallest particle of our universe is covered, protected and energised by *Agni* since every atom contains in it the actual photo-print of the universe vide यथापिण्डे तथा ब्रह्माण्डे (as is an atom so is the world).[3]

The vedic scientists have not only visualised the above fact, but during their extensive research studies by means of *Yagya-Karma (sacrifical ritual)* – following the *shrishthi Yagya* (ritual sacrifice) of Prajāpati found out how Agni enlightens Sun, Moon,

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1. Agni- fire and heat radiation doctrine
2. अग्निष्टा विक्ष्वा भुवनानि वेद (Agnishita vishkwa bhuvnani vaid) It should be known that Agni in this world is a very well developed atomic energy principle, in manifold forms; atomic particles coupled with Agni travel in the form of potential rays from one place to another in universe "गमयति रसान् गच्छति अंतरिक्षे" *(gamayati rasān gacchati antarikshe)*
3. Only a hundred years back, with the beginning of nuclear science and atomic research studies the enormous power hidden in an atōm was experimentally established and 3000 year old scientific studies of vedic literature were acknowledged.

grah-nakshatras and galaxies: ''एकं एवाग्नि बहुधा समिद्ध–एकः सूर्यो विश्वमनुप्रभूत'' (Agni alone can enlighten and inflame all world just like Sun).

The first and initial *sukta* (verse) of the Rigveda establishes the importance of *Agni*, where it has been described as the chief *purohit* (priest) of *shrishthi-yagya* and given the charge of Ritviz, by lord Prajāpati himself, "अग्निमीष्लें पुरोहितं यज्ञस्य देवम् ऋत्विजम् होतारं रत्नधातमम" (Ritviz means the chief performer of sacrifice) followed by the extreme importance of Agni, with such attributive phrases:

अग्निः पुर्वेभिऋषि रीडायो नूतनैरूत	(collecting energy from the East, Agni rejuvenates)
अग्निना रयिमश्नवत् पोषमेव दिवे दिव	(and having this Agni enlightens every direction)
अग्नेयं यज्ञमध्वरं–विक्ष्वतः परिभूरसि	(Agni being chief of the sacrifice glorifies the world)
अग्निर्होता कविऋतुः सत्यश्चत्रश्रवस्तमः	(what had been imagined by poets Agni gives a shape like a painter)

If we go on to explain the detailed meaning of these *mantra panktis* (hymns) it will cover a number of pages, so let us proceed further to utilize matter of other *Mandals* (ambits). In *Asya vāmiya sukta* (chapter name) sage Dírghatapā has broadly explained the latent, hidden, darkened and enlightened forms of Agni in matters of creation and emergence of the universe. Vām is basically the original and older name of Agni. This word *(V*ām*)* is supposed to have emerged from the term *van* coupled with खञ (Khanja) suffix which means-serviceable- and who appeared in the *Yagya-Vedika* of Prajapati with his two brothers-Ashna and Ghritaprishtha (two names). Prajapati had seven sons and divided *vishvā* (universe) in seven parts to have control over this *Vishvā.* He is also known as Vishpati in Vedic terminology.

In Shatpatha Brahman, there is a mythological story (*ākhyāna*) about the importance of *Agni*-the eldest son of Vishpati. The story goes like this: The creator of this *Vishva*, Vishpati one day decided to divide the *Vishva* among his seven sons, so he called all of them and proclaimed his decision. As we all know that wherever there is a division of property it becomes the root cause of dispute. All the seven sons of Lord Prajāpati started quarrelling among themselves, except the eldest son *Agni.* Inspite of equal distribution of the *Vishva*, the fight originated for a better portion of the *Vishva*. This made Vishpati very sad, so the eldest son Agni came to relieve father *Vishpati* from the grief and he started sharing his portion with those who were dissatisfied for one reason or the other. Thus he energized their portion as well. The dispute subsided for some time and father *Prajāpati* pleased with the benevolent nature of Agni and his capability to help energize, blessed him with pouring down the richest quality of *dravya (liquid)* the *ghrata (a product of milk, better than butter)* in his share, knowing it well that his noblest and worthy son would make that smallest portion, the best of all through his energy. Agni not only proved worthy of his merit but he also made this portion so rich and valuable that he could help the brothers, whenever they needed his help. The most important part of this *ākhyāna* appears when *Agni* proving himself worthy of father's grace glorified the title of *putra* (the son) who enlightens others and also the relationship of brotherhood (*bhrātā)*. In times immemorial, both these terms *putra* and *bhrātā* became the eternal gems of a family and are defined in this way. *Putra* (son) is one who fosters the name of his father and even after sharing the prosperity of his father, enlarges it ten and hundred times more and *bhrāta*, who shares father's property with his brothers but keeps himself satisfied with whatever lot was left with him, helps in

enriching their wealth- such is the merit of *Agni*-described in the *Asyāvāmiyo sukta* of the Rigveda.

The *mantra pankti* (line) अग्निना रयि अश्नवत पोषमेव दिवेदिवे'' explains how the positive and negative charge of atoms produces the entire glow of day light in all directions. Every moment this atomic fusion takes place in a perfectly controlled manner by Agni. Otherwise the slightest lapse would create atomic blast everywhere, defeating the principal order (*Rit*) of the universe, designed by creator Prajāpati.

Agni receives the fostering power of this world from the East, and also from those scientific achievements, previously existing, because the remaining three directions (North, West and South) are somehow polluted and are not as pure as the East is. This fact is duly highlighted by sage Sasa-Atreya in the fifth *mandal* of Rigveda, this scientific observation; *maneeshibhihi pavate poorvyah kavih nribhih, yatah parikoshām acheekridat"* (मनीषिभिः पवते पूर्व्यः कविः नृभिः यतः परिकोशाम् अचीकृदत्) R. 5/86/20, meaning thereupon that by being the helper in the divine scientific yagya programs, human beings having special experiences, perform similar yagayas on earth, like lord Prajāpati, doing eternal yagya. But *yagya* performed by human beings on the basis of their previous experiences cannot match Prajāpati's *yagya*, and they prove like a pebble dropped in the calm waters of the sea producing momentary circular waves. As we proceed further, we get acquainted with the nature of scientific experience in this mantra *"na kavyai paro asti svadhāvah"* (न काव्यै परो अस्ति स्वधावः) '*Kāvyai*' in the Vedas, is a synonym of all pervading knowledge including the specialised scientific experimentation. According to this mantra no scientific experiment can take place, without a previously existing solid hypothesis, and the hypothesis must arise from scientists' (poets') own locale. Slowly and gradually on the basis of such experiments, Agni covers the entire universe. "*vishvatah paribhoorasi*" (विश्वतः परिभूरसि) Rig. 1/1/4. Thus only personified Agni-the supreme performer of yagya makes the whole canvas decked with stars, galaxies, suns and moons alive and actually materialised, as if a painter is giving shape to objects in his painting, *Agni-r-hotā kavikratu, satyaschitra shravastamah* (अग्निर्होता कविक्रतुः सत्यश्चित्रः श्रवस्तमः) Rig. 1/1/5. According to *mantra* the sage Vasushruta Atreya also says that the eastern fire is the purest and unpolluted and that Agni, should be invoked in the *vedi* of *Yagya madap*(fire place of sacrifical stage). This agni is very friendly to the residents of earth, v*ishashcha yasya atithih bhavansi*- (विशश्च यस्या अतिथि भवांसि) Rig. 5/3/5. Agni is thus the oldest of old and the newest of new.

Oldest of the old, and the newest of the new/ Energy which is discovered, and brought from the East is the purest one,
Vedic scientists count this brand of energy as most pious / and declared as the older most,
That is why it is first of all evidence of the creation of this universe.
Only Agni has the capacity to lead,
It has the natural quality of original and local progeny / old and new tradition,
East is the incessant source and treasure house,
It is unprecedented and glorious stock of creation/ always burning like fire,
Agni released them all / by his own hands made this world really existent.

Agni's relationship with man and universe in this way is explained at various places so much so that every *mandal* of Rigveda is enriched with it प्रियो विशामतिथि र्मानुषीणाम *(Priyo vishamtithi marnursheenam)* (Agni comes in this world of human beings as a

guest). Although the energy of Agni is present everywhere in the universe, man utilizes this energy for his atomic development programs maximally,*Gaya Atreya* says - O Agni! in the *Yagya Karma* (sacrificial ritual) you are giving power and energy, both to human beings and Gods equally well, मनुष्वत् त्वानि धीमहि मनुष्यवत्समिधीमहि, अग्ने मनुष्वत् अंगिरों, देवान् देवयते यज। त्वहि मानुषजने अग्ने सुप्रीति इध्यसे (*Manushvat twani dheemhi manushvatsamidhimahi agney manushvat angiro devaan devyeta yaj, twavhi manushjhane agney supriti idhyahsey*).

The Relation of Vasus with Agni

Agni is potentially present in the lustre of every particle moving in our atmosphere and takes control of these particles (*Vasus*) like a lord vide – *tvāmagne Vasupati, Vasúnāmabhipramande adhvareshu rājan.* (त्वामग्ने वसुपति वसूनामभि प्रमन्दे अध्वरेषु राजन्।) *Vasus* are most valuable particles scattered all over the universe, even the purest of pure diamonds are composed of them and as such they enter into the bowels (*garbha*) of celestial bodies including our earth and only because of the grace of these valuable *vasus* our earth has been named as Vasundhara. One more notable point about these *vasus* is that Russian Space Scientists and astronauts while travelling in the space have observed these floating *vasus* and collecting these valuable particles tried to prepare diamonds and most precious stones and almost verified the existence of *vasus* as mentioned in the Vedas. The other quality of these *Vasus* is that these are most friendly to every other particles of this universe. The following chart of the *Vasu* (the sparkling particles) would explain their universal friendship

Vasus are not *Agni*, but they contain *Agni*

Vasus are not *aditya (*solar spheres*)*, but they bestow lustre to *Aditya(*Sun*)*

Vasus are not *Indra* but they cooperate with him

Vasus are not *Maruts* but they are flown by *Maruts (*celestial winds*)*

and so on and so forth. That is why *Vasus* are given the title of *Vishva-Bandhu*- (universal brotherhood) in Indian thoughts.

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Life and Energy Conservation:
Scenarios from Middle and Upper Income Housing in India

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Abstract

India's climate pattern comprises six different types, with a truly complex and diverse nature comprising hot dry summer and hot and humid monsoon. Since traditional Indian houses used to be climatically responsive, they required no mechanical systems for air conditioning. Now with growing urbanization, Indian cities are starting to follow to western patterns of urban growth. The modern apartments have greater need for cooling, which cannot be afforded by the larger population. So the designers have a greater challenge to provide adequate comfort without relying upon mechanical systems. Major concerns for designers are reducing the energy embodied in materials and construction as well as reducing energy consumed in high-energy buildings. It is not possible to go back to the traditional styles of architecture but it is necessary to develop appropriate lifestyles which are not a compromise between the needs of energy and resource situations on the one hand and the aspirations and standards of future citizens on the other.

Introduction

This article describes experiences of the development of energy conscious architectural practices in India from the viewpoint of the practitioners. The material is synthesized from the work of our firms: one an architectural design organization that undertakes alternative architectural work, especially sustainable design, and the other a building efficiency analysis and solutions technology firm that works on green building design, certification, energy simulation and total building commissioning. The approach of this entire document is to present opinions about the current situation and future directions. The aim is to engender critical thinking on these crucial issues amongst the readers. Therefore it has been written more in the nature of an article using our experience as the raw material in the laboratory of field practice rather than as a rigorously researched scientific paper.

The Indian Context

India embraces at least six distinct major climate types.[1] Within this diversity, it exhibits complex climates such as the composite climate where the contradicting constraints of the hot dry summer, the hot humid monsoon, and the sharp winter make

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designing buildings a demanding endeavour. A colleague and the principal author had summed up the state of the building design sector in this context at the end of 1980s as follows.[2]

> "Traditional buildings have in some form or another taken into account this climatic diversity and various types of vernacular architecture are rooted in the land. While the (often anonymous) designers of this common-sense architecture do not explicitly state climatological expediency or energy efficiency as the prime goals of their work, it is nevertheless obvious that various forms that are integrated into the subcultures of traditional building design have grown out of this need. Thus the *Jharokhas* (balconies) and *chajjas* (overhangs) of the desert, the wide verandah of the coastal areas, the thick walls and roof of the Gangetic plain, and the unique earth buildings of cold dry Ladakh, all exhibit traditions which weave ornament, function, climate, and ritual into one integrated whole.
>
> 'With increasing urbanization, Indian cities have willy-nilly followed western patterns of urban growth, with results that are not always successful. On the one hand, this has created some of the largest slum settlements in the world, and the other, highlighted the fact that India is even today extremely short of commercial forms of energy – whether in the forms of delivered electricity, or the more basic oil and gas, and even coal.
>
> 'Therefore the dilemma that faces the man on the street when it comes to space conditioning is this: the traditional house was climatically responsive, requiring no mechanical systems to keep it cool, but the modern apartment block or congested squatter settlement is not so. Moreover, the cost of mechanical systems, as high as the cost of building itself, cannot be afforded except by a minuscule minority of the population. Even those who can afford this luxury often pay an extra cost in order to be independent from the overloaded and failure-prone infrastructure services, going in for in-house generators and other devices. All this despite the fact that India is one of the lowest of all nations in per-capita consumption of commercial energy.
>
> 'So when designers look at the building sector, the energy component of the design problem is not how thermal loads and energy consumption can be reduced (since consumption is already minimal), but how greater comfort can be achieved in the present context without relying upon mechanical systems.
>
> 'Persons involved in the building industry are not entirely unaware of these problems, though most get by with the 'business-as usual' approach. However, even from the most unconcerned architects, the output of designs are at least energy conscious in that they contain massive walls, reasonably correct sized openings, windows protected with overhangs, and a thick and somewhat insulated roof, though the reasons for incorporating these

features may be economy and tradition than concern about energy conservation.

'There is an increasing group of professionals and students who are demanding to know more about this area: ultimately energy shortages get reflected in higher priced energy-rich materials and higher mechanical system running costs. Thus, while in the late sixties, a 'solar' house would have been considered anti-establishment, in the seventies it was considered at least acceptably 'experimental', while in the eighties, it is endorsed and given lip service for live projects. The next decade *[i.e., the nineties, since this was written in the eighties]* might see energy conscious architecture take on an important role in building design and construction as the energy crunch intensifies and a large number of sensitized designers and clients enter the arena.'

In fact, there are large number of clients today who would like to have an energy conscious, eco-sensitive, 'green' architectural design. This is especially so for the individual plotted house category, which forms the bulk of a small sized architectural firms' practice.

The largest category of buildings where this would make a difference is multi-family housing, where unfortunately there are still no demonstrable models and it is still not clear what can be done without increasing capital cost since much of this category of buildings are in the private real estate sector. Increased discomfort of poorly designed apartments and reduced initial cost of air-conditioning and the provision of 100% backup (diesel based captive power) has also made the air-conditioned lifestyle increasingly common for the middle class in apartments.

Yet, it is encouraging that in many cases, clients would like to understand the larger (global) logic behind design decisions. Given the choice, they often demand an option that is aesthetically or ecologically satisfying, sometimes at an expense that cannot be justified by the rates of return on investment alone. In fact, there is a 'lifestyle' factor that seems to play a greater role in determining the user-acceptance of any particular feature of a design. This factor is being rapidly and increasingly influenced by the media, especially by advertising and other opinion forming processes.

Major Concerns for the Designer

There are five tasks of prime concern related to the practice of energy conscious architecture in India today. According to our experience, they are approximately in order of importance :

a) **Upgrading the comfort levels without necessarily reducing the energy consumed:** This needs careful understanding. Since the patterns of per capita energy consumption for buildings that are more or less unconditioned (as the majority are), the aim should be to prevent users of such buildings from altering their lifestyles and starting to demand air conditioning as their affluence increases, thereby avoiding going down the spiral of increasing energy

consumption for only an inappropriately small rise in comfort (or to only make up for inadequately used design opportunities).

b) **Reducing energy consumed in high-energy building:** Besides the task above and reducing embodied energy consumption described below, the concern for conservation wherever possible also exists. Naturally, the greatest gains in this area that can be made are for buildings that consume large quantities of energy in the first place. For this reason, this concern shall increase as the economy develops. Even so, this task shall probably not dominate the subject matter of architectural design (at least in housing) when it comes to competing with the first task of upgrading comfort without necessarily reducing the energy consumed.

In this context, as in the case of unconditioned buildings, owners are now more willing to invest in conservation and efficiency even for small rates of returns. This is partly to get rid of the ever undependable power grid, but only partly so. The residue is explained by the lifestyle factor: that the need to feel that a contribution has been made for a better tomorrow, or by the demand for certification, which fetches 'brownie points.'

c) **Reducing the energy embodied in materials and construction:** Socially speaking, this is the most important task for designers, though it often does not get client support especially when the monetary cost of a building component does not match its energy cost. Happily, the proportion of sensitized clients willing to seriously look at the factor of ecological viability is increasing. According to ongoing analysis undertaken by the principal author, the annualized consumption of energy for the building sector may still be higher in the economy compared to operating energy, so this is nationally a very important area of work.

d) **Integrating devices and components in the architectural fabric:** This task is of great importance for designers because without reasonably good integration, the building trades shall not be able to respond to the installation and maintenance of better systems even though the users may express a latent demand for the same. It is the bane of the Indian construction industry that it responds very slowly to the integration of devices. (By our reckoning, it took at least twenty-five years for the electrical bathroom geyser to be properly integrated into house building in terms of plumbing and electrical work: unfortunately, this particular device has now to be 'dis'-integrated in the era of solar hot water).

Integration also assumes importance due to two important demands of lifestyle: aesthetics and neatness. As this article shall attempt to illustrate, these lifestyle factors again dominate over 'scientific' criteria like efficiency and performance.

e) **Supply using centralized/active or decentralized/passive renewable energies:** This area is commonly understood to represent the entire field of energy conscious architecture, but it assumes importance only after reasonable avenues

of conservation under the above areas have been explored and implemented. Here too, there is greater chance of finding client acceptance for a technology due to lifestyle factors than purely on the basis of cost economics.

The list above, derived as it is from practice, displays some features that would not be expected by a purely formal copybook approach based on efficiency and economy alone. Successful implementation of all the tasks depends closely upon lifestyle factors.

Norms, Codes and Bye-Laws in the Overall Framework

There has been talk in official circles of legislating for the field of passive solar (and, by extension, energy conscious) architecture. While this is undoubtedly required to help set the requirements and standards for public buildings (because in these the lifestyle factor cannot be tangibly expressed by the client), it tends to have an inhibiting effect on the inventiveness that is currently displayed in various projects. The greatest danger of a common code of practice, or even of a different one for each climate, is that different building types today use extremely different levels of energy, and the approach towards their improvement is significantly different for each type of building. This fact is easy to miss and, even when not missed, difficult to incorporate in a mandatory code. In our view, it is better at this stage to install the practice of energy-favourable layout planning through example and by the education and training of professionals as well as by raising awareness of owners and users, relying upon the fact that the lifestyle pressures from clients will ensure the adoption of 'green' architectural practices faster than any laws ever could.

What can be worked out, however, are norms for consumption of commercial forms of energy for various category of buildings. In our experience, three types of buildings come to the drawing board. Naming them A, B and C (see Table 1 below), one can tabulate their diverse features better. The table referred to represents one aspect of this difference. Based more on our experience than upon rigorous research, the figures represent the installed power load and the electrical energy consumption (for air-conditioning, fans and lights), in terms of what is typical practice 'today' versus an ideal 'target' which should be possible to realize in best practice within the next decade. A full treatment would require inclusion of non-electrical energy as well as logical weights and conversions for summation and comparison of these. Norms would also be needed to differentiate between different use patterns of buildings (day-only, night-only, day and night, occasional use) and functional type (dwelling, school, hospital, office, cinema, hotel, etc.) Notwithstanding this, the figures in the tables serve usefully within our practice.

Type A building, the fully conditioned building, requires 'comfort-to-specification'. Such buildings consume large quantities of energy and good practice could immediately yield large and tangible savings. This makes it a particularly good sector for retrofits and high efficiency engineering. The architect needs to have a good understanding of mechanical systems in such cases to be able to fully realize the potential of efficiently designed air conditioning.

Building type	A Fully conditioned building			B Hybrid building			C Unconditioned building		
	Today	→	Target	Today	→	Target	Today	→	Target
Peak diversified installed electrical load (W/m^2)	150	→	50	150	→	10	10	→	2
Average electrical energy consumed (kWh/m^2 year)	240	→	60	80	→	20	30	→	5

Table 1. Electrical Energy Consumption in Various Types of Buildings

At the other extreme, type C, the unconditioned building, mostly uses ceiling fans and artificial lights and is still the dominant form of building in the country today.

Type B building is a hybrid of these extremes. It is emerging fast and will very likely become the dominant form in the future. It is built with some low energy cooling devices or systems (e.g., an evaporative cooled building).

An attempt has been made to show the potential that exists for good design in most cases. As already mentioned, it would be very fruitful to try and push buildings of type A from using what they use today to the corresponding target figures. In our opinion this represents a potential to decrease the energy consumption fourfold with marginal or no change in specifications of comfort. This transform is tangible and engineering leadership is required to be able to reach these targets.

Another transformation that is not as easy but more desirable is the upgrading of Type C buildings today to Type B buildings. If the targeted Type B figures are achieved, it will transform Type C buildings to Type B, or in other words, improve comfort levels significantly with less change in the amount of energy consumed than would be the case if Type A buildings would emerge instead. This transformation is the main responsibility of architects and clients since lifestyle options predominate the choices here.

Unfortunately, a large part of confusion in the past has stemmed from the impression that what energy conscious architecture aims to do is to convert Type A buildings into using Type B or Type C levels of energy (with a confusion about the comfort specification and degree of control provided). At least a part of this misunderstanding has been caused by literature from developed countries where this transformation is really within the realm of possibility. Given our climate and conditions, this transform does not seem technically feasible for us within the current next generation, especially since it is unlikely that Type A building user will want to relax their comfort specifications too much. It is this impractical and far fetched transformation that has somewhat unreservedly got support in the past. Such examples are the use of large photovoltaic arrays for producing electricity for buildings or the use of large thermal collection devices to run absorption air conditioning systems.

There is a large fourth group of buildings not mentioned in Table 1 which is either not supplied with electricity or connected to the extent of no more than two or three

lights and two sockets. This could be said to be an extreme form of C, but actually represents a different (the 'no-electrical-energy' building) category which would need upgrading to at least the targeted figures for Type C. This is also a very useful transformation that, if not done carefully, could result in a major and unnecessary burden on the energy resources of the nation. For instance, by upgrading to Type C today level rather than to target level because of easy loans or in the name of equity (which is unfortunately what tends to happen), a clear opportunity available only in the developing nations is frittered away. This asks for an approach where it would be considered desirable to increase energy use but to do so intelligently in order that the increased use could yield more than its proportion of dividends in terms of comfort against the individuals and societal costs incurred.

It is also possible to update the figures in Table 1 and to translate them into costs from time to time, thereby giving a normative indication of the running cost of various types of buildings. This should be compared to real estate values and rents to be able to judge the relative importance of the energy factor in the overall cost of using a building. This latter is unfortunately not very large given that location and dysfunctional land market constraints often hyper-inflate the capital cost of real estate and overshadow all running cost advantages.

If in the future a set of bye-laws is ever revised, it must allow different internally consistent (but maybe mutually incompatible) design strategies to be utilized depending on the climate, type of building and so on. It would be entirely wrong for instance to blindly specify high insulation in Type C buildings. The danger remains that we shall tend to commit exactly this kind of error if we were to set out a case for undifferentiated energy conservation and enforce it by law at this point.

A Lifestyle Scenario of the Middle and Upper Income Groups

Since the bulk of most architectural practices are spent in designing for the middle and upper income groups, and since this paper draws heavily from the experience gained in our practice, The description below of a North Indian family's lifestyle with respect to energy use in a region with a composite climate is adapted from an earlier scenario developed by a colleague and the principal author in the 1990s.[3]

> 'A middle class nuclear urban family of four stays in a rented town house where they would like to invest only in gadgets which they can remove and take away with them when they leave. Banks or financial institutions do not have a presence in the housing market (this may change substantially within the decade) *[this has now happened in the new millennium]* because of the complex and extra-legal complications in terms of ownership and property that have developed in this century, with additional complications of tax evasion and unaccounted wealth. Therefore, without access to easy finance, users tend to install only the basic fittings, namely, incandescent lights and electrical ceiling fans.
>
> 'For the landlord, this means low capital investment. The running costs are directly borne by the tenant who has no interest in investment anyway. The

low and subsidized price of urban electricity (from 2 to 9 US cents per kWh) also helps *[this has risen lately but remains low and subsidized for political reasons]*. As the affluence of the family grows, it typically buys an evaporative cooler mounted on a trolley: this is replaced in two years with a larger window mounted unit or even a full 'desert' cooler for the whole house. This works well for the hot and dry part of the year. If the house has a southern exposure, the short winter is tolerable anyway; otherwise a small electric convection blower or an electric radiator is added to the inventory of household gadgets.

'However, the monsoon season is not well covered by these arrangements and the hot humid days and nights are quite difficult. Therefore, by the time the children are in college or soon after, the master bedroom typically gets a window air conditioner. More window units may follow depending on the affluence, age or priorities of the couple. But along with the shift to vapour compression technology comes another important change: whereas temperatures 30° C or belowat 50% RH (Relative Humidity) felt comfortable earlier, the expectation of comfort soon becomes about 25° C or even 23° C. It feels warm to step out of the air conditioned room to the simple air cooled room.

[Today, this change has happened. Having a window or split air-conditioner in the house is as important as other household gadgets for a middle class nuclear family, as easy financial models have made it possible for the family to afford the same even though it significantly increases the electricity consumption thereafter. The cost of operating energy for just one cooling season is often more than the cost of the device.]

'So, as the couple finally reach a stage where they might be constructing their own house, if the architect suggests systems that would provide temperatures of 28 ° C, they are no longer good enough. Therefore nothing is kept aside for better orientation, wall insulation, or other heat load reducing or passive cooling methods. In any case, the investment required for any passive system is hard to come by, the promises that the architect is making are either not guaranteed or not specific, and the middle class salaried-income family is financially crippled due to the construction of the house in all its other aspects anyway. A hot house (cold in winter) is thus constructed and when the (now probably retired) couple moves in, they shift in with the various gadgets collected over their career anyway. These 'fix' the heat transmitted by the (economically thin) concrete slabs and relatively thinner fired brick walls and exposed large windows.'

The scenario shows large variations in specific instances, but one of the problems that starts the erosion of values described above is the lack of a sufficiently effective conditioning method for the monsoon. This fuels the shift away from passive and hybrid technologies towards vapour compression technology (or its ozone-safe but

inefficient older cousin, absorption technology) accompanied by changes in clothes and habits, leading to a reduced tolerance or at least altered perception of heat. Nationally, it implies a tremendous wastage and under-utilisation of energy.

In terms of the terminology evolved in Table 1, well designed type B examples can prevent many families from converting from type C to type A buildings even if their affluence were to allow them to do so. Otherwise, converting people whose energy expectations have been 'spoilt' once because they have become type A building users to type B use is difficult if not impossible, and bad energy habits take over. The perception then is that everyone has to do with less (due to shortages, rationing and price increases) rather than that to upgrade their use.

Emerging Alternative Lifestyles

The traditional context in current Indian society, even urban society, is sufficiently profuse but lifestyles have developed too much to directly apply traditional design solutions to built environments today, except symbolically. Society can obviously not willingly set its wheels backwards in order to go back to the simpler lifestyle of the past, no matter how romantic, ecologically sound or even possible this choice is. For a start, the level of population and urban sprawl is significantly higher than in the past. Communication and transportation too have changed the way urban space functions. Therefore, it is far more relevant to talk of going forward and developing appropriate lifestyles which are not a compromise between the needs of energy and resource situations on the one hand and the aspirations and standards of future citizens on the other. Only thus we can avoid paying for the current unsustainable economic growth model which leads to ecological disaster and human suffering.

In fact, such 'future' lifestyles are emerging spontaneously. Though not in any way a coordinated or conscious movement, there are a large number of clients who demand better performance from their built environment while at the same time rejecting or moderating demands that will irretrievably harm the natural environment. Though not specifically limited by creed, class, caste, or gender, there is a tendency for the educated middle and upper income groups to take the lead in this demand for a 'green' lifestyle. Undoubtedly, while some of this is only posturing and fashion, many of these clients are willing to put their money where their mouth is: sometimes more than what we as designers would do even for our personal projects. The readers are free to form their own opinion about the future.

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Renewable Energy: A Way Forward for India's Economic Growth

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Abstract

Electricity was never in such demand as it is today. Developing nations, including India, are facing the growing demand for energy. But there is a heavy shortfall in production. The rising demand for energy has led to prices spiraling up and environment related issues. Climate change concerns, coupled with high oil prices, are forcing countries to explore renewable energy i.e. energy that comes from resources which are continually replenished such as sunlight, wind, rain, tides, waves and geothermal heat. Renewable energy technologies are also clean sources of energy that have a much lower environmental impact than conventional energy technologies. The main renewable energy sources for India are solar, wind, hydel, waste and bio-mass. Renewable energy projects are suitable for large-scale needs as well as suited for rural and remote areas where energy is often crucial for human development.

Acronyms/Abbreviations

Co-ops: Cooperatives, IEA: International Energy Agency, PV: Photo-Voltaics, SEGS: Solar Energy Generating System, UNIDO: United Nations Industrial Development Organization

Introduction

Renewable energy comes from resources which are continually replenished such as sunlight, wind, rain, tides, waves and geothermal heat. About 16% of global final energy consumption comes from renewable resources, with 10% of all energy from traditional biomass, mainly used for heating, and 3.4% from hydroelectricity. New renewables (small hydro, modern biomass, wind, solar, geothermal, and biofuels) which are growing very rapidly accounted for another 3% . The share of renewables in electricity generation is around 19%, with 16% of electricity coming from hydroelectricity and 3% from new renewables.

The use of wind power is increasing at an annual rate of 20%, with a worldwide installed capacity of 238,000 megawatts (MW) at the end of 2011, and is widely used in Europe, Asia, and the United States. Since 2004, photo-voltaics (PV) passed wind as the fastest growing energy source and has more than doubled every two years since 2007. At the end of 2011 the PV capacity worldwide was 67,000 MW. PV power stations are very popular in countries such as Germany and Italy.

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Solar thermal power stations operate in the USA and Spain and the largest of these is the 354 MW SEGS power plant in the Mojave Desert. The world's largest geothermal power installation is the Geysers in California, with a rated capacity of 750 MW. Brazil has one of the largest renewable energy programs in the world, involving production of ethanol fuel from sugarcane. Ethanol now provides 18% of the country's automotive fuel and is also widely available in the USA.

While many renewable energy projects are large-scale, renewable technologies are also suited for rural and remote areas where energy is often crucial in human development. As of 2011, small solar PV systems provide electricity to a few million households and micro-hydro configured into mini-grids serves many more. Over 44 million households use biogas made in household-scale digesters for lighting and/or cooking and more than 166 million households rely on a new generation of more-efficient biomass cook-stoves. United Nations' Secretary-General Ban Ki-Moon has said that renewable energy has the ability to lift the poorest nations to new levels of prosperity.

Climate change concerns, coupled with high oil prices, peak oil and increasing government support are driving growing renewable energy legislation, incentives and commercialization. New government spending, regulation and policies helped the industry weather the global financial crisis better than many other sectors. According to a 2011 projection by the International Energy Agency (IEA), solar power generators may produce most of the world's electricity within 50 years, dramatically reducing the emissions of greenhouse gases that harm the environment.

The Rising Demand for Electricity

Electricity was never in such demand as it is today. The hunger of developing nations for energy particularly India, has increased and there is a heavy shortfall in production. The rising demand for energy has led to prices spiraling up and the deterioration of environment. Then there are phenomena like "global warming" which are catching the attention of people across sections and countries. The major concern is the future state of the atmosphere of the Earth which would be completely different if the rate of environmental pollution is not stalled. There is growing emphasis to use clean energy that will not pollute the environment. The conventional fuels – oil, coal, coke, natural gas, etc. – are limited. As the demand for these fuels increases, these resources are diminishing day by day.

Of the total power produced in India, the major source is coal followed by oil and gas that are followed by renewable energy sources. Coal is the cheapest form of energy but greatly pollutes the environment. Renewable energy sources used for power generation represent only about 12% in India. The energy required is not just for generating power but for each and every activity.

There is a dire need to develop technologies from renewable energy sources which are available and could be utilized (solar or wind) or from the sources which could be created and utilized (bio-mass). The main renewable energy sources for India

are solar, wind, hydel, waste and bio-mass. Bio-mass are resources which are agriculture related like wood, bagasse, cow dung, seeds, etc.

What will work for India?

Due to the prohibitive price, solar will remain on the back foot in India in the near future. There are efforts from industries to reduce the cost and make it cheaper. Solar has a great potential and will be utilized by individuals or some institutions for their captive needs. However, large installations will take at least around 5 to 10 years in India to make its presence felt.

There is good potential in India for hybrid systems – currently over 20 gigawatts of diesel gensets produce the energy used in industries such as raw material processing, agriculture and textiles. And with a solar irradiation of 1,500 kWh per kWp and up to 300 sunny days per year, India is a prime location for PV array power.

Wind is the most matured renewable energy source. One area which is fast emerging in the West is Offshore Wind Farms. The Wind energy primarily depends on wind speed as power is cube of velocity. As such, to get the best results, windy site is the primary need. In the beginning 100% depreciation was given to Wind Projects. There was quantum jump in wind farms especially in Tamil Nadu, Maharashtra, Karnataka, Rajasthan and Gujarat. Due to various reasons including misuse, the depreciation has been reduced to 15%.

Hitherto the depreciation benefits are given to big industrialists. To make it broad based with people's participation, Wind Farm Co-operatives on the lines of those in Denmark can be started in India. A WIND FUND can be created and people investing in it can be exempted from Income Tax under section 80C. Wind energy will be the fastest growing of the renewable one. From over 7,500 MW of installations to 45,000 MW potential, there is a long way to go. In a short span i.e. around next five years, wind energy is likely to grow.

"One of the greatest challenges faced by developing countries is access to energy. An estimated 1.3 billion people lack access to electricity, and the lack of a reliable power source is often cited as the greatest burden on entrepreneurs in emerging markets. According to UNIDO (United Nations Industrial Development Organization) the key to progress in developing world energy will be to implement sustainable, decentralized systems with an emphasis on renewable energy, including biomass."[1]

Decentralized systems are necessary because nearly half of the developing world's population is engaged in agriculture—not clustered in cities. A more feasible option than extending power grids to the countryside is to adopt more efficient biofuel systems.

Fuelwood and charcoal are today important existing sources of earnings for poor people, often second only to agriculture in rural areas of developing countries. Improve efficiency technologies in production and use and formalization of these sub-sectors (currently often grey markets and so heavily affected by corruption) would improve,

and make more sustainable returns for the millions of poor people working in this sector.

Biofuels are emerging as another earning opportunity in rural areas, which effectively creates a new valued product alongside existing cash crops, primarily food and fibres. However, it is challenging for poor farmers to understand how to engage with this emerging market which is driven by export promotion and external priorities and deal with uncertainties associated with switching over or integrating biofuel crops. But for those farmers for whom producing current crops is no longer competitive, biofuels provide new earning opportunities if governance and legal protections around the sector are in place.

Sustainable biofuel energy sources in turn create jobs for suppliers and distributors. An example is ethanol in Brazil's ProAlcohol program. This programme has created the world's foremost ethanol economy and made it the second largest producer globally. Rural job creation has been a major benefit of ProAlcohol because alcohol production in Brazil is labor intensive. Around 700,000 direct jobs, plus three to four times this number of indirect jobs have been created. It cost between US$ 12,000 and 22,000 to create each job, which is around 20 times less than in the chemical industry by comparison. Of the 700,000 total jobs, around 300,000 are cane cutters earning US$ 300-400 per month, on a piece rate. Cane cutting is seasonal however with cutters earning US$ 1.35 per hour each day for six days a week during the growing season of six to seven months.

Energy cooperatives as organisational form are growing a lot in popularity because they offer a variety of possibilities for action and design. Currently, more than 80,000 citizens in Germany hold shares in new energy cooperatives. They can already participate with small amounts. In the last years, more than 500 newly-founded energy cooperatives invested a total of 800 million euros in renewable energy. This is confirmed by a recent study of the DGRV (Deutscher Genossenschafts- und Raiffeisenverband, the Co-operative federation for German Co-operatives).[2]

More than 90% of energy cooperatives operate solar power systems, which can be set up nearly anywhere and everywhere with only minimal technical and financial resources. Solar technology and cooperative models are a perfect match. They represent the democratization of the energy supply and make energy supply accessible to everyone, regardless of their budget. Even if they do not have a rooftop of their own, citizens can thus profit.

The members of such energy cooperatives can help protecting the environment and the expansion of renewable energy sources, as well as the promotion of regional value creation as a higher priority than profit. Calculations show that the electricity production of the energy cooperatives completely covers the household electricity needs of their members.

Every minute, enough sunlight reaches Earth to supply the planet's energy needs for a year. This energy is free, but variable depending on climatic conditions. Converting to solar power is highly tempting to the green-inclined but buying and installing solar panels sufficient to provide the necessary electricity for a household is an expensive proposition, even with available rebates and tax incentives. And for some, investigation as well as the technological and practical issues are intimidating. Many communities are increasingly using solar cooperatives or co-ops as the effective means to handle the issues surrounding individual solar conversion.

The major advantages of belonging to a co-op when going solar involve economies of scale. A solar co-op purchasing for an entire community can negotiate wholesale or near wholesale prices on solar panels and designs. The solar co-op can also assist members with assessing the feasibility of going solar and educating them about available financial incentives.

Renewable energy contributes substantially to the total power generation capacity in India. In fact, in Financial Year 2012, only about 56% of the total electricity produced used coal as the source of fuel to generate electricity, 20% power was produced by hydro or water based sources, 12% electricity was generated using renewable energy sources and gas contributed 9% to the total power generation, while 2% and 1% contribution came from nuclear and diesel based power for the FY 2012.

Government of India gives multiple benefits to renewable energy projects such as exemption of industrial clearance, availability of loan, excise duty exemption, custom duty concession, financial support to renewable energy's R&D projects, income tax holiday, accelerated depreciation, preferential tariffs, interest and capital subsidies, energy buy-back and third party sale and trading. At the same time, the Government is also trying to reduce the capital cost of renewable energy projects so that more and more companies can invest in the sector. To fulfill this aim, Government is trying to adopt latest and suitable technologies in the sector and promote healthy competition among the players.

Other forms of renewable energy like biomass, bio-fuel and waste will also require time in India. The technologies to convert jatropha, palm oil or algae into bio-fuels are not yet commercially available and will take time to become economically viable. Algae, if pursued and successful, will be the answer to the worries of energy. It will not only engulf the huge amounts of carbon dioxide but also give higher yields per unit area.

Benefits of Renewable Energy

The main advantage is that Renewable energy technologies are clean sources of energy that have a much lower environmental impact than conventional energy technologies. Renewable energy will not run out. Other sources of energy are finite and will some day be depleted.

Most renewable energy investments are spent on materials and workmanship to build and maintain the facilities rather than on costly energy imports. Renewable energy investments are usually spent within the country, often in the same state, and frequently in the same town. This means your "energy rupees" stay home to create jobs and fuel local economies instead of going overseas.

After the oil supply disruptions of the early 1970s, India has increased its dependence on foreign oil supplies. This impacts more than just our national energy policy.

Low Awareness about Renewable Energy and Energy Efficiency in India

According to a first-of-its-kind survey conducted by Mercom Capital Group titled 'India Renewable Energy Awareness Survey,' only 56% of Indian consumers have heard of 'renewable energy' or 'clean energy', and only 27% of consumers have heard of 'energy efficiency'. Although awareness was low, 71% of Indian consumers surveyed are willing to pay higher rates for electricity from renewable energy sources.

Mercom Capital Group, a global clean energy consulting and communications firm, surveyed more than 500 commercial, residential and rural consumers in India that resulted in strong evidence that consumers are willing to pay more for uninterrupted power and the opportunity to use renewable energy.

"A surprising finding was that 65% of consumers in India are willing to pay more for uninterrupted power. There is a common misconception in India that consumers will not pay more for power, which has been the driving force behind state government policies that have been reluctant to raise power prices to reflect rising costs. This has led to decreased revenue among the power utilities, huge losses, continued power cuts and lack of financial resources to invest in power projects and infrastructure."[3]

Policies are implemented from the top down without any input or buy-in from consumers. There seems to be a general lack of education and awareness among consumers on these issues. How do you expect consumers to support and adopt renewable energy if they do not understand what it is? Energy efficiency tends to cost a fraction compared to new supply but unless consumers are educated about these programs the adoption will be slow and ineffective.

With policies like 'Jawaharlal Nehru National Solar Mission' being implemented and renewable energy gaining importance as a future energy source in India, understanding the perceptions of consumers about renewable energy is a vital factor for these policies to succeed.

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Green Computing: A Sustainable Bond between Energy, Environment and IT Industry

Mikku Dave and Dr. Meenu Dave

Abstract

Energy consumption in the world is growing by leaps and bounds and so is technology. The world of IT stands erect only if both these pillars provide equal strength. The strength thus provided proves to be a boon for IT, but lacks sustainability. On the one hand, the IT industry is flourishing and so does the world in terms of development; yet on the other hand, the green house effects and other types of pollution result in global warming which deplete the ozone layer, thus creating havocs for environment and ecology and putting a question mark on our own survival. A midway is required in order to create equilibrium between the requirement, production and utilization of energy by the IT industry and Green Computing certainly is the answer which can bring about sustainability.

Acronyms/ Abbreviations

CAGR: Compound Annual Growth Rate, CPU: Central Processing Unit, CRT: Cathode Ray Tube, EPA: Environmental Protection Agency, EPEAT: Electronic Product Environmental Assessment Tool, IaaS: Infrastructure as a Service, I/O: Input-Output, IT: Information Technology, LCD: Liquid Crystal Display, NIST: National Institute of Standards and Technology, OECD: Organization for Economic Co-operation and Development, PaaS: Platform as a Service, PC: Personal Computer, RoHS: Restriction of Hazardous Substances, SaaS: Software as a Service, SSD: Solid State Drive, WEEE: Waste Electrical and Electronic Equipment.

Introduction

Energy is the soul if the world is to be considered a body. Without energy, the existence of any system is impossible. Energy forms the base for smooth functioning and enhanced performance of everything. Almost every sector in the world is facing the problem of high energy consumption. IT is also one such sector. Computers have become an essentiality in human lives and dependency on these machines is increasing day by day. Information and Communication Technology is making human life easier as there is ease of service delivery with emphasis on customer care, and above all, the time and cost for service delivery are trimmed down.

With the advent of internet and its world-wide expansion and popularity, there has been drastic increase in the use of energy also. The consequences have been rapid depletion of conventional energy sources, swelled-up prices of electricity, natural gas

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and petroleum products, and increase in global warming due to increased levels of pollution. There is an acute demand for environmental sustainability so that IT services may be delivered to the customers with ever increasing technology and enhanced performance; but that simultaneously, our planet's resources may be consumed and evenly replenished.

1. Energy and Sustainable Development

The driving force behind the universe is energy. Be it in any form – it propels all the life forms and the environment around them. In today's age of scientific revolutions the biggest concern is of generating the energy in a way that not only gives impetus for development but for sustainable development.

1.1 Sources of Energy

It is rather difficult to define energy comprehensively, as energy is polymorphic in nature, yet it can be considered as the measure of the ability or capacity of a system or body to accomplish some task or bring about some change. Energy is something which cannot be observed directly; it can be measured or calculated as per its form. Energy is derived from assorted sources which can be broadly classified into two forms:

A. Conventional Energy

Mankind has been using the conventional energy sources from ages. Conventional energy, also popularly known as fossil fuel, is a natural form of fuel, such as natural gas, coal, firewood and crude oil (including gasoline, diesel, petrol, etc.). It is produced due to anaerobic decomposition of buried vegetation and animal remains over hundreds of years. Conventional energy sources are by and large non-renewable in nature and deplete over time. Nuclear Power (produced by splitting of atoms), Hydro Power (produced from water) and Thermal Power (produced from steam, gas, oil) are also conventional energies (other than the fossil fuel) which are used universally these days. Conventional energy is expensive in terms of transmission, storage and maintenance. Moreover, it is one of the sources of pollution and is responsible for the emission of carbon and other green house gases. Disastrous emissions of nitrogen monoxide, sulphur and mercury that pollute the environment are due to burning of coal.

B. Renewable Energy

This type of energy is generated through renewable natural resources and thus is also known as *renewable energy* or *alternative energy*. This kind of energy does not deplete the natural resources and is not hazardous for the environment. Renewable natural resources like sun (Solar Energy), water (Tidal Power, Wave Power), wind and earth's heat (Geothermal Power), freshly decayed vegetation or animals (Biomass energy), etc. contribute to this form of energy. Unlike the conventional energy resources, these are non-exhaustible and less expensive interns of transmission and storage because of local availability.

OECD shown in the following diagram is an international economic organization which has 34 member countries including the major economies of the world like U.S., Japan, Germany, France, U.K., Australia, South Korea, Italy, Denmark, New Zealand, Norway, Sweden, etc.

The growing demand for energy as perceived for future requirements is as shown in the Figure 1.1

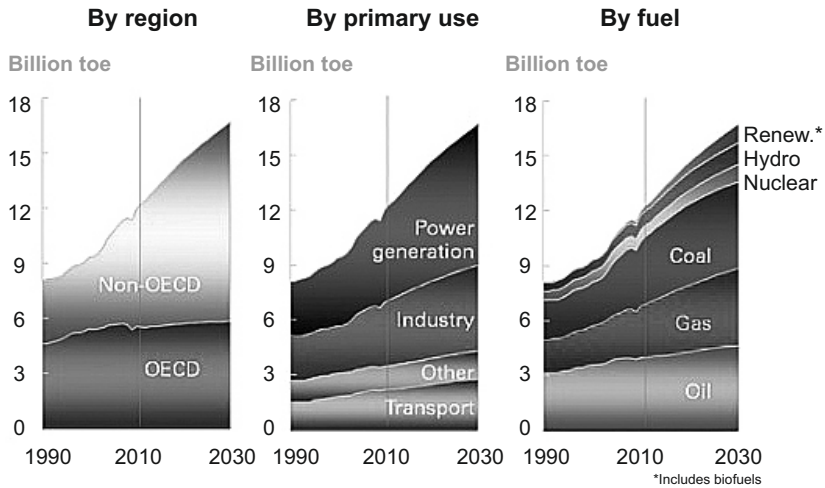

Figure 1.1 Growing Power Demand Source: BP Energy Outlook 2030, (2012)

1.2 Sustainability

Aldo Leopold, in 1949, held the view that the health of the ecosystem is of paramount importance: an environmental policy is right if it preserves the integrity of an ecosystem and wrong if it does not.

One of the best known definitions of sustainability was generated by the "Brundtland Commission", the World Commission on Environment and Development, headed by the former Prime Minister of Norway. As quoted by Toman (1994), the Commission defined sustainability as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs". The debate over sustainability has focused on two key aspects: the first is the degree to which "natural capital" can be viably replaced by human capital, and secondly, the obligation the present generation owes to future generations.

Nobel Laureate Robert Solow (1992) defined sustainability as making sure the next generation is as well off as the current generation and ensuring that this continues for all time. He argued that the man-made capital (any kind of machinery, buildings, etc.) and knowledge are substitutes for natural capital, especially the natural resources. With the depletion of conventional energy sources, ways should be found to reduce energy consumption or replace the machinery built that utilizes non-conventional energy sources.

Renowned economist Tablot Page of Brown University defines sustainability as managing depletion, pollution, and congestion. For depletion, he suggests to keep broad aggregates of resources constant from one generation to the next, for example, energy, metals, wood, soils and water.

2. Computers and Energy Consumption: A few facts

We are living in an era where we cannot even think to exist without the computer technology. The computer is an important electronic equipment around which our daily life revolves. A computer uses ample amount of energy in form of electric power.

2.1 Facts about Individual Computer System

- In general, the CPU utilizes 120 Watts (W = 1 joule/second) of electricity. A typical CRT monitor consumes an additional 150 W. Thus, a standard office computer that is assumed to run for 8 hours per day, and for 5 days a week, can use up to 561.6 kW fossil fuel derived energy.
- LCD monitors, also commonly known as "Flat screen" monitors, which are widely preferred for their efficient use and space, require 266 kg of fossil fuels for the production of a single piece and even contain significant amounts of mercury (4-12 mg/unit) which can leak from improperly discarded systems.
- The amount of power used by a computer depends on three different things. Firstly, it is the configuration. Power consumption by the processor and the motherboard, number and size of primary and secondary memory devices and the number and type of peripheral attachments amount to the total energy calculation. Secondly, it is the usage also that matters in terms of utilization. Maximum CPU utilization and heavy disk I/O jobs consume more of power. Lastly, it is the "power mode" of the computer. There are three states–Standby, Hibernate and Sleep-which can reduce the power consumption of the monitor to as low as 0-5 watts.

2.2 Facts about Commercial Computerized Setups

- A data center is a centralized and dedicated facility which is used to house an organization's computer systems, associated equipments and IT operations; for the purpose of storage, processing, management and dissemination. In order to carry out the work efficiently the data centers are designed in such a way that they consume enormous amounts of energy. A data center in reference to energy can be seen as comprising of two functional components – processing power and cooling, and the utilization of energy by each component is approximately 50% of the overall use of energy by the data center.
- At a data center used by Google, when the servers are used at 100%, the network power is approximately 20% of the total power consumption, whereas when the server utilization decreases to 15%, the network power shoots to 50%.
- Online companies typically run their data center based facilities at maximum capacity round the clock, irrespective of the demand. Thus the result is that data centers can waste 90 percent or more of the electricity they pull off the grid.
- Data centers can also be considered as stationary diesel polluters. In order to prevent problems due to power failures, substitutes used are banks of generators which emit diesel exhaust. Usually, regulations for environment protection are not stringently followed, resulting into hazardous air pollution.

- Mark Bramfitt, principal program manager at PG & E (Pacific Gas and Electric Company) stated that "Data Center servers use 50 times the energy per square foot as an office does".
- The New York Times claimed that worldwide, the digital warehouses use about 30 billion watts of electricity, roughly equivalent to the output of 30 nuclear power plants, according to estimates industry experts had compiled. Data centers in the United States account for one-quarter to one-third of that load, the estimates show. "It is staggering for most people, even people in the industry, to understand the numbers, the sheer size of these systems," said Peter Gross, who helped design hundreds of data centers. "A single data center can take more power than a medium-size town."
- According to recent disclosures, Google's data centers consume nearly 300 million watts and Facebook's about 60 million watts of power.

3. Inception of Green Computing

The first wave of the concept which later on came to be known as *"Green Computing"* or *"Green IT"* started roughly two and a half decades ago. The notion gained momentum slowly and has expanded with massive traction over the last decade.

- The first widely known effort in the promotion of energy conservation in a greener way was made by EPA in 1991, with the introduction of *"Green Lights"*, which was an energy-efficient lighting program.
- In year 1992, another program "ENERGY STAR" program was introduced by EPA. This laid the compliance requirements with energy efficient specifications for computer equipments, like switching to standby mode if inactive for a specific period. Personal computing devices such as computers, printers, monitors, etc. which comply with the ENERGY STAR guidelines exhibit an ENERGY STAR label on the product.

Green Computing is not a trend but is today's need for sustainable development. Green Computing can be seen as a practice towards designing, building and operating computer systems to be energy efficient. The goals are to maximize energy efficiency during the product's lifetime, reduce the use of hazardous materials, and promote recyclability or biodegradability of defunct products and factory waste. This clearly explains that Green Computing is not only about purchasing lots of 'green' hardware, but it points towards a holistic approach for efficiency and sustainability.

4. Major Driving Forces behind embracing Green Computing

- Internet has become the heart for the efficient running of any enterprise/operation. The major uses of internet can be classified as:
  a) Entertainment: uploading/downloading of audio/video, on-line games etc.
  b) Communication: social networks, tweeting, instant messaging, audio/video chat, news groups, message boards etc.

c) E-commerce and E-transactions

d) Disaster Management: Online storage, backups

e) Research and Development

f) Webinars

g) Informing the public or reporting campaigning, Webcasts

These are just a few usages. Every now and then new areas and industries find presence on the internet. Internet usage is growing at more than 10% annually leading to an estimated 20% CAGR in data center demand. Thus use of green computing is very necessary.

- Though technology is increasing the performance of servers with low power consumption per CPU, yet, the quantity of servers is increasing in order to keep up with the industry requirement. The size of data centers is increasing, even when more servers are being packed in the same footprint. Increased use of blade servers (which have shrunk the size by 70% of the original) has not been able to solve the problem. Usage of watts per square foot has increased from hundreds to thousands and is still on the rise.
- Conventional energy sources are exhausted at an increasing rate and non-conventional resources are not yet properly utilized for wide commercial usage. As a result, energy costs are shooting up. If green computing is not properly implemented, high costs of energy can act as an impediment for future setups of new ventures.
- Servers are not always efficiently utilized. The underutilization of servers is the major cause of pollution and the customer is also overpaying for operations and maintenance support.
- One of the most important reasons for adopting green computing should be the green house effects and the high carbon emission rates. The total power consumed by data centers in the United States alone is estimated to be between 1.5% and 3% of the annually generated power in the country. Their collective annual carbon emission of 80 metric megatons of CO_2 is approximately equivalent to the carbon footprint of Argentina and the Netherlands.

5. Green Computing Measures

To optimize the efficiency of operations and equipments, a mix of integrating new approaches is required, which are discussed as follows:

5.1 Green Computing based Plan

A green computing based plan should be laid which strictly follows the following steps:

- Procurement of green electronic and computer equipments should be done as per government guidelines and recommendations. Purchases should be EPEAT

registered products. EPEAT (endorsed by non-profit Green Electronics Council) on the basis of environmental characteristics, aids in evaluating, comparing and selecting computers, monitors, notebooks and netbooks. It also provides a holistic set for the evaluation of the performance for the design of products.

- For PCs, instead of separate graphics card, onboard graphics should be opted. Spinning hard drives should be replaced by SSDs or low-energy hard disks.
- For data centers use of multicore processors should be increased. These processors run at lower voltages, consume less energy and make better use of memory and other architectural components.
- Power management software should be used. This software according to the workload requirements of the processor conserves or utilizes processor power.
- Cooling systems or efficient thermal management is also required. Data centers should be designed with variable and good air flow and liquid heat removal systems. Variable Cooling delivery can lead to efficient heat dissipation.
- Recycling is also an important phase in green computing plan. Governments have laid down stringent recycling policies and other disposal related recommendations. If computing equipments are disposed in landfill, harmful emissions into the environment take place. Disposal or recycling should be carried out as per the manufacturer disposal programs.
- With a focus on electronic waste, control on hazardous materials in hardware manufacture and energy efficiency, many environmental regulations have been laid for the manufacture of electronic and electrical equipments. Some of the widely known and used standards are WEEE directive (imposes responsibility for electronic and electrical waste on equipment manufacturers), Energy Star 4.0 (standard for regulation of energy performance), RoHS (imposes restriction on the use of hazardous substances like lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls, and polybrominated diphenyl ethers), etc.

5.2 Virtualization

- Virtualization is a computing paradigm that segregates computing technology and the underlying hardware. This paradigm can be applied to resources like networks, storage, memory, operating systems, software application and hardware. Virtualization creates a virtual version of the specified resource where the framework divides the resource into one or more execution environments.
- Virtualization can drastically reduce the number of servers in a data center, thus decreasing electricity consumption and waste heat and consequently the size of the necessary cooling equipment. Some investment in software and hardware may be required to implement virtualization, but it is usually modest compared to the savings achieved.

- With today's servers, consolidation ratios in the 10:1 to 15:1 range can be achieved without placing stress on server resources. Virtualization can reduce data center energy expenses by 10% to 40%.

5.3 Cloud Computing

- Based on 'pay as you go' concept, and as defined by NIST, cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g. networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.
- Companies can reduce their carbon footprint by making use of one or more cloud service delivery models:

  [1] **SaaS**: It is the most popular service delivery model. The companies subscribe to pre-packaged applications that run on cloud infrastructure and allow access from a variety of devices. Enterprises are rarely responsible for much beyond some configuration and data quality management. Popular examples are GoogleApps, Microsoft Office 365, etc.

  [2] **IaaS:** The cloud provider manages the network, servers and storage resources so that IT managers no longer need to buy, track or decommission hardware. They only need to manage operating systems, databases and applications. Depending on the service provider, they may be able to configure networking components in limited ways. Amazon.com's core offering is IaaS. Other examples are Microsoft Windows Azure, GoGrid and Flexiscale.

  [3] **PaaS:** Enterprises use PaaS to develop, deploy, monitor and maintain applications while the cloud provider manages everything else, including the operating system and middleware. Overall, PaaS lowers total cost of ownership more than IaaS. Microsoft Windows Azure, Google App engine and Force.com are prominent examples. The ultimate objective of this model is speed enhancement with low cost for development and deployment.

- Servers in company data centers generally run at a very-very low capacity, whereas cloud vendor servers run at 80% or more capacity. Use of cloud computing can also reduce the need for high power PCs and laptops.

6. Green Computing related Power/Energy Metrics

Data Centers and power consumption is the biggest issue when energy conservation comes into picture. In order to improve the efficiency of the data centers, various power/energy metrics have been proposed. Some of the widely used metrics are presented here:

A) DCiE: Data Center Infrastructure Efficiency

Estimation of DCiE is carried out as

$$DCiE = IT\ Equipment\ Power / Total\ Facility\ Power$$

Here IT equipment power is the load related to computation and storage of IT and network equipments. Total facility power includes IT equipment power along with the load of power delivery components, cooling system components and other miscellaneous load of the data center.

DCiE value of about 0.5 is considered typical practice and 0.7 and above is better practice. Some data centers are even capable of achieving 0.9 or higher DCiE value.

B) PUE: Power Usage Effectiveness

PUE is calculated as:

PUE = 1 / DCiE = Total Facility Power / IT Equipment Power

PUE reflects the relation between the energy used by IT equipments and energy used by other facilities. If a PUE of 2.0 is indexed, then it means that for every watt of IT power consumed, an extra watt is consumed for cooling and dispensing power to the IT equipment. Typical data centers have a PUE index of 1 to 3.

C) HVAC System Effectiveness

HVAC stands for Heating, Ventilation, and Air Conditioning. The HVAC system energy is the sum of the electrical energy for cooling, fan movement, and any other HVAC energy use like steam or chilled water. It is estimated as:

HVAC Effectiveness = IT / HVAC + (Fuel + Steam + Chilled Water) × 293

Value of all the given components is calculated on an annual basis for the given formula. Higher the value of this metric, higher is the potential to reduce HVAC energy use in a data center.

D) SWaP

In order to plan the current and future needs, and also to control the data center costs, the metric of SWaP (Space, Watts and Performance) is used. The SWaP is calculated as:

SWaP = Performance / Space × Power Consumption

For the given formula, Performance is calculated in terms of industry-standard benchmarks, Space is measured in reference to the height of the server in rack units (RUs) and Power is the watts consumed by the system. With this metric, comparative analysis of performance of different servers is carried out to find the servers which give the optimized performance as per the requirements.

E) DCeP: Data Center energy Productivity

The DCeP characterizes if the energy consumed is useful for work in a data center. The DCeP is calculated as follows:

DCeP = Useful work produced / Total energy consumed to produce that work

Useful work is the tasks performed by the hardware within an assessment window. The calculation of total energy consumed is the kWh of the hardware times the PUE of the facility.

Conclusion

The concern should be about the impact of the advanced IT services on the environment, the significance of the environment for rapid advancement in the IT services and the appropriate way of regulating the energy usage so as to achieve a balance in the requirements of advanced technology and the requirements of a clean and green environment. This is not the sole responsibility of the producers alone; the consumers also have an equal role to play. As a matter of fact, all the participants of the world economic system – the respective governments, the business, governmental and non-governmental organizations and the consumers – have to be collectively responsible for the effective implementation of green computing. The need of the hour is to go for an advanced treatment of the problems related to improper and extravagant usage of energy in order to attain higher levels of sustainable development.

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Rajasthan Solar Water Pump Programme: Creating a Better Future for Farmers

Dr. Dinesh Kumar Goyal

Abstract

Government programmes generally address a few specific challenges whose impacts remain confined to limited aspects of lives of targeted beneficiaries.

The innovative initiative in Rajasthan (a State in India) of combining stand-alone federal and state government schemes and effective implementation is creating unprecedented synergies, addressing multiple challenges, mobilising stakeholders, making far-reaching impacts in farmers' lives, conserving precious groundwater and conventional energy and harnessing solar energy. The author shares how the programme was conceptualised and implemented on large scale in remote areas, a composite off-grid irrigation package comprising of creating water harvesting structures, collecting water, drawing through solar-powered pump-sets and irrigating through drip irrigation.

From 34 solar pump systems installed in 2010-11, the figure rose up to 4000 in 2012-13. The target for 2013-14 is that of 10,000 thus making it the largest solar pump programme in a State and anywhere in the world.

Acronyms/ Abbreviations

BOT: Build, Operate & Transfer, CSR: Corporate Social Responsibility, DHDS: District Horticulture Development Society, GoI: Government of India, GoR: Government of Rajasthan, JNNSM: Jawahar Lal Nehru National Solar Mission, MIS: Management Information System, MNRE: Ministry of New and Renewable Energy, NBM: National Bamboo Mission, NHM: National Horticulture Mission, NMMI: National Mission on Micro Irrigation, NMMP: National Mission on Medicinal Plants, PWD: Public Works Department, RKVY: Rashtriya Krishi Vikas Yojana, SLSC: State Level Sanctioning Committee, SWPP: Storm Water Pollution Protection, WHS: Water Harvesting Structure

Introduction

Rajasthan is faced with acute water shortage. It has about 10% land and 5% of country's population but only 1% water sources. Thus, taking the population as a common denominator, Rajasthan has a disadvantage by a factor of two in terms of geographical spread of its population and hence of agriculture land. It has a disadvantage by a factor of five in terms of availability of water; combined together, a disadvantage factor of the order of ten when it comes to supply of irrigation water to its agriculture fields. Further, erratic rainfall and recurring droughts have exacerbated the situation. Over the last 100 years, on an average, almost every district in the state has experienced drought in one form or the other.

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Over 60 percent of the State's population depends on agriculture/ horticulture for their livelihood which is often marred by low productivity mainly due to inadequate or non-available irrigation. The State has more than 15.7 million hectare of land suitable for agriculture out of which just 35 to 38 percent is irrigated. About 70 percent irrigation is done through wells/tube-wells energised mainly with grid-power/diesel-generators. There is a long queue of farmers seeking electricity connections for irrigation purposes. At present, approximately 60,000 farmers are waiting to get a grid-based electricity connection to help them use electric motors on wells for irrigation purposes. Moreover, expanding electric-grid is not feasible in many far-flung areas of the State, almost 70 % of which is desert.

The ground water situation in the State is alarming and has deteriorated rapidly in last two decades. Out of 249 blocks, nearly 200 blocks are in the highly critical zone. The situation is of grave concern since almost 90 percent of total groundwater withdrawal is being utilized mainly through flood/furrow-irrigation methods in the State which have mere 35 to 45 percent water-use-efficiency.

Nonetheless, Rajasthan is blessed with one of the best solar insolation on earth (6-7 kWh/m2/day) combined with maximum sunny days in a year (about 325), which makes it one of the most attractive destinations for harnessing solar energy for various purposes, especially irrigation.

Purpose of the initiative

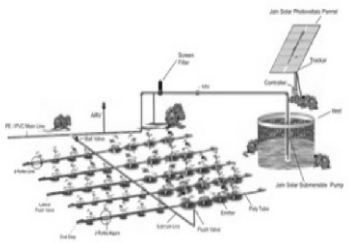
- Enhancing irrigated area in the State and giving farmers an opportunity to diversify to remunerative high-value horticulture crops thereby increasing productivity
- Groundwater Conservation through utilisation of efficient irrigation methods
- Narrowing the gap between demand and supply of power and reducing the waiting time for grid electricity connection
- Harnessing available solar-energy resources to replace the expensive and polluting diesel pump-sets
- Providing irrigation facility to farmers living in remote locations where electricity grid is less likely to be extended in near future
- Saving farmers of the drudgeries of irrigating during night or early morning hours, usually when the grid-power is most often supplied to agriculture consumers on the ropes

Strategy

The state government fixed targets through the State Budget announcement and sought Government of India funds through Ministry of New and Renewable Energy, National Horticulture Mission, National Mission on Micro Irrigation among others. While subsidy was converged under assorted government schemes, technical back up was sought from State's Energy department and regulatory framework developed for effective implementation. The Rajasthan Horticulture Development Society was

aggressively involved for short-listing and empanelling manufacturers of solar panels. The District Horticulture Development Societies, district collectors and other field functionaries were extensively involved for implementation and monitoring and ensured coordination of synergies among State Government Departments (Horticulture, Finance, Agriculture, Energy), Government of India departments (MNRE, Agriculture) and stakeholders (beneficiaries, manufacturers, public representatives).

Solar Water Pump System - With Drip irrigation



Desired benefits

- Enhanced agriculture productivity
- Adoption of drip-irrigation
- Reduced farmer queues for grid connections
- Reduced burden of electricity distribution companies
- Replacement of polluting diesel pump-sets with environment friendly solar pumps
- Multi-fold impacts especially creation of livelihood for rural folks

Period of Implementation and Achievements

Large scale implementation of the scheme was initiated in 14 districts with the installations of 1675 solar pumps in year 2011-12. All the 33 districts were covered in the next year i.e. 2012-13 with installation of 4500 solar pumps. The initiative continues to expand with an ambitious target of installing 10,000 solar pumps during 2013-14 as is shown in Table1.

Table 1- Yearwise targets and achievements

Year	Project	No. of Dist.	Target	Achieve-ment	Project cost (₹Cr.)	MWp	Pump capacity	Subsidy	Funding Source
1	2	3	4	5	6	7	8	9	10
2008-09	Government Farms	7	14	14	0.75	0.025	1800	100%	RKVY
2010-11	Pilot Project	6	50	34	1.83	0.097	2200/3000	86%	JNNSM, RKVY
2011-12	First major jump	14	500	1675	95.86	4.967	2200/3000	86%	JNNSM, RKVY
2012-13 (in progress)	Second major jump	33	2200	4500*	258.29	13.340	2200/3000	86%	JNNSM, RKVY, State
2013-14 (projected)	Third major jump	33	10000	10000	584.69	30.000	2200/3000	86%	JNNSM+ RKVY/ State Resources

*4000 by 30.06.2013

Strategies adopted for transformation

Convergence of Federal schemes and State Support

A large number of Government of India (GoI) schemes are being implemented by the State's Horticulture Department, comprising National Horticulture Mission (NHM), National Mission on Micro Irrigation (NMMI), National Mission on Medicinal

Plants (NMMP), National Bamboo Mission (NBM), Jawahar Lal Nehru National Solar Mission (JNNSM), Rashtriya Krishi Vikas Yojana (RKVY) and state plan programmes.

All of these schemes were studied in detail and various permutations and combinations were considered. Finally the water harvesting structure (WHS) schemes for creation of surface water resources and drip irrigation under NHM were combined with JNNSM, RKVY and State resources. Functionally, the base was the NSM and financially, the resources were tied; 30% subsidy under MNRE and 56% subsidy from RKVY and/or State resources. The tie up was posed to RKVY's State Level Sanctioning Committee (SLSC) which provided the additional support; if RKVY support dwindled, Government of Rajasthan (GoR) promised to fill the gap to make the total subsidy as 86%.

Upward scaling of targets

It was then planned to scale the solar water pump programme to unprecedented heights. From a mere target of 50 in 2000-11, it was scaled to 500 (10 times i.e. 900% increase) for 2011-12; to 2,200 (4.4 times over i.e. 340% increase) for 2012-13; to 10,000 (4.55 times over 2012-13 i.e. 354% increase) for 2013-14. In terms of achievement, the performance was even better as can be seen in Table 1.

Decentralization of implementation process

Earlier, the sanctions, payments, etc. were released from the State Headquarter, but with large scale enhancements of targets the system was decentralised and the district authorities were empowered to issue the same. Thus, the District Horticulture Development Societies (DHDSs) under the chairmanship of District Collectors were made effective to implement the scheme. Initially, there were some reservations at the State level but the gradual success of the programme and close interactions with field authorities, collectors and public representatives removed apprehension at the State headquarter level. The decentralised process also freed the skeleton staff at the state level to concentrate more on policy making and its implementation; the beneficiaries also did not have to come to State Capital for every work relating to the programme implementation.

Solar Panel manufacturers alone to Bid

Initially, there was a great debate whether manufacturers of solar panel alone, or motor alone, or suppliers of solar panels or motors be permitted to bid. After a lot of deliberations it was decided that only manufacturers of solar panels could bid. In the overall average cost of the solar pump system, say about Rupees five lacs, about 75% cost is for solar panels and 25% for motor and allied equipment. This approach of bids only from solar panel manufacturers attracted the serious bidders who could actually maintain the system after supply.

Structural Provisions to Ensure Sustained Support for Beneficiaries

Maintenance: It was made mandatory for the manufacturers-cum-suppliers to guarantee maintenance free-of-cost for five years since the date of installation and then

after sales service for another five years. This condition was borrowed from the experience of PWD where the roads constructed with a five year maintenance clause, the condition/quality of such roads was found much superior, compared to the roads constructed with one year maintenance; the larger the maintenance period greater the obligation on the contractor for better quality. The equipment is insured for natural calamities etc.

Civil work, Auto tracker, 100w bulb*:* The system must be supported on six legs firmly entrenched through civil structure that can bear wind load and protect from attack by cattle. The supplier should provide an additional light outlet of 100W for lighting during pump operation, one home lighting system, as an integral part of the system.

Testing of pumps and panels: A major snag in the Solar Pump programme was unreliable test reports about Solar panel and pump performances. A 43-column format has also been developed to be maintained by manufacturers, and district and state authorities which will be helpful in development of integrated MIS.

Transparency and stakeholder participation

Transparent selection system*:* The applications from the prospective beneficiaries were obtained by district authorities in widely advertised campaigns so that every farmer had accessibility and equal opportunity for applying. Wherever the number of applications received exceeded the target for the district, selection of beneficiaries was made by DHDS under district collector by draw of lottery. Then the list of selected ones was declared then and there.

Transparent e-tendering: In order to establish transparency, e-tendering was resorted to. Adequate time-line, pre-bid conferences and removal of confusions ultimately led to short-listing of 4 manufacturers for 2011-12 and 12 for 2012-13. Soon, the competition came into the play and the best of manufacturers bid for the programme. Two stage bidding, technical and financial, was adopted. Once the vendor for L-1 was declared, most of the other bidders agreed to supply at the L-1 price which became a benchmark for the whole State of Rajasthan. The State being so widely dispersed, short-listing of a large number of manufacturers rather proved to be a boon.

Transparent and active involvement of beneficiaries in selection of supplier: The selection of a supplier for the solar-water-pump-set out of the empanelled manufacturers-cum-suppliers was left to the beneficiary i.e. farmer who was approached by almost all the short-listed ones. A thorough interaction between the beneficiary and prospective supplier indirectly imparted a lot of technical knowledge and prompt after-sale service arrangements to the beneficiary. Giving this liberty to beneficiaries has brought transparency in the whole process as well as created competition between suppliers to win the trust of the beneficiaries.

Innovation and replicability

The initiative has several unique/distinct aspects including integration of various schemes of GoI such as JNNSM, RKVY, NMMI, and NHM, as well as the State-support, if required, to make the total subsidy 86% of the capital cost.

The initiative has made exceptional and far-reaching desirable impacts directly to the lives of farmers and their families, conserved the resources precious in the State (groundwater and energy) and harnessed the potential of clean and free solar energy in the state. This stand-alone government initiative has created unprecedented synergies and effectively contributing towards addressing multiple challenges that the State faces.

Economies-of-scale and BOT: Huge potential exists for economies-of-scale as the model is scalable and replicable in other States. The solar technology is foolproof and able to replicate on large scale for the farmers of the country and even globally. The manufacturers may adopt the States to commission and operate the project on BoT basis with the assistance of the government. Presently, the cost of solar energy appears high but large scale adoption and production will lead to further cost cutting. The feasible costing and the assistance from the state/ central government will encourage more number of farmers to opt for the technology. With the partnership of state energy departments, Vidyut Vitaran Nigams and private partners, the technology could be disseminated at large scale. Private entrepreneurs can invest in agriculture and rural sector through BoT.

There is a vast scope of replication of this initiative in India, with estimated 2,00,000 solar pumps (on surface water bodies or ground water bodies up to 50m depth, connections up to 7.5 HP) in next 5 years. The expected total investment, at ₹ 5,00,000 a system, is about ₹ 10,000 crore (₹ 100 billion, or 1.6 billion US$).

Efficiency and effectiveness of outcomes

The 'Scheme' is increasingly contributing towards enhancing the total irrigated area under cultivation in the State while reducing groundwater and grid-connected electricity consumption/requirements by utilising solar power available in abundance and deploying drip-based micro-irrigation systems at large scale.

This single initiative has been contributing towards addressing some of the most crucial challenges being faced by the State viz. need for efficient utilisation of water resources; reducing the gap between power demand and supply; enhancing irrigated area thereby agriculture productivity; harnessing solar-energy resources available in abundance.

Combining capital subsidies available under various schemes for farmers, this opportunity has contributed towards making agriculture a remunerative occupation for farmers by way of replacing the requirement of expensive grid-power with solar power and by enhancing farm productivity, saving precious groundwater by promoting drip-based efficient irrigation system that has 90 percent water-use-efficiency compared to 30-45% percent in case of flood/furrow method.

Sustainability of the initiative

Past system's maintenance: To ensure sustainability of the solar pump systems already installed, suppliers are mandated to provide maintenance free-of-cost for five years since the date of installation and after sales service for another five years.

Cost-benefit analysis: The overall economic benefits in terms of energy and water saved, emission curtailed, crop production enhanced, etc. needs to be captured, quantified and pooled through appropriate institutional mechanism. Further, non-economic benefits too need to be considered and quantified and factored into the cost-benefit analysis.

Economies-of-scale and BOT: There exists a considerable scope for bringing the costs down with economies-of-scale and thereby creating a self-sustaining market with minimal government support. As mentioned above, for instance, the manufacturers may commission and operate the project on BOT basis with minimal assistance from the government. Large scale adoption and production through solar energy will lead to cost cutting. With the partnership of state and non state agents the technology could be disseminated at large scale. The future invites private entrepreneurs to invest in agriculture through BoT.

Precedent created: Now that the administrative, financial and regulatory systems have been tried and firmed up, up-scaling is limited mainly by the funds and other resources available, not only for Rajasthan but also for the other states in the country. For instance, Rajasthan's 'expression of interest and bid process' is replicable in other States as well.

Impact/ benefits resulting

Improvement in delivery time of services

Earlier the DoH was catering to only about 50 solar pump units in a year and now to about 4,500 units, an escalation 90 times, i.e. about 9000 per cent. As a corollary, the service time per unit has reduced by the same amount.

Simplified procedures

This initiative is effectively implemented and monitored through the following essential and simplified procedure. (An MIS is already approved for development in 2013-14).

Table 2 – Implementation and monitoring of Rajasthan Solar Pump Programme

S.No.	Particulars	Owner
1	Allocation of targets for the State	MNRE/CM budget
2	Sanction of 30% subsidy	MNRE
3	Sanction of additional subsidy	RKVY/State FD
4	Empanelment of Solar Pump Manufacturers	DoH
5	Information about various models, their components, costs.	DoH
6	Impanelment of Dealers/Agents	Manufacturer
7	Allotment of targets to District Level Officers	DoH

8	Fund transfer to Districts	DoH
9	Application from farmer	ADH
10	Scrutiny of files by AO/ Scheme OIC (communicate deficiencies if any)	AO/ Scheme OIC
11	Application short-listing/ details of short-listed beneficiaries	ADH
12	Information to farmer to submit quotation of desired brand	ADH
13	Quotation from farmer/ supplier	Farmer/ Dealer, ADH
14	Acceptance of quotation	ADH
15	Administrative sanction and its communication	ADH
16	Letter to farmer for farmer share	ADH
17	Deposit of farmer share	Dealer/Farmer
18	Work order, its communication, payment of application money to manufacturer	ADH
19	Updation of material assembled and request for Pre-Dispatch-Inspection	Manufacturer
20	Pre Dispatch Inspection executed	DoH
21	Material dispatch to beneficiaries details by manufacturer	Manufacturer
22	Physical verification of material supply	DoH Official
23	Release of 36% funds to manufacturer	ADH
24	Installation status information	Dealer/ Supervisor
25	Physical verification	Official of DoH
26	Photograph of solar pump system	ADH
27	Website information updation	Manufacturer/ADH
28	Release of funds to manufacturer after successful installation	ADH
29	Utilization Certificate	ADH (For DoH) DoH (For GOI/FA)

Beneficiary feedback

The feedback from the beneficiaries, public representatives, researchers, manufactures and other stakeholders has been positive owing to the transparent systems developed as follows:

- Decentralization of the implementation process to district level
- Transparent e-tendering
- Beneficiaries Transparent Selection in camps and through lottery
- Transparent and active involvement of beneficiaries in selection of supplier
- Decentralization of the implementation process to district level
- Structural provisions to ensure sustained support for beneficiaries over the years (Maintenance, Insurance, Civil work, Auto tracker, 100w bulb)

Measurable indicators

The estimated improvements owing to solar initiative are as follows:

Electricity saved: Almost all the solar water-pumps have been installed in the areas where either grid-connected electric power is not available or availability is inadequate. With 4,000 solar pumps, most of them of 3000wp each, the installed capacity is about 12

Table 3 – Measurable Indicators - Rajasthan Solar Pump Programme

S.No.	Item	Unit	Total
1	MNRE approved rate with DC pump	Rs./Wp	190
2	MNRE approved rate with AC pump (DC rate minus 15%)	Rs./Wp	161.50
3	Average solar pump capacity	Wp	3,000
4	No. of pumps in 2012-13	No.	4000
5	Equivalent electric power saved (4000x3000 wp)	Mwp	12
6	Duration in hours a pump runs/day	hrs.	6
7	No. of units (KWh) saved per day	Kwh	18
8	No. of days a pump runs in a year	days	200
9	No. of electric units saved per pump per year 18 x 200	Kwh	3600
10	Cost per Kwh of electricity	₹	5
11	Money saved by solar pump per year 3,600x5	₹	18000
12	Conventional grid, distribution capital cost saved (not considered)	₹	-
13	Diesel cost saved per year (diesel generation is about twice costly than electric)	₹	36000
14	Diesel saved per pump per day	Litre	3
15	Diesel saved per pump per year	Litre	600
16	Diesel saved total, per year (4000 x 600)	Million Ltr	2.4
17	Foreign exchange saved per year, crude price @ ₹ 20/Litre	Rs. million	48
18	Diesel subsidy saved by Govt. per year (24,00,000 x ₹ 10/Litre)	Rs. million	24
19	Diesel subsidy saved by Govt. in 15 years (₹ 2.4 Cr x 15 years)	Rs. million	360
20	Area Irrigated per pump per crop	Ha	3
21	Area irrigated total, 2 crops a year (4000 pumps x 2x 3)	Ha	24000
22	Water required for surface irrigation per Ha	Cubic Mtr	5000
23	Water saved per Ha due to drip irrigation (40% of 500)	Cubic Mtr	2000
24	Total water saved, 24,000x2,000	MCM	48
25	Additional production value due to irrigation through solar pumps	₹	1,00,000
26	Total Addl production value due to irrigation through solar pumps	₹ million	2400
27	CO_2Emission for one 1 kWh electricity produced by Diesel	Kg	0.29
28	Total CO_2 generation avoided, 12,000 KWh x 0.29 kg	Kg	3480
29	Curtailment in farmers' wait-list for electric connection	Nos.	4000

MWp during 2012-13. This has resulted into replacing the generation of grid-electricity mainly generated through consuming conventional fuels like coal and gas.

Irrigation: An estimated 12,000 Ha of additional land has been brought under irrigation. With at least two crops every year compared with the earlier scenario of having just one monsoon-fed crop in entire year, 24,000 Ha has been irrigated. It is reported that many farmers have started having three crops every year and have shifted to far more remunerative horticulture/cash crops including vegetables and fruits. This initiative has started bringing desirable transformations in the lives of the farmers and their families as the incomes have gone up.

Water, Diesel, FE saving: Migration to mandatory drip irrigation (it has at-least twice the water-use-efficiency vis-a-vis furrow method) has saved 48 million cubic meter

water. Also 2.4 million litre diesel; ₹ 24 million diesel subsidy; ₹ 48 million foreign exchange are saved annually.

Carbon-dioxide: Estimated emission of 3,480 Kg of CO2 has been avoided.

Five year plan: It is estimated that with 1,00,000 solar pumps installed in next 5 years, this initiative will significantly curtail the long queues of farmers waiting for electric connection, reduce burden on electricity distribution companies and will extend irrigation facility to additional 3,00,000 hectare of land which will result into productivity enhanced by manifolds.

The benefits? Enhanced agriculture productivity, adoption of drip-irrigation, shortened farmer queues for grid-connections, reduced burden of electricity distribution companies, replacement of polluting diesel pump-sets with environment friendly solar pumps - multi-fold impacts especially creation of livelihood for rural folks.

MNRE Motivates other States to follow Rajasthan initiative

In the initial stages, Rajasthan was the only State which had scaled the programme to such heights and implemented successfully and, therefore, the Ministry of New and Renewable Energy (MNRE), GoI, on 8th February 2012 asked the author to make a presentation to MNRE to share Rajasthan experience with other State Secretaries, solar panel manufacturers, motor manufacturers, MNRE officers, etc.

Officers from Tamil Nadu visited Rajasthan and had extensive discussions with the Principal Secretary of the Department in Jaipur and he was invited by other States like Tamil Nadu and Maharashtra to make a presentation of Rajasthan case. MNRE also asked Rajasthan to host a National Conference at Jaipur with a view to replicate the Rajasthan success story in other States. The Agriculture Department, GoI, asked the PSHR to make a presentation in National Conference on NHM on 17.07.2013. A team from ADB had extensive discussions about funding the Rajasthan scheme. Queries are being made from other countries like Pakistan as well.

Future benefits, issues and challenges

The SWPP of Rajasthan has identified a number of important challenges and opportunities for the MNRE, GoR, manufactures, scientists, and so on, which can drastically change the non-conventional energy scenario in India, especially with regard to use of solar energy in rural areas. A few are mentioned hereafter.

Storage of unused potential: The solar energy through the solar water pump is utilized only for the period the pump is operative which may be for 3-4 hours a day and that too not for all the solar days during the year. Thus, the capacity of the solar panels may remain highly underutilized. The unused potential can be tapped by way of storage of energy in batteries and other devices provided appropriate technologies become available and cost effective.

Other usage: The stored potential energy could be used for other alternative purposes such as domestic lighting, community lighting, agriculture harvesting, etc.

Connecting to conventional grid: If enough solar pump units are installed on cluster-based approach and if conventional grid is already passing through the cluster, or may become available in future, then the extra solar energy converted to electrical energy can be fed to the grid, for application of grid-energy in-situ or at a distance. Thus, the programme may become a net donor to the electric grid rather than drawing from it.

Low cost funding: The solar efforts are to be maintained for a long period of time which condition requires that adequate subsidies are made available. Alternatively, there is need for low or zero-interact cost funding especially from UN agencies, federal governments, state governments and one attractive and meaningful funding can be sourced from Corporate Social Responsibility (CSR) obligation of the companies.

Linkages with MNREG etc.: The solar programme can be tagged on with the already on-going programmes like the Mahatma Gandhi National Rural Employment Guarantee Scheme, the Rashtriya Krishi Vikas Yojana and so on.

Reduction in subsidy: Any programme should be able to withstand on its own feet, although the solar pump programme may take a while before doing so. At least 25% subsidy may be required for say another 10 years or so, and the federal/state policies need to cater to this requirement.

Carbon credit: The solar pump programme is an excellent candidate for claiming carbon credit. But presently, the application process is cumbersome, numbers of consultants available are inadequate and the consultancy costs are high. There is need for training the staff particularly that of the implementation agency who would qualify for obtaining carbon credit. As the market for carbon dioxide trade is highly fluctuating, and sometime solar pump programes may not even be feasible in terms of application cost vs the sale amount realized, it is essential that not too many stakeholders (implementation agency, beneficiaries, subsidy or finance providers, suppliers of solar panels/pumps, etc.) make separate claims; only the implementation agency should take up this task. Also, the net sum realized may be flown back to financing/subsidizing of future solar pump projects.

Mass manufacturing and cost reduction: If the programme picks up to a significant level, then the manufacturing costs of solar panels and pumps can be reduced substantially. If definite and systematic orders flow to the market, through a transparent and a time-line approach of the federal / state governments, then the manufacturers will be encouraged to upgrade and establish new unit and the competition will cause reduced prices. The ultimate benefit will be to the beneficiaries and the exchequer.

Integration of scheme in the country: Presently, only a couple of States like Rajasthan have implemented solar pump programme in a well coordinated and transparent manner, with a large number of target beneficiaries. Efforts need to be replicated elsewhere also, particularly in the states with adequate solar isolation. Presentation of Rajasthan case study was made to Maharashtra and Tamil Nadu by the Principal Secretary, Horticulture, Rajasthan. Now, there is a need for national and international conferences for dissemination of information among all the stakeholders like the public

representatives, public servants, prospective and present beneficiaries, manufacturers and suppliers of solar panels and pumps, academicians, scientists and so on. MNRE or Ministry of Agriculture or State Government of Rajasthan may host such conferences.

National MIS: The large scale implementation of the scheme requires an integrated Management Information System for every stage of the scheme - identification of the beneficiaries, filling of application form, selection of beneficiary, indenting for equipments through e-tendering, installation of solar panels and pumps, transfer of funds through RTGS, follow up and maintenance of supplies, performance measurement of equipment and corrective measures and so on. A large amount of data needs to be collected and correlated and meaningful reports need to be generated. Any large scale mishandling may lead to inappropriate utilization of funds and serious audit objections which may impact the future progress of the scheme.

Maintenance/Insurance: Appropriate conditions need to be built in the contracts with the manufacturers/suppliers for maintaining the solar panels, pumps and other supplies for at least five years. The equipments also need to be insured for natural calamities, theft, etc. Stringent provisions will need to be made for theft of solar panels and motors and their re-use elsewhere. When adequate equipments have been supplied to a particular geographical area, then the supplier must maintain a minimum technical staff and control room / BPO service for maintenance of equipment.

R&D for solar in agriculture / horticulture sector: While a larger number of uses are made of solar energy in other sectors, the horticulture and agriculture sectors have tremendous potential for application of solar energy. Synergies of MNRE and Agriculture Department of Govt. of India need to be coordinated and new R & D efforts need to be made for more extensive use in agriculture / horticulture sector. MNRE's solar pump programme and NHM's drip irrigation programmes may be implemented together.

Solar Parks: The federal and State Governments may encourage establishment of solar parks especially dedicated to use of solar energy in horticulture / agriculture sector. Manufacturers may establish working demonstration units which could be used for training, publicity and so on.

Horticulture Department for solar pump scheme: Wherever a State Government has created a separate Horticulture Department, it should be the sole responsibility of the Horticulture Department to implement the solar pump programme. The State agency dealing with non-conventional energy sources may be inadequate to carry out a large scale solar pump programme so involving agriculturists as stakeholders who may feel more comfortable with agriculture / horticulture department is necessary.

Sharing of Experiences

Learning from each other's experience is essential for constant incorporation of new ideas and amendments in the older ones. Countries like The Netherlands and Israel have made significant progress in horticulture schemes especially efficient use of water and solar energy and, therefore, exposure and exchange visits especially for policy makers, farmers, academicians, etc. is worthwhile. Successful implementation in India will generate interest of other developing countries, especially neighboring countries. Such a network will further reduce prices of equipment and stabilize technologies.

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Study of Energy Expenditure in Rural Households of Rajasthan

Namrata Sengar and Ravi P. Vaishnav

Abstract

This paper presents the results of the survey conducted to study the changing trends of the energy consumption and expenditure pattern in rural households of Rajasthan, India, and discusses the scope and measures for the renewable energy penetration in the rural areas. For the survey, the households were divided into three classes on the basis of their income - lower, middle and high income households. It has been found that wood, kerosene, LPG, electricity and their combinations are being widely used in rural areas for the applications such as domestic cooking, animal feed cooking, water heating, water pumping and home lighting. The results show that the lower and middle income households spend around 20% of their total income on fuels whereas the energy expenditure for the high income group households is around 30% of their earnings. The major energy expenditure for the lower income households is on domestic cooking (33%) whereas for the higher income households it is for water pumping (62.33%). Around 70-80% of all the categories of the households use wood, though with combinations of different fuels. The energy expenditure is also the highest for wood among LPG, wood and kerosene. Wood is mainly used for animal feed cooking and water heating. The paper discusses the role of renewable energy sources in common rural applications to yield fuel savings and protect the environment.

Acronyms/ Abbreviations

NGOs: Non-governmental organizations, LPG: Liquid Petroleum Gas, REC: Rural Electrification Corporation

Introduction

Looking at the present energy scenario and future concerns, it becomes essential to divert the dependence of the present energy requiring applications from non-renewable fuels to the renewable energy resources. Further, the environmental concerns related to the utilization of the non-renewable sources of energy are also forcing us to move towards cleaner options. But before shifting the partial load from the non-renewable sources of energy to renewable sources, it is important to know the most used applications, quantity of fuels as well as expenditure being incurred. The widespread use of renewable sources requires a greater understanding of the available options. This calls for a detailed survey of the energy consumption and expenditure pattern.

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The majority of population (70%) in India resides in villages. Households are responsible for about 40% of total final energy consumption of the nation. Earlier studies regarding the energy consumption in rural areas of India indicated that more than 80% of the energy consumed is from non-commercial sources such as firewood, agro-waste and dry dung.[1-3] Mostly inefficient cooking methods are used for non-commercial sources of energy which further economically burden the households, lead to wastage of valuable fuel and generate substantial emissions of health damaging pollutants.[4-6]

With penetration of LPG and electricity, the consumption pattern is changing in villages. Therefore, it was considered essential to perform a survey according to the different income groups which would help predict the energy expenditure pattern and also consider different applications in rural household sector.

This paper presents the results of the survey conducted to study the energy expenditure pattern in the domestic sector of the villages of Rajasthan, India. The survey has been performed keeping in mind the commonly used fuels such as LPG, electricity, wood and kerosene and various common applications which involve usage of energy in the domestic sector of the villages. The use of LPG, wood and kerosene, apart from domestic cooking, has also been considered for cattle feed cooking and water heating applications. The use of electricity for the daily requirements of lighting (including cooling and entertainment) has been considered, as well as its use for pumping of water. The results have been analyzed to predict the scope for green energy (such as solar, wind biomass etc.) penetration in the rural areas.

Survey Details

The survey has been performed in twelve villages situated in Kota district of Rajasthan, India (25o10′N, 75o50′E). Twelve villages which are situated near Kota city at a distance of 5 – 40 km. with a population in the range 1000 – 13,000 have been chosen for the study. As the survey aimed at studying the energy expenditure pattern in the household sector of these villages, it was considered appropriate to classify the households according to their income range. The households have been divided in three classes – lower, middle and high income households. Table 1 shows the classification of the households according to the income groups and the total percentage of the households in each class. Distribution showing the percentage of households with electricity connection, water pumps, cattle and requirement of hot water has also been presented in the same table. As electricity is one of the major energy expenditure areas, it is essential to know the number of households having electricity connection. Further electricity is used for both lighting purposes as well as for lifting and pumping of water. Therefore, it was considered important to know about the percentage of households in each category which have pumps and the number of pumps they possessed. Apart from the major energy consumption in the form of electricity and domestic cooking, other energy uses for the households are for animal feed cooking and heating water. Therefore, information has also been collected and compiled about the households which have animals and which use hot water.

Table 1. Distribution showing the percentage of households belonging to different income ranges and with electricity connection, water pumps, cattle and requirement for hot water:

S. No.	Household Type (Income Indian Rupee)	Household %	Percentage of Households with			
			Electricity Connection	Water Pumps (Number of Pumps)	Cattle	Hot water use
1.	Low Income Household (< ₹ 5000/-)	57.15	93	45.8(1)	62	27
2.	Middle Income Household (₹5000-12000)	23.80	95	70.0(1-3)	65	45
3.	High Income Household (>₹12000)	19.05	100	75.0(2-4)	94	81

The major constituent in the energy expenditure for the rural households is the cooking fuel. Therefore, during the survey, information has been collected about the use of different cooking fuels and the percentage of the households in each category which use these fuels. It has been found that mainly LPG, wood and kerosene are being used as cooking fuels. The various combinations of fuels (LPG, wood and kerosene) used by the different income groups is presented in form of venn diagrams in Figs. 1-3:

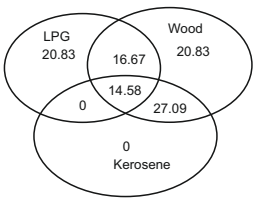

Figure 1. The percentage distribution of low income households for different combinations of cooking fuels (LPG, wood and kerosene).

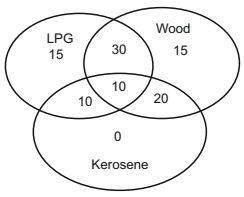

Figure 2. The percentage distribution of middle income households for different combinations of cooking fuels (LPG, wood and kerosene).

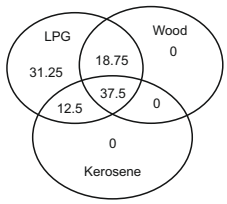

Figure 3. The percentage distribution of high income households for different combinations of cooking fuels (LPG, wood and kerosene).

The average monthly expenditure in ₹ (Indian rupee) on different fuels such as LPG, wood, kerosene and electricity for the different household categories is presented in Figs. 4-6. Here the terms Electricity-I and Electricity-II are used for the average monthly expenditure on electricity excluding water pumping and including water pumping, respectively.

From the data collected through the survey, the total expenditure of the different households on fuels and the percentage of this expenditure for each application have been calculated.Mathematically it can be expressed as

$$\text{Percent expenditure for a particular application} = \frac{\text{Fuel expenditure for particular application}}{\text{Total expenditure on fuels}}$$

The results for the percent expenditure on the fuels for various applications for the low, middle and high income group households are presented in Fig. 7, 8 and 9, respectively. The applications that have been considered are the most common

household requirements such as lighting, water pumping, domestic cooking and animal feed cooking/water heating. The home lighting here represents the expenditure on electricity used for lighting, cooling and entertainment purposes.

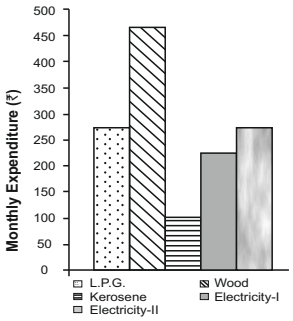

Figure 4. The average monthly expenditure in ₹ on LPG, wood, kerosene and electricity for low income households

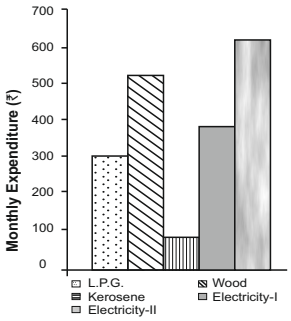

Figure 5. The average monthly expenditure in ₹ on LPG, wood, kerosene and electricity for middle income households.

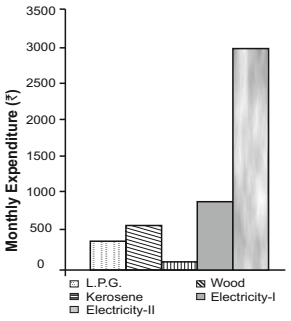

Figure 6. The average monthly expenditure in ₹ on LPG, wood, kerosene and electricity for high income households.

The sequence is LPG, wood, kerosene, electricity I and II. Electricity-I refers to the expenditure on electricity excluding water pumping whereas electricity-II refers to the expenditure on electricity including water pumping.

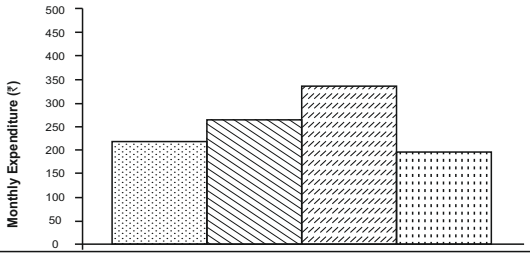

Figure 7. Percentage expenditure on fuels for various purposes by the low income households. (Sequence –left to right- home lighting, water pumping, domestic cooking and animal feed cooking/water heating)

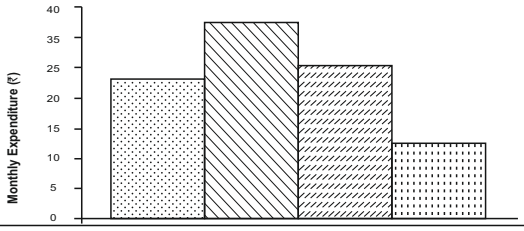

Figure 8. Percentage expenditure on fuels for various purposes by the middle income households. (Sequence –left to right- home lighting, water pumping, domestic cooking and animal feed cooking/water heating)

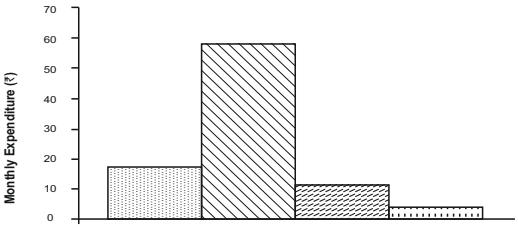

Figure 9. Percentage expenditure on fuels for various purposes by the high income households. (Sequence –left to right- home lighting, water pumping, domestic cooking and animal feed cooking/water heating)

Results

From the results obtained through the survey performed in the twelve villages of Rajasthan it is clear that around fifty seven percent of the households in the villages belong to the lower income group, and nineteen percent belong to higher income group. From Table 1 it can be inferred that the major fraction of population in the villages belong to low income households.

It can also be concluded that the penetration of electricity to the villages has been quite good and all the twelve villages chosen for the survey have electric supply. This may be attributed to the fact that these villages are in the vicinity of Kota, which is a well developed city, otherwise still around 40% of the rural households in the country are waiting for electricity connection.[2,7] Rajasthan has remote unelectrified 493 villages and 90 hamlets as verified by Rural Electrification Corporation (REC) as on 31st March 2012.[8] It is interesting to find from the survey of the twelve villages that even from the low income households around 93% households have electricity connection. From the middle income households around 95% households have electricity connection whereas all of higher income households in the villages have electricity connection.

The use of cooking fuel in the villages is not limited to domestic cooking but it extends to the animal feed cooking and heating water. From Table 1 it is clear that with the increase in income, the percentage of the households which possess animals and use hot water increases. Around 62% of the low income households and around 94% of the high income households possess cattle. Only 27% of the low income group households use hot water whereas 81% of the high income households do. Therefore, it can be inferred that the expenditure on the animal feed cooking and heating of water would be more for the high income households.

Furthermore it can also be seen in Table 1 that only 46% of the lower income group households use water pumps and they only possess one. Whereas around 70% of the middle income group use water pumps possess one to three of them. More than three fourth of the higher income group households use water pumps and the number of water pumps is higher (two to four) compared to the other groups of households. Therefore, it can be inferred that the major use of electricity and major expenditure in higher income group households of the villages is for water pumping application.

The usage of the different combinations of cooking fuels for the different income group households is presented in Figs.1-3. The survey results show that there is a wide difference in the use of fuels by the different income group households. Figs. 1-3 clearly indicate that mainly the combination of wood and kerosene is used by the low income households, followed by only LPG, only wood and LPG-wood combination. All the three fuels are used by 15% of the households in the low income range. It is quite interesting to find that kerosene alone as a fuel is not used by any household in all the three income ranges. Middle income range households mostly use the combinations of LPG and wood, followed by wood-kerosene, LPG alone, wood alone, LPG-kerosene and all the three fuel combination. On the other hand, the three fuel combination is used

mainly by the higher income group households, followed by LPG alone, LPG-wood, and LPG-kerosene combination. Wood alone, kerosene alone and wood-kerosene is not used by any household in higher income group.

According to Figs. 4-6 which present the average monthly electricity expenditure for the households in different income groups, it can be concluded that the electricity bill rises considerably with use of electricity for water pumping. It can be seen that the expenditure on electricity when using water pumps almost doubles for lower and middle income group households whereas for higher income group households the expenditure on electricity gets multified by 3 to 4 when using pumps. The latter is around ₹ 4000/- which constitutes around ₹ 50,000/- per year.

Figs. 1 and 4 show that more than half of the low income households use LPG and their monthly average expenditure is around ₹ 275/-. From Figs. 2 and 5 it can be seen that around 70% of the middle income households use LPG and the monthly average expenditure is around ₹ 315/-. All the households of the higher income group use LPG and more than ₹ 400/- are being spent on it per month.

The consumption pattern for the different households as seen from Figs. 1-3 shows that around 70-80% of households in all the income groups use wood. The average monthly expenditure on wood for low income group households is around ₹ 465/-, whereas for middle income group it is around ₹ 525/- and for higher income group it is ₹ 625/- according to the Figs. 4-6.

The average monthly expenditure on kerosene for households of different income groups depicted in Figs.4-6 clearly illustrates the fact that expenditure on kerosene is quite low as compared to the other fuels. The reason is that the use of kerosene in the household sector has reduced to a considerable extent with the availability of the LPG and electricity in the villages. The major expenditure on kerosene is by the lower income group households, followed by the middle and higher income group households.

From Fig.7 it can be seen that for the low income group households the maximum percent expenditure is on cooking fuels for domestic cooking which is around 33%, followed by the expenditure on electricity for water pumping purposes which is 26%. The results show that low income households spend less energy or consume less electricity for lighting, cooling and entertainment purposes. On an average the monthly expenditure on fuels for the low income households is around ₹ 1049/- if the expenditure in use of water pumps is also included. For the households which do not use pumps the monthly expenditure is around ₹ 750/- for lighting, cooking including animals feed/hot water purposes. Therefore, the low income households spend around 20% of their earnings in fuels or in other words their energy expenditure is 20% of their income.

Similarly, from the study of expenditure on fuels for the middle income group people it has been found that the average monthly expenditure on fuels is around ₹ 1700/-, which is again around 20% of the total income of the household. From Fig. 8 it

can be seen that the maximum percent expenditure is for water pumping followed by the percent expenditure on domestic cooking.

The study of Fig. 9 reveals that for the high income group households the maximum expenditure is for water pumping (62.33%) followed by the expenditure on electricity for lighting purposes (19.41%). The total energy expenditure for the high income group households is around ₹ 4800/-, which is around 30% of their average income. This shows that higher income group households spend more on electricity as compared to the lower and middle income group households and that too mainly for water pumping.

Discussions on Renewable Energy Options

The study of the energy expenditure of these households shows that the lower and middle income households spend around 20% of their total earnings on fuels whereas the higher income group households spend around 30% of their income on fuels. Therefore, it can be concluded that a major part of the income of the households is being spent on fuels which is mainly used for cooking, lighting, water pumping and water heating applications. In spite of this important expenditure on energy, the per capita energy consumption in India is quite low compared to the per capita energy consumption in developed countries (4% as compared to U.S.A. and 22% of the world average). Hence, to improve living standards and sustainable development, it is essential to make adequate energy available through cleaner and greener options. Solar energy can be put into different uses in different areas, such as provision of solar electricity and solar photovoltaics in social housing, solar collector systems to provide hot air for rural applications, solar water heating in domestic sector and solar cookers for domestic and animal feed cooking etc.[9-18] As devices operating through solar energy are available for all the common rural applications ,it is advisable to use solar devices as much as possible.

The box type solar cookers which are affordable, convenient and efficient can be easily used for domestic or animal feed cooking. Therefore, the load on wood and LPG can be shifted to the solar cookers and the expenditure on these fuels can be reduced considerably. Similarly, the solar water heaters can be used for the water heating application. The cost of the water heater is high and it cannot be afforded by the low income group households without financial help but it is clear from the survey that generally low income households seldom use hot water. The main use of hot water is by the high income households and for them the water heater is easily affordable. Therefore, the high income group households should be motivated to take initiative in use of solar energy for various applications. Similarly, lower and middle income households should be financially helped to be able to use solar energy. Given the future increase in energy consumption it would help in maintaining pollution free environment besides saving fuel. It has been reported that more than 400 million tonnes of agro-residues and wastes are generated in India every year and a small part is used for domestic cooking needs and other applications.[19] The estimated potential number of biogas plants which could be installed in Rajasthan is 915000 but only 7% of them are

currently built. Biogas plants are capable of annual savings of 0.24 million tons of LPG equivalent while producing bio-fertilizer equivalent to 62.8 million kg. of urea equivalent or 11.6 million tons of organic manure per annum. Further, the estimated potential of power production from wind energy in Rajasthan is 5005 MW whereas the installed capacity is 2355 MW as on 31st March 2012.[20]

Thus, there is enough scope for renewable energy penetration in the household sector of rural areas of India. The installation cost of some of the devices is high so policy makers should formulate policies to help promote and popularize their use. Financial help and various incentives should be provided to the households as it would be highly beneficial in self sustenance and development of the areas. The advantages of renewable sources of energy are immense not only in saving fuel but also in reducing carbon emissions. Use of renewable energy resources in various applications can be taken up as Clean Development Mechanism Project and carbon emission trading can also be done on its basis. This would further help in sustainable development and improving the living standards in financially viable way. For the popularization, it is essential to create public awareness and dissemination of technical know-how to the users. The co-operation and involvement of educational institutes, NGOs and companies should be invited and encouraged.

Conclusions

From the study it has been concluded that in the rural areas 20-30% of the earnings of the households is being spent on fuels. The major energy expenditure for the lower income households is on domestic cooking (33%) whereas for the higher income households it is for water pumping (62.33%) followed by lighting. Thus the major energy consuming applications are cooking, water pumping and lighting. Though LPG is being used by majority of the households, still the consumption of wood far exceeds the consumption of LPG. Around 70-80% of all the categories of the households use wood with different fuel combinations. Wood is mainly used for cattle feed cooking and water heating applications. Electricity is mainly used for lighting and water pumping. The partial load of these applications in rural areas can be easily shifted to renewable energy sources such as solar, wind and biomass. Favourable policies and sustained efforts can help promote renewable energy sources in rural areas of developing countries.

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Tapping Electrical Energy from Oxidation of Municipal Solid Waste using Aluminium Anode in a Single Chamber Membrane-less Microbial Fuel Cell

Ramachandar B S, Biswas Tuli and Gupta A B

Abstract

Energy is the key input for socio-economic development of any nation. The demand for electrical energy and the amount of waste dissipated are ever increasing with the increase in population. Municipal solid waste is one of the sources for electricity generation but requires high technical context. Energy can be recovered from the organic fraction of municipal solid waste. Microbial Fuel Cell (MFC) is one promising technology for electricity production from organic substrates through the microbial activities like bacteria (electron donors). A single chamber membrane-less microbial fuel cell was developed in the laboratory to tap electricity using Al anode obtained through the electron generated by bacterial metabolic activity from municipal solid waste. Three identical single chamber MFCs of 18 L capacity each were constructed. Earthing/grounding system was used to complete the electrical circuit obviating the requirement of cathode. The anode potential was increased by change in design of MFC with different configurations of electrodes. Initially, there was no change in anode potential due to non formation of biofilm on the electrode. After a 7 days period, initial voltage of 0.41 volts was observed. After 10 days, the voltage increased to 0.82 volts when moisture content between 30% and 40% was maintained in the reactor. An average voltage of 0.69V was received from MFC3 reactor between 15th and 60th day. The percentage of COD removal in MFC3 was 36.6% and in MFC2 31.3%. The percentage of COD removal and electricity production can be increased by increasing the number of electrodes; their placing; proper choice of electrode having lesser resistance; and addition of mediators such as glucose, lactate, acetate, which may be derived from domestic waste water. This MFC based system showed promise to develop an easy means for deriving electrical energy from waste dumpsites. Further investigations are needed to obtain more stable and higher magnitude of electrical output.

Acronyms/Abbreviations

Ω: Ohm, COD: Chemical Oxygen Demand, MFC: Microbial Fuel Cell

Introduction

Both, the demand for electrical energy and the amount of waste disposed are ever increasing with the increase in population. Microbial Fuel Cell (MFC) is one promising technology for electricity production from organic substrates through the microbial activities like bacteria (electron donors). Municipal solid waste is one of the sources for electricity generation but requires high technical inputs as it is in a dispersed and dilute form.

Some promising technologies such as hydrogen fuel cells, MFCs are under development for electricity production. Microbial Fuel Cell has a significant role for generation of electricity from waste water or solid waste as a new potential renewable

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source of energy. MFC generates electricity through the oxidation of organic matter in the presence of fermentative bacteria under mild operating conditions. The potential (biologically mediated) is developed due to bacterial metabolic activities through a series of oxidation-reduction reactions generating electrons and protons under different electron acceptor conditions. This creates bioelectricity.

The performance of MFCs depends on the system architecture, internal resistance, species and amount of bacteria on the anode, type of organic matter, chemical characteristics of the medium (pH, solution conductivity and chemical concentration) and the electrode surface characteristics. With the consideration of above parameters, a single MFC generates a maximum working voltage of 0.3-0.7V due to redox potential between the respiratory enzymes of anodophilic bacteria and cathodic reactant, suggesting the electricity production is limited (Logan, February 2008).

In order to enhance MFC technology, it is very important to understand the limitations that it faces. MFCs are still difficult to upscale due to their low power production. The maximum power density reported is 2.15kW/m3 and considers only the anode area but not the entire system volume (Nevin K.P, 2008). Because of this, such systems tend to occupy large area and are thus not put into an effective use on small scale or in households. Another major limitation is cost; the components such as graphite, proton exchange membranes etc. used in MFCs on a laboratory scale are very expensive.

The power densities obtained from MFCs mostly depend on the type of fuel and reactors used and typical configuration employed, a review of literature is shown in Table1.

Microorganism	Substrate	Anode	Current (mA)	Power (mW/m2)	Reference
Shewanella putrefaciens	lactate	woven graphite	0.031	0.19	Kim et at., 2002
Geobacter sulfurreducens	acetate	graphite	0.4	13	Bond et al., 2003
Rhodoferax ferrireducens	glucose	woven graphite	0.2	8	Chaudhuri et al., 2003
Rhodoferax ferrireducens	glucose	porous graphite	0.57	17.4	Chaudhuri et al., 2003
Rhodoferax ferrireducens	glucose	graphite	74	33	Chaudhuri et al., 2003
Mixed seawater culture	acetate	graphite	0.23	10	Bond et al., 2002
Mixed seawater culture	sulphide/ acetate	graphite	62	32	Tender et al., 2002

Table 1: Power densities of MFC's

An attempt has been made in the present study to construct a MFC that simulates a solid waste dump site. Electrodes are placed below the top surface to capture the electrons produced during anaerobic/aerobic oxidation for the waste. This was achieved through the construction of single chambered MFCs which were run in parallel under different set of conditions/substrates and analyzed for their electrical output.

Methodology

Design of single chamber MFC

In the initial attempts, MFC with a maximum volume of 3L was investigated. Copper rod (diameter 3mm) was used as material for the electrode. Reactor was found unfit for the study because of non-development of biofilm in it and also due to its small volume. Keeping the above mentioned problems into consideration, three identical single chamber MFCs were made for the experiments. The volume for each reactor was kept 18L. The size of MFC was 30 x 22 x 28cm with a slope of 3 in 30 at the bottom to facilitate the collection of substrate/leachate through outflow channel. The cells were made of glass acrylic sheet, chosen for its transparency and good structural integrity.

Electrodes

The anode electrode had strips of aluminium with a pure copper wire wound around it acting as a current collector. The total resistance of the anode electrode was 420 Ω.

MFC assembly

The main goal of MFC assembly was to avoid ejaculation in the cell and congregate all cells in a similar manner. The first step was to adobe the anode over the bottom of the opening on the MFC. In MFC1 only one anode electrode was used and an earthing system completed the electric circuit so that there was no requirement for a cathode system. In MFC2 two anodes were used, whereas in MFC3 three anodes were used. All these anodes were wrapped with a pure copper wire acting as current collector. The bottom channels were fitted with ball valves to control the leachate as well as to collect it.Inferior tightening can lead to leakage and the fluctuation of the biofilm developed on the bottom anode. Aloft tightening condenses the cover and makes it expand evidently. The oblique force caused by this enlargement on the glass Perspex can cause cleavage in the edges, so it is very significant to have a definitive tightness for each cell. Due to the deformity of the cell lid, the cell choking will also have an effect on the distance maintained between the anode and the cell, which was an additional reason why a definitive tightness was desirable. The graphical representation of single chamber MFC is shown in Figure 1.

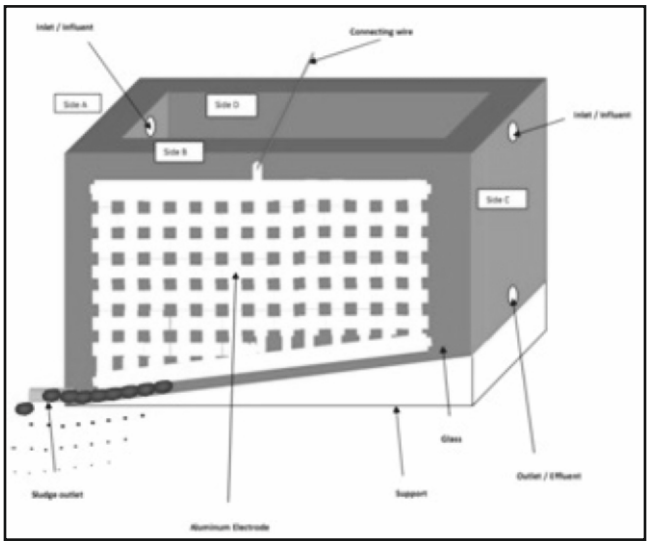


Figure 1: Graphical representation of single chamber MFC

Simulated municipal solid waste

The biodegradable waste was collected from Jhalana Doongri, Jaipur city. In this area the biodegradable waste fraction of Municipal Solid Waste was analyzed. It included commercial food waste such as catering waste and waste from markets; forestry residues, including bark, wood residues; agriculture waste, including animal husbandry excrements (solid and liquid manure), straw residues, sugar beet and potato haulm, residues of beans growing, peas, flax and vegetables, spent mushroom compost; and wastes from the food and beverage industry, including breweries and malt houses, wineries, fruit and vegetable production industry, potato, sugar beet leftover and soils, slaughterhouse residues, meat production.

The waste used in MFCs for the present study was simulated from above wastes. The characterization of this waste is shown in Tables 2 and 3.

S.NO	Content	MFC1 (grams)	MFC2 (grams)	MFC3 (grams)
1	Cucumber	300	300	300
2	Jack fruit	----	475	475
3	Peas	1050	1050	1050
4	Egg shells	45	45	45
5	Tea powder (wet)	100	100	100
6	Cabbage	150	150	150
7	Onion peels	550	550	550
8	Potato peels	750	750	750
9	Banana peels	850	850	850
10	Food waste	950	950	950
11	Flesh/feather waste	25	25	25
12	Garden waste	10	10	10
13	Paper waste	10	10	10
	Total	7790	8265	8265

Table 2: Characterization of waste used in this study

The total moisture content in each MFC is calculated as shown in Table 3

S.NO	Sample	Weight of Sample in each MFC (grams)	Total Moisture Content (%)
1	Cucumber	300	3
2	Jack fruit (except in MFC1)	475	3
3	Peas	1050	32.7
4	Egg shells	45	0.25
5	Tea powder (wet)	100	3
6	Cabbage	150	0.18
7	Onion peels	550	1.76
8	Potato peels	750	62.5
9	Banana peels	850	2.12
10	Food waste	950	9.5
11	Flesh/feather waste	25	0.16

Table 3: Moisture content in each MFC

Operation of MFCs

In MFC1 only one electrode was placed at the bottom of the MFC. A number of preliminary experiments were conducted to assess the feasibility of tapping of electrical energy directly from biodegradable waste without collection of gas. In MFC1 the initial voltage was 0.1V after day 3 and it was noted as 0.82V on day10. Later two similar MFCs named as MFC2 & MFC3 were operated for parallel assessment. A multimeter was attached to measure voltage from MFCs. No pre-treatment was given to anode or cell like sterilization.

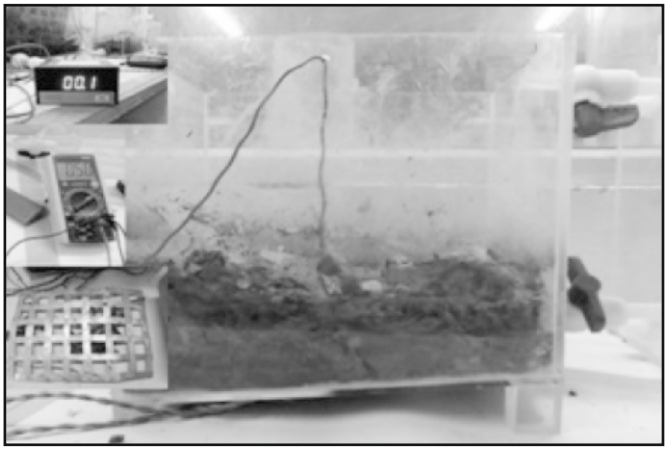


Figure 2: Picture of MFC showing Current, Voltage and electrode used in the reactor

Only voltage was monitored in MFC1 (with single anode), maintained on 30- 40% moisture in the cell for 109 days. Moderate temperature was maintained for microbial growth which helped in formation of biofilm on the electrode. Voltage and current were monitored in both MFC2 and MFC3 as shown in Figure 2 by maintaining moderate temperature as well as 30-40% moisture level in the cell for 60 days.

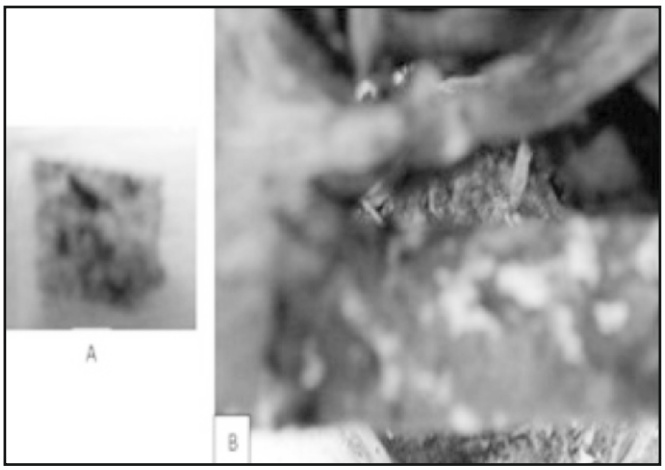


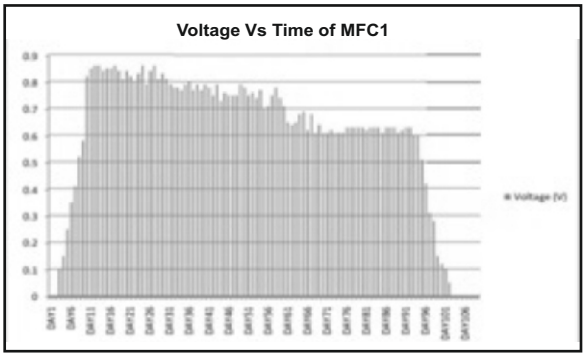
Figure 3: A) Microscopic view of bio-film developed on the electrode B) General view of bio-film developed on the electrode

The cells were assumed to reach a steady state when the voltage remained more or less constant over a period of one week. This state occurred after about 3 weeks initially but dropped again before stabilizing after 52 days of MFC operation. At this instant, the operating curves were determined. All the readings were taken at regular intervals. The general view and microscopic view of biofilm developed on the aluminium electrode are shown in Figure 3.

Results and discussions

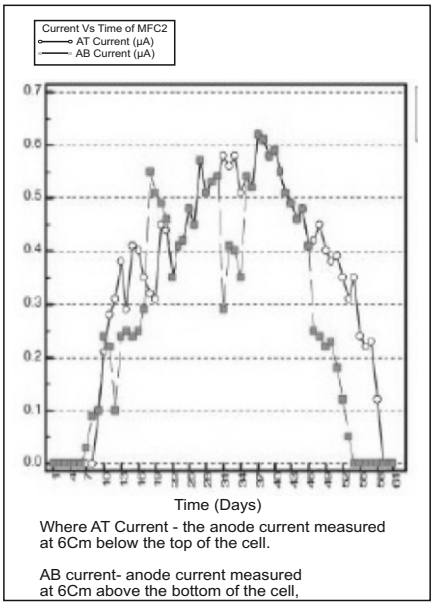
The single chamber MFC1 was fed with approximately 7.8 kg of biodegradable waste with initial COD 1660mg/G. From Graph 1, it is observed that the voltage readings were low initially but improved as the experiment continued. This was because of the oxidation of organic matter by the biofilm formed on the electrode.

MFC1 sustained for 109 days with peak voltage of 0.86V and an average of 0.6V. MFC1 showed stable performance for about 66 days. The MFC2 was fed with 8.26 Kg of biodegradable waste with initial COD of 1660mg/G. The resistance between the two anodes has significant role in the circuit: as the distance between them increases then the resistance also increases. From Graph 2, it can be seen that initially the currents did not develop due to low electron transfer on the electrode, since it had a high resistance of about 420Ω. The current increased gradually with the degradation of waste.

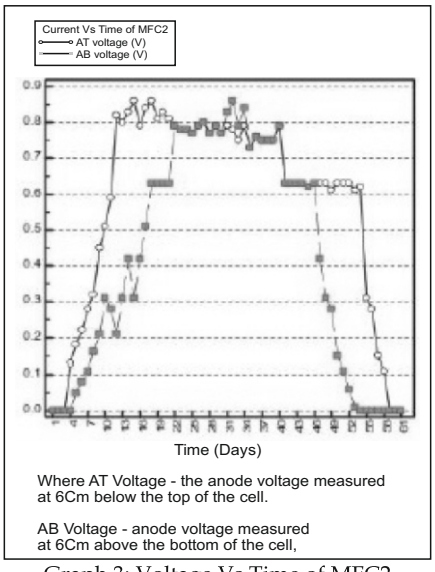


Graph 1: Voltage Vs Time in MFC1

Graph 2 also shows that the magnitude of AT current was higher than AB current. This is due to higher oxygen availability at the top of the cell compared to the bottom therefore offering higher state of oxidation with a consequently higher release Where AT Voltage – the anode voltage measured at 6Cm below the top of the cell. The peak AT current was observed in the MFC2 which was 0.62μA (observed after 35 days of operation) and sustained for only 2 days. The average AT current was observed as 0.1 μA and there were no fluctuations for over a period of 55 days. Later anoxic conditions at the bottom resulted in reduction of the microbial growth. From Graph 2, the AB current was observed to be much lesser than the AT current due to anaerobic conditions at the bottom, resulting in lower electron transfer. The peak AB current obtained in the MFC2 was 0.62 μ A, but it sustained for one day only. MFC2 run for a period of 60 days. Due to prevalence of anaerobic conditions, current reduced to almost zero perhaps due to acidic conditions after 54th day. From Graph 2 and Graph3 it can be stated that the curves of current and voltage are almost similar.

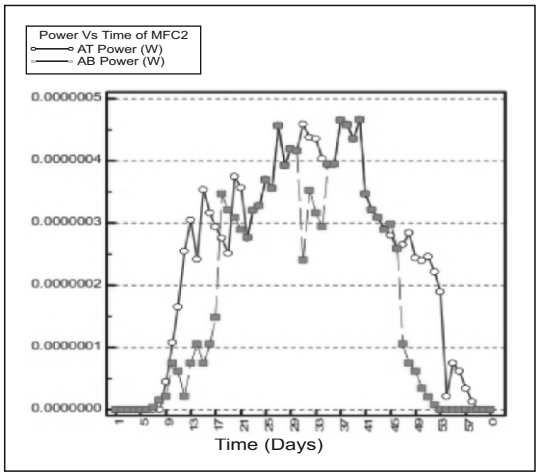


Graph 2: Current Vs Time of MFC2



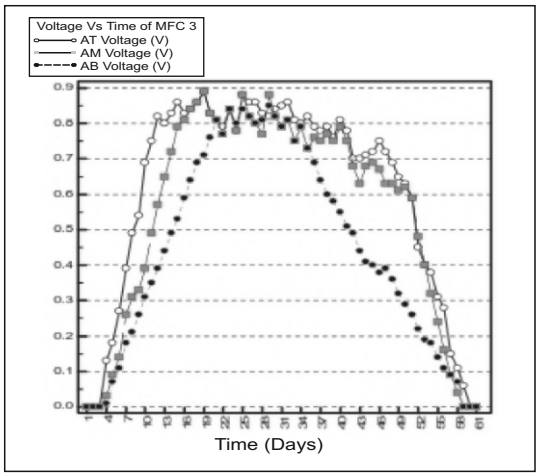
Graph 3: Voltage Vs Time of MFC2

From Graph 4, it is observed that the AT power obtained was much higher than AB power for the entire period. The average AT power was obtained as 1.971x10-7 W and the average AB power obtained in the MFC2 was 1.87373x10-7W. i.e. the energy produced by the anode, placed at the top of the cell was higher than the anode placed at the bottom of the cell which indicates that the placing of anode plays a key role in production of electrical energy.



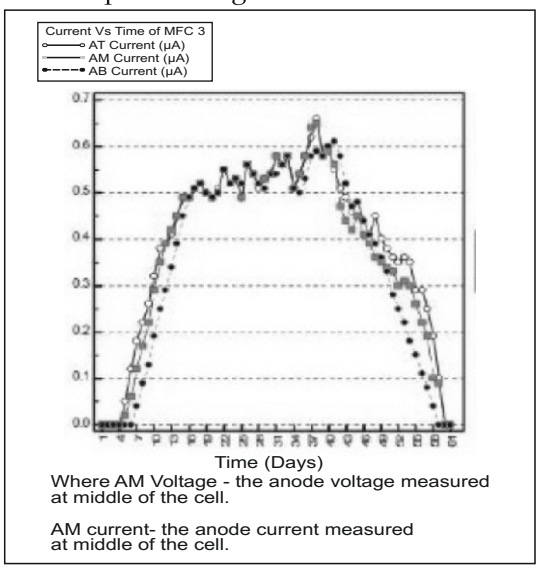
Graph 4:Power Vs Time of MFC2

From Graph 5, the average voltages of AT, AM and AB were 0.69V, 0.33V & 0.1V respectively. These voltages were sustained for 56 days out of 60 days of operation but the peak voltages of AT, AM and AB sustained only for 12 days. The peak AT current of 0.66µA was observed in the MFC3 after 40 days of operation and sustained for only 3 days. The average AT current was observed of 0.39 µA with little fluctuations in the next 15 days. Later anoxic conditions at the bottom resulted in reduction of the microbial growth. No current was observed after the 59th day.

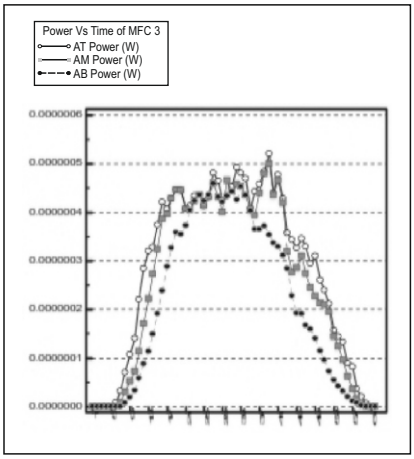


Graph 5:Voltage Vs Time of MFC3

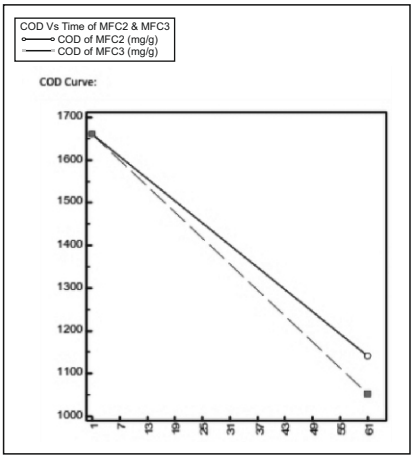
Graph 6, the AB current was observed much lesser than the AT and AM currents due to anaerobic conditions at the bottom, resulting in lower electron transfer. The peak AB current obtained in the MFC3 was 0.61 µ A, but it sustained for one day only. MFC3 run for a period of 60 days. After the 59th day, the current reduced to zero due to prevalence of anerobic conditions in MFC3. The AM current peak was observed on 37th day with 0.65 µA magnitude, but decreased gradually and reduced to zero due to acidic conditions on 60th day.



Graph 6:Current Vs Time of MFC3



Graph 7:Power Vs Time of MFC3



Graph 8: COD Vs Time of MFC2 & MFC3

From Graph 7, the AT power obtained was much higher than AB power and AM Power for the entire period. The average of AT, AM and AB powers were 3.198x10-7W, 2.223 x10-7W and 1.182 x10-7 W respectively therefore the energy produced by the anode, placed at the top of the cell was higher than the anode placed at other places in the cell.

COD removal was monitored in MFC2 and MFC3 which is depicted in Graph8. Initial COD concentrations were measured as 1660mg/G. COD concentrations decreased over time and dropped to 1140 and 1052 mg/G after 60 days in MFC2 and MFC3 respectively. Higher COD reduction was observed in MFC3 due to higher number of electrodes employed. Percent COD removal in MFC2 and MFC3 was 31.3% and 36.6%.

Recommendations

The growing pressure on the environment and the call for renewable energy sources will further stimulate the development of this technology, leading soon to its successful implementation in practical purposes. High voltage can be achieved by connecting those MFCs in series, similar to the conventional fuel cells stacked in series. It is observed that having good network of anode electrodes, i.e. anode in good with substrate, will reduce the losses to some extent. It requires electrons only to travel little distance to reach the anode, thus reducing the resistance offered by the substrate as the resistance is directly proportional to the length it needs to travel.

Conclusion

Microbial fuel cells do hold promises towards sustainable energy generation from the municipal solid waste in the near future. Many bottlenecks yet exist, that only a multidisciplinary approach and intensive research can address. The power densities of MFCs mostly depend on the type of fuel and type of reactors used and their configuration. These initial results indicate that such a MFC configuration can yield a high electricity output from the MSW dump sites and can provide a practical and

viable solution for tapping energy from organic oxidation, as the dispersed methane from such sites is extremely difficult to tap. Intensive research is required to increase the yield by increasing the number of electrodes and assessing the optimum spacing between them.The major factor for high yield of electrons is maintenance of aerobic conditions, which can be enhanced by periodic turning of the waste. The yield became zero after a few weeks of operation in all the reactors. That can be due to the development of an acidic environment after anaerobic conditions or even to the trapping of heat of oxidation within the waste matrix which does not allow microbes to work efficiently. The operating conditions can be optimized after controlled experiments in order to have a high net yield of energy.

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Energy needs Law or Law needs Energy?

Dr. R.S.Solanki

Abstract

India is one of the fastest growing economies in the world. In order to sustain its prosperity and growth, strengthening of its power sector is the need of the hour. Indian power sector is the fifth largest in the world and has made significant progress over the years. It has gone through substantial overhaul. If we speak in global terms countries like US and China have done a tremendous work. For example, China's Renewable Energy Law is an important piece of legislation in the energy sector and provides for the largest state sponsored commitments towards renewable energy. The Energy Policy Act (EPA) addresses energy production in the United States and includes issues such as energy efficiency, renewable energy and climate change technology. It is also a curious fact that despite the presence of domestic and international policies and regulations, international market is rift with controversies. The latest one in the energy sector is of US-China trade of solar energy products. The need of the hour, therefore, is not only effective legislations but their proper implementation and a hassle free global energy environment.

Acronyms/ Abbreviations

BEE: Bureau of Energy Efficiency, EPA: Energy Policy Act, NHPC: National Hydropower Corporation, NTPC: National Thermal Power Corporation, PEEREA: Protocol on Energy Efficiency and Related Environmental Aspects, WTO: World Trade Organisation

The universe is mysterious and so are human beings. Referring to the ancient Indian texts Vedas, one can say that when man tried to solve this mystery, he realized that at the time of creation of universe, the only two things which were present were Matter and Energy. Matter expresses itself in five forms, *panch mahabhutas* or five basic elements which are *Prithvi* or Earth, *Jal* or Water, *Vayu* or Gas, *Tej* or Fire and Akash or Space. While analyzing the idea and the role of Matter the Vedic Sages realized that Panch Mahabhutas or the five forms of the matter are incomplete or actually dead in the absence of *Jeevan Shakti/Urza* (Energy).[1]

This energy is important and so is its conservation. Today, in the era of Globalization, nationality has crossed its barrier and now a citizen of a country is also a Global citizen. Trade and commerce have gone global. To facilitate and regulate trade at national and international level various laws have been framed across the sector.[2]

Our country is one of the fastest growing economies in the world. In order to sustain and uplift its growth and prosperity, strengthening of power sector is the need of the hour. Indian power sector is the fifth largest in the world and has made significant progress over the years. India has moved very quickly to deliver electricity to more

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people, excluding the reach of its grid to an average 24 million more people each year since 1990 (World Bank-led report, Marianne Lavelle, quoted in Asian Journal of Water, Environment and Pollution July 2013).The sector has also undergone substantial structural changes. When we look at the history of Power sector regulations, the first instance is evident in 1897, when the government of Bengal granted an exclusive 21-year license to the Calcutta Electricity Supply Corporation to supply electricity to Calcutta after the successful commercial generation of electricity in India in Kolkata, 1879. The Electricity Act 1910 is the first Act in the power industry, which was introduced before Independence. The Act provided the basic framework for supply of electricity in India and encouraged the growth of the industry by issuing licenses to private companies.

Then came the Electricity (Supply) Act 1948, which was based on the UK Electricity Supply Act 1926. Under this Act the Central Electricity Authority (CEA) was established at the central level to develop a sound, adequate, and uniform national power policy along with the State Electricity Boards (SEBs) at the state level. The Act also elaborated the financing norms and institutional framework for the electricity industry in India. The Central government amended the Electricity (Supply) Act 1948 and established the National Hydropower Corporation (NHPC) in 1975 to build hydropower plants and the National Thermal Power Corporation (NTPC) to set up coal-based power plants.

The era of economic reforms started in India in 1991. Keeping the requirements of open economy in mind, the government made an amendment to the Electricity Act 1910 and the Electricity (Supply) Act 1948 through the Electricity Laws (Amendment) Act of 1991. The amendment allowed private participation in thermal, hydro, wind, and solar power projects along with 100% foreign ownership.

Energy conservation also became a major part of discussion by this time and emerged as a major policy objective, and thus came The Energy Conservation Act 2001. It set out energy consumption norms for large energy consumers, provided Energy Conservation Building Code for new buildings and emphasised on use of new appliances to meet energy performance standards. A Bureau of Energy Efficiency (BEE) was also created to implement the provisions of the Act.[3]

To replace the Indian Electricity Act 1910, the Electricity (Supply) Act 1948 and the Electricity Regulatory Commissions Act 1998, the Electricity Act 2003 was passed by the Parliament. The bill sought to provide a legal framework for enabling reforms and restructuring the power sector. The Act came out with the National Electricity Policy, emphasis on rural electrification, open access in transmission and distribution and some other provisions. It mandated the regulatory commissions to regulate the tariff and issues of license. This Act focused on laws relating to generation, transmission, distribution, trading and uses of electricity. The Act was amended in 2007 to enact with greater power, clarity and emphasis on assessment, fines and legal framework to check commercial losses due to theft and unauthorized use of electricity.

Globally, to create open and non-discriminatory energy markets throughout the world and to cover all aspects of commercial energy activities including trade, transit,

investments and energy efficiency, the Energy Charter Treaty (ECT) was signed on 17 December 1991 at Hague which is an international agreement establishing a multilateral framework for cross-border co-operation in the energy industry. It was a political declaration of international energy principles with the intent of negotiating a legally-binding treaty, setting the pace for development of the Energy Charter Treaty. The legally binding treaty was signed in Lisbon in December 1994, alongwith a Protocol on Energy Efficiency and Related Environmental Aspects (PEEREA). The treaty as well as the protocol came into effect in April 1998. There was also an agreement to effect amendment to the trade-related provisions reflecting the change from the General Agreement on Tariffs and Trade to World Trade Organization processes. A Strategy Group was also established to promote modernization of energy sector. While the roots of the Energy Charter Treaty are found in Russia-EU relations, the treaty is the only multilateral legal framework of its kind objective expanding beyond its original purposes.

The framework of Energy Charter Treaty follows the rules of the multilateral trading system as embodied in the General Agreement on Tariffs and Trade (GATT), which later became the World Trade Organization (WTO). Additionally the treaty covers trade of all energy materials (e.g. crude oil, natural gas, wood fuel etc.), all final energy products (e.g. petroleum, electricity etc.) and energy related equipment. The rules so set are for trade in goods only, not trade in services, nor does it concern itself with intellectual property rights.

After creating open and non-discriminatory energy markets for energy trade, a form of international accountability for violation of these conditions also became necessary. The treaty is responsible for protection of Foreign Direct Investments (FDI). It also protects investors and their investments from political risks involved in investing into a foreign country like discrimination, expropriation, nationalization, breach of contract, damages due to war etc. The treaty covers virtually all aspects of commercial energy activities including trade, transit, investments and energy efficiency. It is a legally binding treaty and includes dispute resolution procedures also. It seeks to promote principles of non–discrimination and openness of global energy markets to encourage foreign direct investments and global cross-border trade.[4]

At the global level, if we talk about the Energy laws, countries like US and China have done a tremendous work. In United States, Energy law is a function of the federal and local governments. It is regulated extensively at the federal level through the United States Department of Energy. The most recent major law in the US is the Energy Policy Act of 2005 and an amended American Recovery and Reinvestment Act of 2009. This legislation is an attempt to overcome growing energy problems and provides tax incentives and loan guarantees for energy production of various types. The law also directed the federal government to have purchase of energy efficient products. The Energy Policy Act (EPA) addresses energy production in the United States and includes energy efficiency, renewable energy, oil, gas and coal, nuclear matters and security, vehicles and motor fuels including ethanol and hydrogen, electricity, energy tax incentives, hydropower and geothermal energy and climate change technology.[5]

The Energy Independence and Security Act 2007(EISA 2007) is also one of the important legislations of the US focusing on promotion of renewable energy, energy efficiency, metering and higher fuel economy standards. [6]

China's Renewable Energy Law is also an important piece of legislation in the energy sector and provides for the largest state-sponsored commitments toward renewable energy. China's government has set the goal of 10 percent renewable energy use by the year 2020. Power grid operators would now be purchasing resources from registered renewable energy producers. Adequate provisions are made for financial incentives such as a national fund to foster renewable energy development, discounted lending and tax preferences for renewable energy projects etc.The Act is made with a view to protect the environment, prevent energy shortages and reduce dependence on imported energy. China's new law sets the stage for the widespread development of renewables, particularly for commercial scale renewable generating facilities. Through this legislation, the State officially encourages the construction of renewable energy power facilities. The law includes other details related to the purchase and use of solar photovoltaic (PV) and solar water heating as well as renewable energy fuels. Finally, the law includes specific penalties for non-compliance with the law.[7]

There are policies and regulations for energy trading in national and international markets, yet the recent US-China anti-dumping case and India-US-China case are instances of major hurdles in the growth of energy sector.

In our country, the solar industry manufacturers have been requesting the government for anti-dumping duties on imported equipment for quite some time now. Moser Baer, Indo solar and Lanco solar are some of the major manufacturers that have suffered losses because of the inability to compete with cheap imported products. So, now it is under consideration to impose anti dumping duties on these products imported from countries like US, China, Malaysia, Taiwan and some local importers. These countries are exporting solar products at very low prices thus affecting the local solar industry in the country. Following this proposal, the US filed a request with the WTO to intervene and protect the interests of the American manufacturers.[8]

Globally, the latest controversy in energy sector is of US-China trade of solar energy products which seems to be the world's largest antidumping and anti subsidy trade cases where China's bulk exports at low prices have derailed the US companies in this sector. The negotiations are going on and now they have reached a plan to design the global solar panel market into a series of regional markets. It would sharply raise the price of solar panels exported from China, the world's dominant producer, by requiring Chinese companies to charge more while limiting the total number of solar panels they could ship. [9]

The move of making such imports costly by the importer countries is proving very unpopular not only among the exporters but also among environmentalists all over the world. Some environmental groups are already upset that the tariffs have made solar energy less affordable, making it less competitive with more polluting fossil fuels.[10]

Conclusion

To conclude, two things need special mention here. First is the behavior of the US. As an importer of cheap solar products from China, it has imposed heavy duties on it and has also given huge amount of subsidies to its own manufacturers. At the same time when India tried to do the same thing for protection of its own industry from cheap imported items, it has knocked the door of WTO. The dual standards of a country as an exporter and an importer need to be changed.

Lastly, if our country wants to seek energy autonomy or energy independence, development of sustainable sources of energy is the key. Although provisions on renewable energy are part of the Energy Act of India, but the experience shows that Electricity Act 2003 is not at all effective in facilitating the much needed transition to a sustainable energy system.

There is a need to remove some ambiguities or amplify some provisions in the Electricity Act 2003 relating to provisions dealing with renewable electricity generation and setting up a target in relation to electricity generation from renewable sources in coming years. It is a good sign that at least the government has taken up a step to move in this direction. The Renewable Energy (Promotion and Compulsory use) Bill 2010 along with The Energy Conservation (Amendment) Bill, 2010 are already before the Parliament. So the need of the hour is to ensure smooth passage of the energy bills and their effective implementation.

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Energy: Future Policies and Challenges

Laure Larroquette

Abstract

It is nowadays acknowledged that access to energy is essential for the development of any society, would it be economic or social. So essential that a new concept, that of energy poverty, has been defined as the minimum energy consumption needed to sustain lives. Around 2.7 billion people still rely on traditional fuels to cook and heat their homes and 1.4 billion people still have no access to electricity. Energy poverty is yet to overcome. On the 21st September 2013, the Institute of Development Management (IDM), Jaipur, organized a consultation on "Energy: future policies and challenges." Padma Bhushan Prof V.S. Vyas, Deputy Chairman of the State Planning Board of Rajasthan chaired the session and Shri Kunji Lal Meena, I.A.S, CMD, JVVNL was the Chief Guest. The seminar started with a presentation highlighting the links between energy and economic growth, environmental deterioration, climate change, social development and international conflicts before exposing the case of India. Then the discussion took off on various energy-related topics. This report offers an overview of the challenges and opportunities regarding energy at the global level with special mention of India. It concludes with the suggestions that arose during the consultation.

Acronyms/ Abbreviations

CMD: Chairman and Managing Director, IAS: Indian Administrative Services, IDM: Institute of Development Management, IEA: International Energy Agency, JVVNL: Jaipur Vidyut Vitran Nigam Ltd, Mtoe: Million Tonnes of Oil Equivalent, NGOs: Non Government Organisations, O&M: Operation and Maintenance, RAS: Rajasthan Administrative Service

Introduction

A consultation on the theme of Energy : Future Policies and Challenges was organised by IDM Jaipur on 21st September 2013. Hon'ble Padma Bhushan Prof. V.S. Vyas, Deputy Chairman State Planning Board of Rajasthan chaired the session and Shri Kunji Lal Meena (I.A.S, CMD, JVVNL) was the chief guest. People from different walks of life such as retired IAS, RAS, scientists, media persons participated in it. After the initial round of introduction Laure Larroquette and Ramachandar B S made the presentation on the theme.

Here is a simple fact: human society cannot exist without energy. Whether it is the use of human energy as the original source of energy or that of fire, the energy of flowing water and wind, that of coal, steam, oil, electricity and gas, access to energy has always underpinned the development of any society, would it be economic or social. Yet 2.7 billion people still rely on traditional fuels to cook and heat their homes and 1.4 billion (17% of the world's population) people still have no access to electricity; 85% of which live in rural areas.

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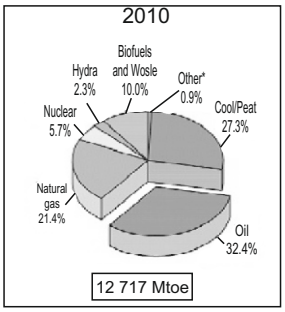
1. Types and sources of Energy

Over the last 200 years, the majority of our energy has come from non renewable sources such as coal, oil, natural gas or nuclear source. Those resources are called non renewable as they are finite and will one day run out. Moreover, environmental impacts of these energies have started worrying societies around the world. In reaction, a new type of energy has been developed during the past decades: renewable energies, carbon emission free and relying on infinite resources such as wind, solar, hydropower, bioenergy or geothermal energy.

Figure 1 presents the share of each fuel in the world energy supply.



*Other: wind, geothermal, solar, heat,...

Figure 1 : Fuel share of World Total Primary Energy Suppy[1]

As can be seen in Figure 1, non renewable energies represent the major part of our energy supply (87%). Table 1 shows pros and cons of the use of non-renewable and renewable energies that can explain this choice in energy source. The high efficiency rate of non renewable energies in particular explains why our societies still rely so much on those despite the growing concern for their environmental impacts.

Type of Energy	Pros	Cons
Non renewable energy	• Efficiency • Large power-generating capacity able to meet industrial and city needs (easy upscaling) • Continuous power • Coal and oil are easy to handle and transport • Mature technologies, ready for market • Mitigation measures for environmental impacts ("clean coal", waste disposal for nuclear waste,…)	• Finite resources • Environmental impacts ✓ GHG emissions ✓ Disturbance of habitat by mining and drilling (land and sea) ✓ Threat of oil spills and explosions (gas exploitation) ✓ Disposal of waste (nuclear, coal ashes,…) • Social impacts ✓ Risks in mining and drilling ✓ Nuclear radiation from nuclear and coal plants ✓ Asthma and lung cancer • Nuclear plant: expensive • Legal proficiency regarding damages • Targets for terrorism (large scale power generation structures) • Dependency on imports of energy
Renewable energy	• Renewable and widely available • Can be used almost anywhere (in theory) • Can be domestically produced for energy independence • Less environmental impacts ✓ Non-polluting. Carbon free except for production and transportation of material for infrastructure ✓ No fuel to drill, frack, mine, transport or burn ✓ Reuse of waste (bioenergy) ✓ No waste disposal issues	• Low efficiency (except for hydropower and solar thermal energy) • Intermittent source (except for hydropower) • High upfront costs • Limited scalability • Social impacts ✓ Disturbance (visual, aesthetic, noise, …) ✓ Relocation, loss of income, activities, culture … due to dams ✓ Bioenergy: competition with food production • Environmental impacts ✓ Loss of biodiversity: birds and bats (windmills) and fishes (dams) ✓ Dams: disruption of the natural flow of rivers, erosion, landslides, serious geological damage, major flooding ✓ Windmills: local change of temperature (mixing of air) ✓ Geothermal: water usage and sulphur dioxide emissions

Table 1: Pros and cons of the use of non renewable and renewable energies

2. Energy and Economic Growth

Energy is a major intermediary input in production and thus in economic growth. The question that arises is: does energy availability and quality drive economic growth or is energy use only a side effect of growth?[2]

What has been observed is that there is a simultaneous increase over time in energy use and GDP globally and in individual countries as can be seen in Figure 2. But the relationship between GDP growth and the increase in energy use has not been clearly defined yet. Nevertheless, industries and individuals feel the need for better energy efficiency and a shift to higher quality fuels. The two reasons behind this are obviously that of reducing costs in energy but also the fear of energy bankruptcy.

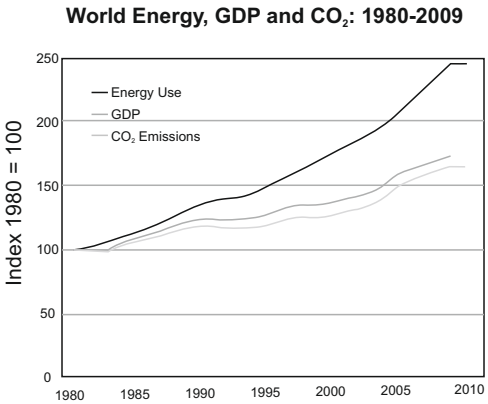


Figure2 : World energy, GDP and CO_2 evolution from 1980-2009[2]

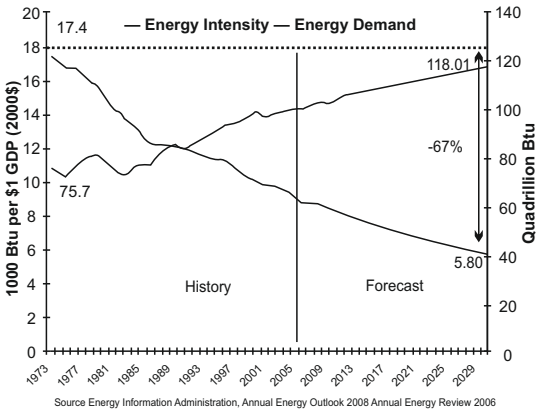


Figure3 : Energy intensity and demand for energy in the U.S. economy, 1973-2005[3]

Let us notice that "increasing energy efficiency" is not synonymous of "Reducing energy consumption". Figure 3 shows clearly that even if energy intensity (the measure of the amount of energy it takes to produce a dollar's worth of economic output) decreases, energy demand is still growing. It is quite easily understandable: imagine you were to buy a car with better fuel efficiency than your current one, would you use it more, or would you use it less? Industries' answer: we will use it more. Indeed, greater energy efficiency means more energy for the same cost so more production and more profit.

Energy use has then impacts on economic growth but economic growth itself calls for a growth in energy requirement that also has economic impacts:

- Huge investment outlay in energy production and distribution infrastructure to meet the demand (USD 1000 billion in next 10 years for India to meet just the electricity generation infrastructure)
- Higher dependency on import energy that can be a threat to economic stability itself

3. Energy: environmental impacts and climate change

The two main environmental impacts of energy use are depletion of natural resources and pollution. Table 2 displays most of the impacts of energy use on natural

resources and shows that in 120 years maximum, all our current non renewable resources will be completely over and societies will have to rely on other sources of energy to keep their standard of living.[4]

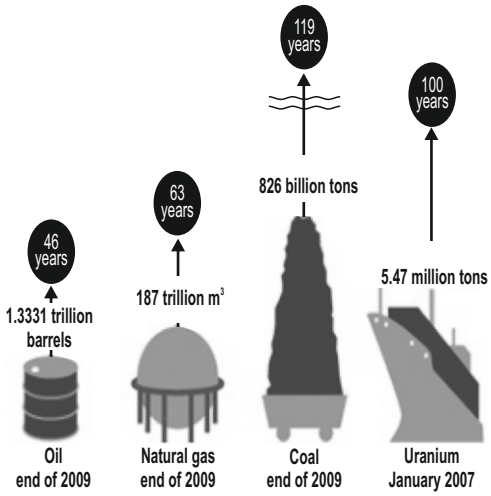
Depletion of non renewable resources[5]	Other impacts on natural resources during energy production[6]
	• Deforestation • Destruction of land and sea habitat (mining, fracking) • Water use : 66 billion cubic meters (bcm) annually today meant to increase to 135 bcm by 2035 • Air pollution ✓ GHG emissions (burning of fuel, waste disposal,…) ✓ Urban air pollution due to increased fuel use in transportation ✓ Acid rains – SO2 emissions in South Asia and South East Asia are expected to grow 150% and 200% over 2002 by 2030 under certain growth scenarios • Water pollution ✓ During drilling/fracking/mining activities ✓ From industrial waste ✓ Due to waste disposal (leachates in groundwater)

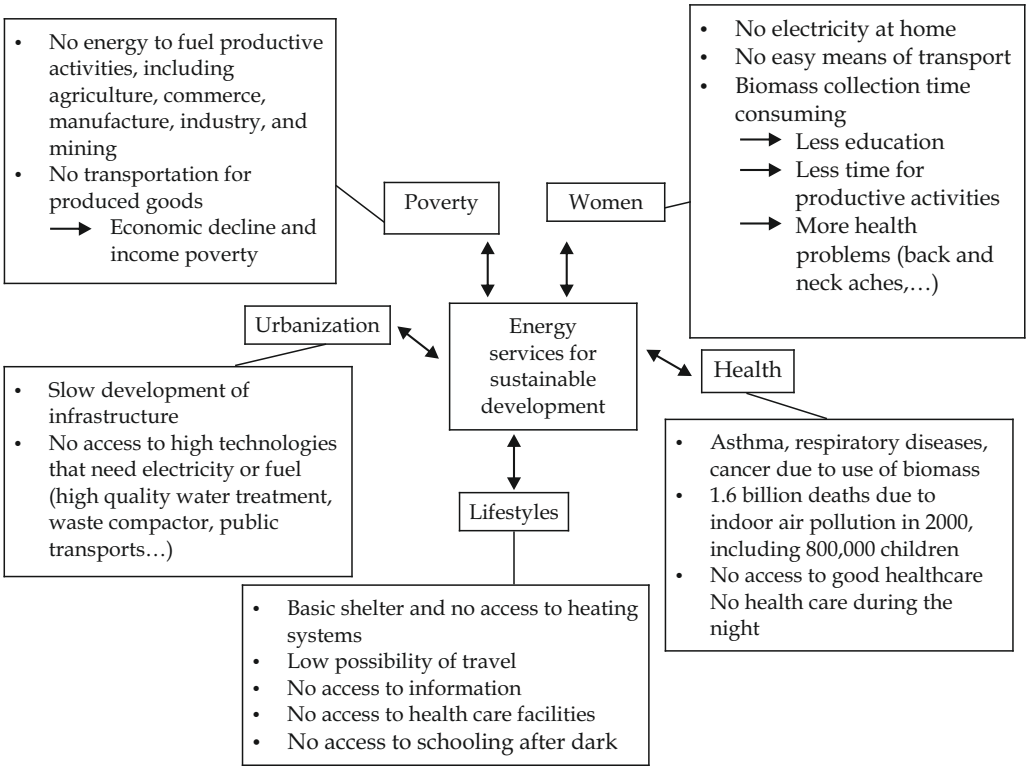
Table 2 : Impacts of energy use on natural resources

Moreover, it is now acknowledged that climate change will impact the resources and thus energy consumptions patterns. Indeed a change in temperature will change energy consumption habits (fuels for heating, air conditioning,…), peak demands and the efficiency of power production (cooling issues). It will also affect the water resource and its availability, potentially causing problems to cool energy production plants, to grow crops for biomass and biofuel energy and reducing the efficiency of hydroelectric power plants. More energy might also be needed to provide water itself. Sea level rise, storm surge, and extreme events may damage infrastructure and thus disrupt the supply of natural gas, oil… It may also create problems in fuel transportation (import/export). The melting of the Arctic Cap is also a growing concern as it will lead to a race for oil deposit that might start political conflicts around the world. Last but not the least, climate change will, of course, have direct impact on renewable energies and their efficiency as they all come from climate dependent resources.[7]

4. Energy and Social Development

Energy services are crucial in the provision of basic human needs such as adequate food, shelter, clothing, water and sanitation, medical care, schooling and access to information. Poverty is the inability to meet those material needs and is often measured thanks to monetary indicators.[8] This poverty is also called income poverty. Nowadays it has been accepted that energy is also essential to live and thus energy poverty has been defined as the minimum energy consumption needed to sustain lives. ten years ago it used to relate to a lack of access to electricity only.[9]

Figure 4 : Social impacts of energy poverty



Lack of access to proper energy has a lot of social impacts as can be seen in Figure 4 above. For those reasons, there is a real need to integrate the poor in energy issues in national energy and economic planning at the national and local level. Initiatives already exist such as

- Subsidies encouraging low consumption devices by providing infrastructural support and make payments per poor household served
- Partnership with the private sector to provide capital, entrepreneurship and linkages to modern technology providers through public-private partnerships
- Policies providing lower prices for the "first kWh" used so that poor people can access the minimum energy amount required to live.

Studies have also shown that people are willing to pay for high quality fuels when they can. It shows that energy is one of people's priorities for comfort and that financial measures can be taken to help solve the energy poverty problem.[10]

5. Energy and politics: the energy "conflicts"

Access to energy emphasizes development inequalities as it is strictly limited to the countries of the "South": countries from Africa, Latin America, Middle East, South Asia and Indonesia.[11]

In addition, energy self sufficiency and the pending dependency on energy import also create gaps between countries and can lead to major conflicts as energy

becomes a weapon in the hands of those who can export and control it. This is for instance what recently happened between Israel and Egypt when Egypt decided to cut off Israel's natural gas supply. Officially, this decision was taken in response to a dispute over Israeli payments for Egyptian gas but many saw in that move a will from Egypt's new government to demonstrate its disagreement with the Israeli U.S.-supported regime.[12]

Ownership issues over resources are also a major cause of conflicts as most of the natural resources are trans boundary. Conflicts over oil and gas have been witnessed recently between Sudan and South Sudan since they seceded in 2011 or in the South China Sea between Philippines and China.[13] Conflicts over water are also very common. India itself has been involved in two major conflicts:

- With Pakistan over the water from the Indus basin (China, Afghanistan, Pakistan and India). The World Bank had to intervene as a third party and an agreement over the use of water, the Indus Water Treaty, was signed in 1960
- With China over the water from the Brahmaputra basin (China, Bhutan, India, Nepal and Bangladesh) as China has been wanting for many years now to divert water from the South of their country up to the North where water is lacking (South-North Water Diversion Project). This would, of course, deprive India from an important part of its current water supply and have huge environmental impacts in the Indian part of the basin (downstream area).

Other renewable energies (solar, geothermal, wind) have this great advantage that even if they are "transboundary resources", they are infinite and thus no source of conflicts.

6. Energy: the case of India

India is the first country with the largest population without access to electricity or improved fuel for cooking as shown in Figure 5. Indeed, as per 2013 Energy Statistics data,[14], 293 million people have no access to electricity in India. Respectively 62.5%, 12.3% and 10.9% of rural households use firewood, crop residue and cow dung as primary cooking fuel.

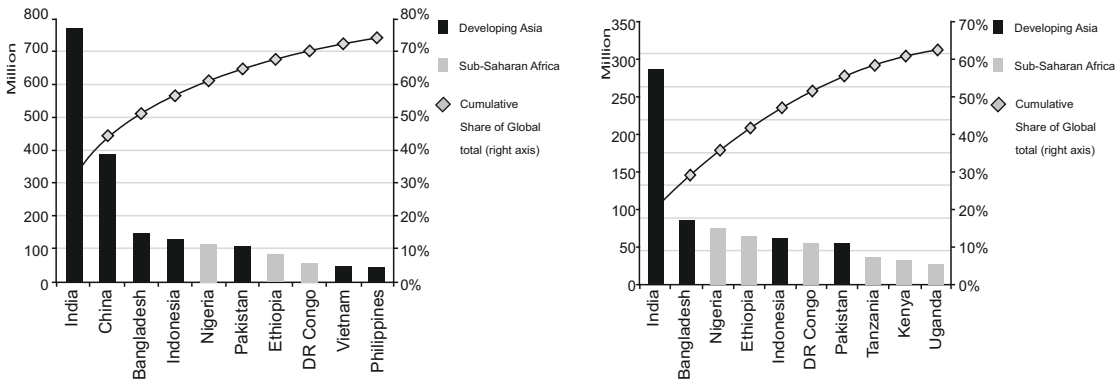


Figure 5: Countries with the largest population with no access to electricity (left) or improved energy for cooking (right)

India's per capita energy consumption only represents 1/5th of the global average because of poor access to facilities. It is an economy primary based on coal (52%) and oil (30%) consumption. Gas only represents 10% of the total share in energy consumption when hydroelectricity and nuclear energy combined represent less than 3%. It is also highly dependent on import (the imported component of oil is 1.8 times that of the amount produced!) which could be a concern for future energy security.[15]

The three main challenges for the energy sector in India are:

- To reach the poorest as 69% of the population lives in rural areas and 17% in slums. Those people often do not depend on commercial sources to meet their energy needs and live in areas either remote or difficult to access for infrastructure[16]
- To sustain 9% GDP growth which means creating 6.5% growth in energy supply
- To sustain its natural resources. Indeed, India still disposes of an abundant quantity of coal but it is mainly constrained to regional locations and poses some environmental concerns as seen above.

Nevertheless, India has a good energy production capability: it still disposes of 30 years' supply of natural gas at current consumption rate and could produce up to 50,000 MWs through nuclear power, enough supply for a few thousand years! Up to 90,000 MWs could also be generated through renewable energy as can be shown in Figure 6 but this requires investment in technological innovation and infrastructure that are yet to come.[17]

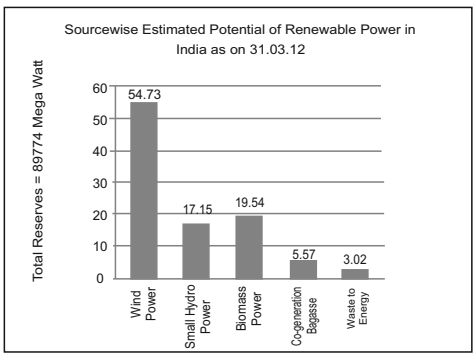


Figure 6 : Estimated potential of Renewable Power in India (2012)

Moreover, specific climate conditions in each state make the distribution of renewable power inhomogeneous: a study reveals that Gujarat would have the highest share of it of about 13.91% (12,489 MW), followed by Karnataka with a 12.3% share (11,071 MW) but that Rajasthan's share would only be of 7%, mainly on account of wind power potential.

Future critical energy technologies to develop in India are then

- Waste to energy technologies (ex: converting municipal wastes into electricity)
- Clean coal technology
- Exploration and exploitation of natural gas / gas hydrate resources
- Nuclear technologies (especially those involving utilization of thorium)
- Replacement of petroleum products in the transport sector by fuel cells, hydrogen, electricity etc.
- Development of improved solar photovoltaic and thermal systems

Only by fostering technological innovations, cooperation between companies, global partners, educational institutions, government and NGOs and developing a clearer regulatory environment in the energy sectors will India be able to face the energy challenges ahead.

Conclusion

Access to energy is said to underpin social and economic development but it is actually necessary to sustain lives themselves. In turn, protecting natural resources is then essential to sustain energy production and thus sustain lives. Energy access is still a challenge in the southern part of the world, especially in India, highlighting development inequalities and giving birth to political or economic conflicts over exported/imported fuel or transboundary resources.

India itself is a paradox: with a GDP per capita of $1492 and an economic growth rate of 6.2% in 2012, it still shelters 293 million people (i.e. 23% of its population) without access to electricity at all, the largest population in the world without access to this basic facility and 20% of the global share of people lacking electricity. Facing the depletion of its natural resources and the duty to comply with international norms on environmental pollution, India will have to invest in both energy conservation measures and technological innovation to bring electricity to its poorest inhabitants. Developing a clearer regulatory environment in the energy sectors including coordination and synergy amongst ministries of the federal government and creating an investment climate including capital market regulation are also of prime importance for India to face the energy challenges ahead.

During the Consultation, Prof Vyas stated that conventional energy resources could only be used temporarily and emphasized the importance of social and economic viability of alternative sources of energy. For Prof A.K. Ojha, executive director IDM depletion of fossil fuel in parallel with environmental issues linked to conventional resources cry for a need to change for alternate fuel like waste to energy. He recognized the potential of nuclear energy but warned the participants against the risk associated with reactor meltdown and radiation.

Shri Kunji Lal Meena compared conventional and alternative sources of energy and defined the need for their technical development and thus the need to invest in research. Professor Usha Chandra from the department of physics of the University of Rajasthan, Jaipur insisted on the importance of partnerships between industries, government and research departments of the universities so that they all work and invest their resources in the same direction. There are currently several established networking tools at national and regional levels that create links between universities, business and research technology organizations but they are inefficient. These mechanisms need to be constantly evaluated, reviewed and updated, especially as innovations in terms of media change communication capabilities and expectations. Recently for instance the Department of Science and Technology (DST), Rajasthan, developed a free ball bearing for wind turbines to increase the revolution of the wings

but this innovative technology is still unused as they did not know who to address to have it manufactured. DST said they are ready to use their funds for the energy sector and suggested increasing collaboration with small and medium enterprises as well as with major corporate.

Dr Vivek Agrawal, Trustee Secretary Centre for Development Communication, Jaipur enlightened the participants on the potential of energy from municipal solid waste as it would tackle at once two of the main issues India is currently facing: that of energy production and that of waste disposal. Nevertheless, he insisted that health effects associated to this energy production should not be forgotten and need proper mitigation measures. The two main causes for health problems in producing energy from solid waste are due to the emission of toxins during the incineration process and the handling of solid waste. Studies show that health related costs for one waste worker are on average of ₹ 50,000 per ton of waste collected.

The need for education in terms of energy consumption and waste management and the need for integrated energy policies were also discussed. For Prof. Vyas, both can help solve conflicts and reduce resistance from political and local communities. Shri Kunji Lal Meena clearly stated that a rational energy policy is necessary to succeed in expanding new energy while achieving energy efficiency.

Last but not least, it was pointed out that the expenditure on energy import by India compares quite high to that of many countries as 7.3% of India's GDP is spent to import 33% of its total energy consumption when Japan for instance imports 90% of its energy and only spends around 3% of its GDP on it. Measures to reduce this cost such as using cheaper means of transport or reducing transmission and distribution losses for instance were suggested. Shri Kunji Lal Meena also stated that government subsidies should be reviewed in order to orient the energy future of India.

Finally, the biggest challenge in the energy sector around the world is the difficulty to adopt a holistic view of its development. India is no exception to that difficulty. Finding the right balance between all those aspects will be the only way to achieve global and local sustainable development.

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Economic Development in Asian Cities and Perspective in Terms of Solid Waste Management

Dr. Vivek Agrawal, Sahil Dhar and Lehar Arora

Abstract

There has been stupendous economic development of Asian Economies in the past three decades. However, waste generation in such countries has also risen exponentially. Asian Countries have imitated the economic progress of many of their more progressive western counterparts, but imitating the processes of waste management from the same would not be the right way to go ahead. Most of the countries have an existing informal sector which has been working in the unscientific waste transportation and dumping sector. The way forward is to organize this already existing informal sector which would lead to the massive upliftment of the weaker sections of the society. Organization of the waste management sector not only has social and technical benefits but also economic benefits because the organization of this sector leads support to ancillary, micro and small scale industries as a whole.

Introduction

In the last two centuries Industrialization and Globalization have been the primary reasons for change in the social and economic conditions of human beings in various parts of the world. Developed countries have been on the forefront of these phenomena and are being closely imitated by developing countries on the same path. However, this rapid globalization and industrialization has also given birth to consumerism which has completely changed our life style. The Consumerism movement is essentially economic materialism whereby, we as consumers are bombarded with new product placements which might not be needed in the first place for simple living. Waste generated by this rapid urbanization and consumerism has been a continually growing problem at a local, regional and global level for all the countries. Apart from the changing economic fortunes of the countries which have been a part of rapid urbanization it has also brought forth the problems of increasing waste and refuse generated after using the products. The more developed a nation is the more serious is its commitment towards the concept of waste management. On the other hand, in developing economies, the emphasis of proper waste management is very recent and historically, they have been dealing with waste as a sanitation problem, in which the emphasis is on displacing waste rather than following the process of waste

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management which targets the concepts of 'reduce, reuse and recycle' and has zero waste, clean energy and maximized material recovery as its ultimate goals.

The basic difference between waste management being done in developed countries vis-à-vis their counterparts in developing countries is the fact that the former do it in a more sustainable way than the latter. Since, developing countries aspire to make sweeping changes to their socio-economic status and become developed countries, they need to address the issues relating to the final disposal of solid waste. Solid waste disposal has become one of the essential elements of strong economic future and as countries become more developed they realize that the waste being generated is an opportunity rather than a cost, and move into the practices of scientific waste management rather than archaic concept of sanitation towards waste. The Economic justification for dealing with waste is multi-pronged. Apart from the obvious public health issues which a nation can face, it can cause many related ill effects to the country's image and tourism.

Perspective of Asian Economies on Solid Waste Management

The Asian Subcontinent is the largest continent with the largest population among land masses on the earth. When we look at the economies of these Asian countries most of them, even though each country is diverse in terms of culture, environment, historical ties and government systems, share many common traits such as high population density. Most of their economies are still in the 'developing' stage and have unequal segregation of wealth in their societies, have health and hygiene issues as their Achilles heel and so on. If one looks at the way most of these developing economies have been dealing with their waste in the past centuries, one notices that the "waste" is generally managed by a certain section of the society. If we look at the economies of South Asian countries like India, Pakistan, Bangladesh, Nepal, Sri Lanka, Malaysia, Indonesia, etc., they have particular sections of people who deal with the issues of rag-picking, sanitation and dumping of waste and who have been doing this for many generations. Most of them are social outcasts, or people who have not been able to break free from their 'inherited' jobs. These jobs not only pose tremendous health hazards like respiratory infections but also highlight the fact that health is obviously not a priority. These jobs at present are the last resort of the poorest in the society, however, this informal sector consists of original recyclers who could be amalgamated in the organized sector. Asian perspective is not only about effective and scientific implementation of waste management processes but also about the upliftment and empowerment of those who have traditionally been a weak point in the societies of these countries.

Another common trait of dealing with waste in all these countries is the fact that 'waste' as a term has a lot of negative connotation. It is primarily looked upon as a polluting agent and something that is not required, also as something that should be displaced and dumped if it is generated. We have to realize that waste could be a resource. Since it is going to increase in future, rather than looking at waste as an entity which comes with cost, it needs to be seen as a big opportunity for resource generation

and boosting economy. Effective waste management ensures that waste is explored as a resource, which can be further tapped for recycled materials, clean energy and employment apart from the obvious fact that our societies become cleaner and healthier. The fact that waste is useful has been realized by many developed economies which can be proved by the fact that waste trading is becoming an industry in itself whereby countries have started to trade with each other. Examples of countries such as Sweden which import waste for energy generation are trends which will only become more frequent and larger in scale as more and more countries expand their economies.

The western countries have some common aspects which bind them together in terms of waste management practices which are being followed. For example, all the countries have heavily mechanized processes for waste management. Asian countries, on the other hand employ thousands and millions of people in the highly unorganized, fragmented, archaic sector of waste and sanitation. So, for the Asian countries to simply copy and paste the western model would be a huge mistake and would give rise to other societal problems. Asian countries are unique and so are their problems. If they would mechanize at the same level as their European counterparts, it would result in unemployment of the unorganized sector and would increase the hunger index and correlated crime rate. It is important for the Asian countries to find sustainable solutions to their waste management problems, the way forward is to convert the informal sector into an organized one. Doing so would not only ensure empowerment and training of the already existing people but would also attract new professionals to the sector. This would also result into upliftment of the people and better hygienic practices for them. On the down side having high employment compared to mechanization could be a threat to the health of people involved in the sector. Thus, just ensuring that the sector becomes organized and people employed get dignified jobs is not enough, one would have to ensure that stringent health and sanitation guidelines are prepared and followed by the people involved. The waste management sector once organized has a bright future because of the fact that rapid urbanization and development is bound to exponentially increase the waste generation. Thus, this sector is always going to need more people, effective processes and better management techniques. Organization of the sector also brings the benefits of better trained human resources and a bright future for waste management professionals.

Organizing the sector is a process and the first step in the process is good governance and stringent yet flexible guidelines which would set the boundaries and references for the future players in the industry. Benchmarks for the authorities and organizations involved have to be defined and the various practices relating to hygiene have to be made mandatory. For example, in developed countries which are more efficient in waste management, strict rules for municipal governance have been defined and they even penalize not only those organizations which default on the set guidelines but also the local citizens, if any rules are broken. Governing guidelines help in establishing an attitudinal change on the part of the organizations and even the common man. For example, once the rules for Municipal Solid Waste Management

were notified in the year 2000 for India, much improvement and awareness have taken place and waste management has started to be considered as something of importance. This however, does not take away the fact that India is lagging behind in issues of waste management.

Way Forward for Asian Economies

In Asian economies the process of waste management has been carried out by the informal sector for centuries. The informal sector is a big opportunity which can be tapped to put the Asian economies in a position where they could empower the people constituent of the informal sector. Taking the example of some other economies like Argentina where the existing informal sector has slowly started changing, can be implemented in Asian economies in a similar manner. For example, the local governments can begin by recognizing the contribution of this sector to the economy, by supporting other businesses such as scrap trading etc. This transformation of the informal sector to organized one is not only going to result into better income for the waste workers but also more recognition and social visibility. To organize the sector, private participation also needs to be facilitated. Scope for private sector participation in waste sector in countries like India where only 8-9% of the total waste is currently being disposed off scientifically is huge.

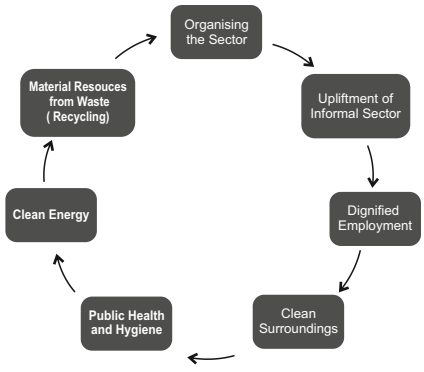

Figure 1: Benefits from the Organisation of the informal waste sector

India	Argentina
Rag Pickers – "Kachrewala" "Kabadia"	"Carteneros " starting to transform into "Urban recoverer"
Informal sector is STILL unorganized	Informal Sector is beginning to be ORGANISED
Low Income, Social Outcasts	Better Income, Social Recognition
No visibility in contribution to Economy	Recognition for contribution to the Economy

Table 1: Comparison of the solid waste sectors in India and Argentina

If we look at the GDP per capita map of the Asian economies, we observe that most of the Asian economies have their per capita income below US $ 20000. GDP per capita has a direct correlation with the waste being generated in an economy. Going by that reasoning, most of the economies due to their emerging state are going to face the problems of a burgeoning waste generation in near future because they are on the path of becoming bigger economies. Thus, to make the way forward easy in the context of waste management, it is high time for all these countries to start taking steps to address this future potential problem. This supposed bottleneck and threat could be converted into an opportunity if addressed in the right way. The right way is not to simply copy western economies but to play on strengths, which in our case is the INFORMAL sector.

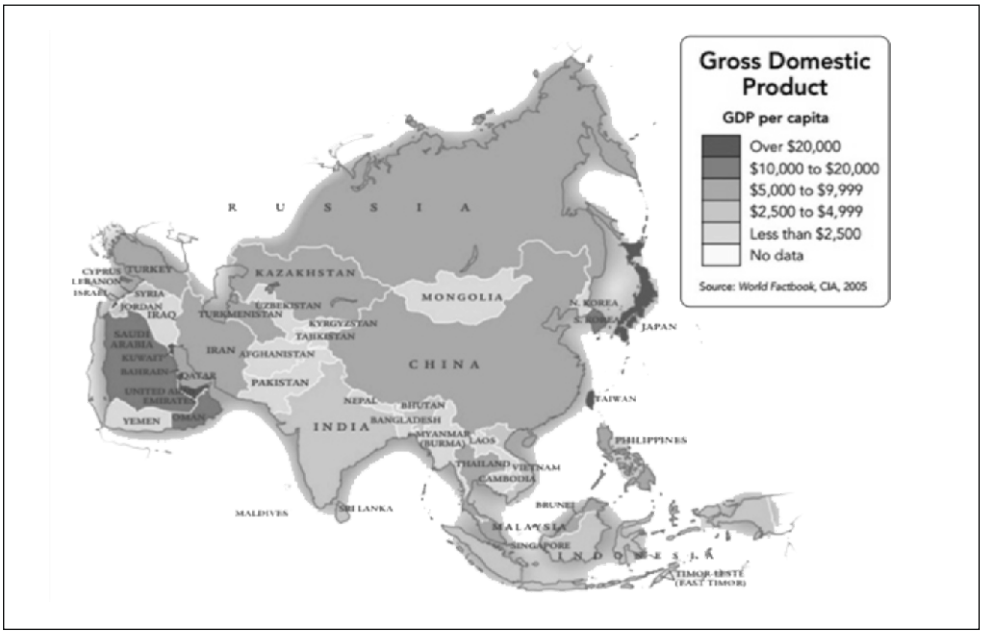

Figure 2 : Gross Domestic Product of Asian Countries

Conclusion

The practices of the waste management industry are still archaic in the context of developing countries, whereby, all the processes which are being followed are essentially a part of the sanitation processes. The implementation of the scientific methods of waste management at present is bare minimum. The way forward is not only to change the mindset of the people involved but also make them realize the opportunities that lie in the waste management sector itself and the kind of social change it could bring through its effective implementation. The sector not only has the potential to be sustainable in itself, but also has widespread opportunities for people, governments and the country itself. The economic and social impact of waste management practices have been seen in the context of more developed countries, and it is high time that Asian countries realize the same, albeit customizing them in their own context. They have to use the huge existing informal sector and convert it into an organized one which would result not only in the achievement of ultimate goals of cleanliness, clean energy and resource maximization from waste but also result in the upliftment, dignified employment and empowerment of the people who have been involved in this business for generations.

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Unsafe Abortions and Maternal Mortality in India

Dr. Abha Sharma

Abstract

Unsafe abortion is one of the most neglected health issues in India. Unsafe abortions are reportedly killing a woman every two hours in the country. Recognising the preventable nature of maternal deaths and morbidity due to unsafe abortions, the Indian Parliament passed the MTP Act in 1971 to enable women to seek abortion for many indications. Yet unsafe abortion is the third leading cause of maternal mortality in India, leading to 8 per cent of all maternal deaths annually. Ironically even over 40 years after the implementation of a liberal MTP Act, unsafe abortions continue to outnumber safe and legal abortions in India. It is a well documented fact that despite the existence of the MTP Act rights of women and girls to life, health and development are violated when they go through an unsafe abortion. The morbidity attributable to unsafe abortions is extremely high and still 80 per cent of Indian women are not aware that abortion is legal in India.

Acronyms/ Abbreviations

ANMs: Auxiliary Nurse Midwives, MMR: Maternal Mortatlity Rate, MTP: Medical Termination of Pregnancy, MVA: Manual Vacuum Aspiration, PCPNDT: Pre Conception and Pre Natal Diagnostic Techniques, PHCs: Primary Health Centres

Introduction

The Medical Termination of Pregnancy Act came into force in India way back in 1971 to provide women the access to abortion services under certain specified conditions. Yet, it is a great irony that millions of women who need these services are denied their right. It may sound strange but it is true that more than 80 per cent of Indian women still do not know that abortion is legal in the country.[1] Approximately, out of the 6.4 million abortions taking place in India each year, around 3.6 million (almost fifty percent) take place in highly unsafe and unhygienic conditions by untrained and ill-qualified backstreet providers.[2] Some experts feel the abortion rates may be under-reported.

Unsafe Abortions and Maternal Mortality in India

India recorded 6.5 million abortions (of the total 10.5 million abortions in the South and Central Asia region) in 2008 out of which 66% were deemed unsafe. There were 620,472 reported abortions in 2012; experts say the true number of abortions performed in the country could be as high as 7 million, with two-thirds of them taking place outside authorized health facilities. As a result 8 per cent of all maternal deaths in

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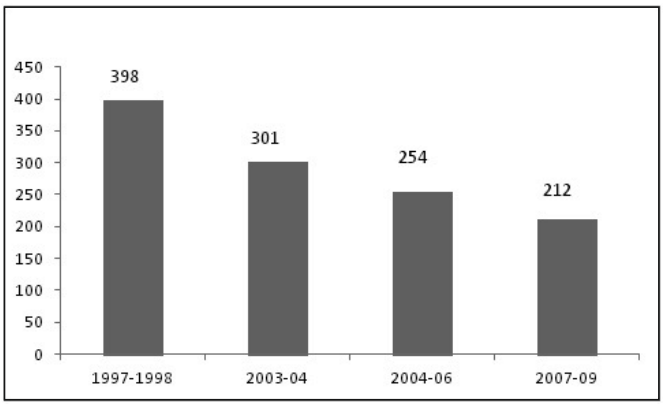
India are due to unsafe abortion as per the Maternal Mortality Ratio (MMR) and Sample Registration System (SRS) data provided by Ipas, India, an international NGO working on increasing access to safe abortion services. Unsafe abortion is the third major cause of maternal mortality in India but morbidity attributable to unsafe abortions is even more important. As per the data available with the Registrar General of India, the present maternal mortality ratio in India is 212/100,000 live births. Though mortality rate from unsafe abortions has slightly declined as compared to the 12% reported in 2001 but the morbidity rate from unsafe abortions continues to be still quite high. Unfortunately, there is no countrywide data available on unsafe abortion related complications. Figures made available by Ipas from a 2003 national facility survey are alarming. As far as accessibility of safe abortion services in the public health system where MTP is available is concerned, only 73 per cent district hospitals in major states of the country had this facility.

While India's MMR has declined from 254 per 1,00,000 live births in 2004-06 to 212 in 2007-09, no recent incidence study provides data after 2002-03 on unsafe abortions. Ipas had made the observation using national census and SRS data that one woman dies of abortion-related causes every two hours in India. India has been quite vocal in expressing shock on Savita Halappanavar's death in Ireland. But the country itself has a shamefully high death rate due to unsafe abortions or lack of availability of abortion services.

Trend in MMR in India:

Figure 1: Trends in Maternal Mortality Ratio (1997-2009) in India



Source: Provisional Population Total, Paper 1 of 2011. Census of India 2011 and special Bulletin on Maternal Mortality Ratio in India 2007-09

The availability of trained providers and facilities is also very low in many states particularly, Rajasthan, Madhya Pradesh, Bihar, Jharkhand, Uttarakhand and Maharashtra compared to other states in India. A recent survey conducted by Ipas India in five states looked at the perceptions and practices of providers, men and women and chemists with respect to medical abortion.

Abortion: legal,yes,but available?

For rural women PHCs are the first contact points but unfortunately not all PHCs and community health centres provide MTP services. In such a situation rural women

are forced to attempt abortion at home through medication, homemade concoctions and traditional methods with the help of untrained providers or traditional practitioners.

A number of community based studies have also revealed that all unsafe abortion related complications may not be life threatening but still tend to cause disruption in the lives of women.

Table based on studies on unsafe abortion:

Location	% of women reporting morbidity	
Madhya Pradesh (ICRW 2001)	56.80%	
Maharashtra (CEHAT 2003)	63.10%	
Maharashtra (KEM 2000)	67%	6% life threatening 3% of all maternal deaths
West Bengal (DFID 1999)	48.30%	Nearly half of them severe
Tamil Nadu (Ramachandar & Pelto 2002)	24%	Just over half of them severe
Pondicherry (JIPMER 1999)	41.80%	24% needed hospitalization

Abortion was never illegal in India even before the MTP Act came into force. Therapeutic abortion to save the life of mother was always legal. "In India, induced abortion or medical termination of pregnancy is permitted under section 312 of the IPC and the MTP Act. Yet of the 4 to 5 million abortions that take place annually in India, more than two-thirds of them are illegal and performed outside the statutory provisions of the MTP Act by untrained, unskilled persons and are performed under highly unhygienic conditions."[3]

The table 1 below summarizes findings from several different community based studies that looked at how many women were aware of the MTP law:

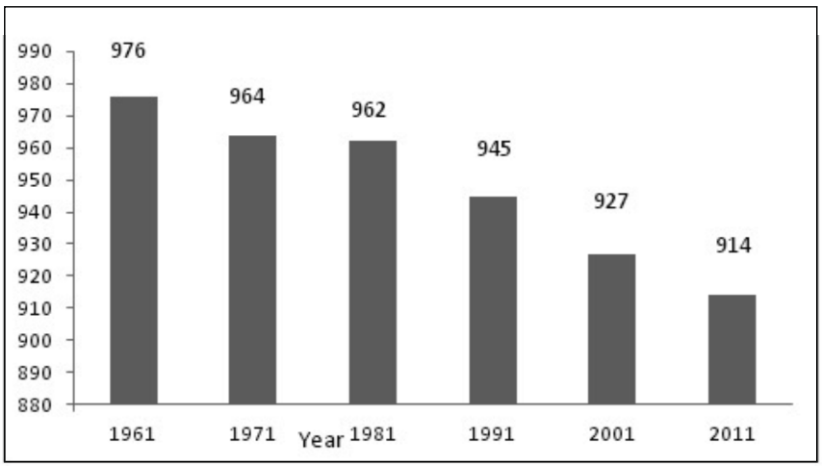
	% of women who did not know that MTP was legal
Jharkhand (Ipas 2007)	82%
Rajasthan (Pop Council 2002)	84%
Madhya Pradesh (ICRW 2003)	49%
Maharashtra (KEM, 2000)	37%(all of whom had just had an MTP)

Table 1 : Women awareness of the MTP Law from several different Community based studies

Declining Child Sex Ratio:

The latest census (2011) data reveals no happy tidings on the child sex ratio front. It reveals a dismal picture with the child sex ratio of 914 females per 1000 males. This is down from 927 in 2001 and 945 in 1991. It is a well known fact that gender biased sex selections exist in the country in order to get a boy. The preference for boys, many times called as the "son syndrome" is due to the socio-cultural and economic reasons inherent to Indian society. It is another manifestation of gender discrimination but many times illegal use of diagnostic techniques perpetuate injustice against women.

Figure 2 : Trend in Child Sex Ratio (1961-2011)



Crackdown on Ultrasound Machines and denial of Safe Abortion Services

The PCPNDT (Pre-Natal Diagnostic Techniques (regulation and prevention of misuse) Act came into force in 1994 to prevent selective sex determination. It was amended and renamed as Pre-Conception and Pre-Natal Diagnostic Techniques (Prohibition of Sex Selection) Act in 2003 to make it more comprehensive in view of the rapidly changing technology.

In addition to the deep rooted socio-cultural factors for son preference, easy availability of ultrasound technology is considered to be one of the prominent causes of skewed sex ratio in India. The name of ultrasound machines has almost become synonymous with sex selection resulting in crackdown on unethical sonography clinics across the country. It has, however, resulted in unfortunate side effects. In many cases, this well meaning drive to curb gender biased sex selection has made it difficult for women to access a safe abortion, even in cases of genuine need.

With such curbs, women always face a growing threat of restriction to access to abortion, especially second trimester abortion as they fear to be thought guilty of terminating pregnancy for sex selection. Most common reasons/situations when most women opt for abortion are:

- they cannot afford another child
- contraception failure
- rape or pre-marital pregnancy

though it cannot be denied that two to four percent of all abortions taking place in India are indeed son selective abortions. According to a United Nations Population Fund 2011 report, 4.6 per cent of all female births did not occur due to pre-natal sex selection.[4] Though awareness of family planning is not bad among women, they are not always able to adopt birth control methods either because of cost, non-availability or lack of permission from husbands apart from fear of side effects. Additionally, women are hesitant to visit public hospitals because of long waiting times or unsympathetic attitude of staff or because doctors insist on the husband's signature.

Contradictions and Ambiguities

The contradictions in laws and rules also add to women's woes. On the one hand, there is an important promotional literature of two of the most commonly known abortion pills- MIFEPRISTONE and MISOPROSTOL—these are to be distributed for abortion at home. On the other hand, this is contrary to the provisions of the MTP Act, which specifically stipulates that MTP can be done only in an approved centre. An abortion induced in contravention of the MTP Act is punishable under Section 312 and related sections of the Indian Penal Code.[5] Due to media reports highlighting skewed sex ratio and govt. action on erring sonograhy clinics, the Drug Enforcement agencies have also intensified their action. The chemists are not supposed to stock these drugs beyond the permissible limit and patients are required to supply personal information before buying the medicine. The social stigma attached to abortion in Indian society also makes things worse. All doctors are of course, expected to follow the law and maintain proper documentation but due to ambiguities in the interpretation of PCPNDT Act by the regulating agencies, many times doctors are wrongfully taken to task. Therefore, even the doctors do not feel inclined to take up abortion cases for fear of being booked for having conducted sex selective abortion.

Creating an enabling environment

The WHO has defined unsafe abortion as "a procedure for terminating an unwanted pregnancy either by persons lacking the necessary skills or in an environment lacking the minimal medical standards, or both" (WHO 1992).

Savita's death is one among 358,000 maternal deaths annually (based on 2008 WHO data) around the globe. Almost 95 per cent of all unsafe abortions occur in developing countries (WHO 2004) or where abortion is severely restricted in law and in practice. Globally, abortion complications constitute 13 per cent of all maternal deaths.[6] Each year about 47,000 women die from complications of unsafe abortion.[7] An estimated five million women suffer temporary or permanent disability, including infertility.[8]

As per the WHO almost all abortion related mortality is preventable if performed under medical supervision and through use of correct techniques in sanitary conditions. The government agencies and health system should ensure an enabling environment to respect, protect and ensure fulfillment of the human rights of women through comprehensive policies and regulatory mechanism.

Proposed amendments to the MTP Act

Since unsafe abortions still outnumber safe and legal abortions in India, voices have been raised to amend the law. Obstetricians and gynaecologists have also demanded amendments in the Medical Termination of Pregnancy (MTP) Act and the Pre-Conception and Pre-Natal Diagnostic Techniques (PCPNDT) Act to help doctors practice without problems while following medical ethics. At various medical conferences, doctors have emphasized the need to protect themselves from unnecessary harassment from regulating and implementing agencies like the health department or civic bodies.

Keeping in mind the recent medical advancements in the field of diagnostic technologies also, the Ministry of Health and Family Welfare has decided to examine

and amend the MTP Act. In this regard, the Ministry of Health and Family Welfare had appointed an expert group to examine the MTP Act and amend it to enable increased access to safe abortion services.

The amendments propose to:

- expand base of legal abortion providers
- increase access to legal abortion services for women
- increase upper gestation limit for legal MTPs
- increase clarity of the MTP law

A WHO study conducted in 2006 in Vietnam and South Africa looked at the safety issue in providing abortions using MVA and it was disclosed that nurses were able to provide abortion services using MVA just as safely as doctors. Therefore, the WHO brief recommended that "first trimester Manual Vacuum Aspiration abortions performed by government trained and accredited nurses, midwives and mid-level health care providers in South Africa and Vietnam were comparable in terms of safety and acceptability to those performed by doctors. Countries seeking to expand safe abortion services can consider an approach similar to that taken by South Africa and Vietnam." In Bangladesh even field workers are trained to conduct abortions.

The proposed MTP amendments in India are exactly on the lines of above WHO recommendations, at least in the case of expanding the base of legal abortion providers. It has been recommended to increase the base by including medical practitioners with Bachelor's degree in Unani, Ayurveda or Homeopathy. It is also proposed to include nurses with a three and half year's degree and registered with the nursing Council of India under the list of legal providers for medical termination of pregnancy.

Other hindrances

The operational barriers in the present MTP law limit access to safe and legal abortion services also by the fact that opinion of two service providers for second trimester pregnancies is essential. The proposed amendments will have the condition of one service provider only since in many situations two providers are not available.

Ever since the implementation of the MTP Act more than four decades ago, lots of technological and medical advancements have taken place. Late abortions are relatively safer than before so it has also been recommended to insert a sub-section to allow termination of pregnancy necessitated in cases of foetal abnormalities.

The MTP Act needs more clarity and comprehensiveness and since proposed amendments recommend inclusion of Unani, Ayurvedic and Homeopathic practitioners as legitimate providers for abortion services, some terms like supervision of only "registered medical practitioners" will have to be replaced with "registered service provider."

Conclusion

Abortion has been legal in India for almost four decades now but it is still highly stigmatized in Indian society. A large number of women are forced to seek services of

untrained providers due to unavailability of safe abortion facilities, especially in rural areas. Various studies have shown that policy alone cannot have the desired effect as is evident in the case of MTP Act, which has failed to provide the safe abortion rights to Indian women. It is necessary to build a supporting environment to provide access to safe abortion and build community awareness on its medico-legal aspects. The country needs more medico professionals and mid-level providers to cater to the rural and town women and provide comprehensive abortion care. More ANMs (Auxiliary Nurse Midwives) and other grassroot health workers can also be trained to provide safe and comprehensive abortion care to women.

It is highly necessary to sensitize all stakeholders and collaborative action is needed to promote safe abortion and handle post-abortion morbidity. Policies should not only aim to respect, protect and fulfil the human rights of women: the issue of stigma and discrimination against women who seek abortion services need to be handled with utmost sensitivity. International, national and regional human rights bodies should recommend decriminalization of abortion and adequate provisions of abortion care to ensure the protection of women health and life.

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"People" Savy JDA Apathetic to "People's" Needs
—An RTI Case Study

V.N.S.Bhatnagar and Nishant Kumar Ojha

Abstract

JDA claims to work for the benefit of citizens but unfortunately who the citizens are has not been properly defined. Are they the automobile owners only or others too who may prefer to walk or pedal bicycles? The roads are being widened but for whom? The authors have analysed a case of RTI where the applicant had sought information from JDA regarding maintenance, upkeeping, broadening of roads, footpaths etc.,standard width of footpaths determined by the Authority, purpose of constructing foot overbridges; reasons for not allowing private buses in BRTS corridor etc.

Due to feudalistic behaviour of officials, the applicant faced many difficulties even in filing the application. Finally he wrote to JDC, then only his application was entertained. His application was sent to all zonal PIOs since information was not available at the HQ. Most of the PIOs asked the applicant to appear in person before them for identifying the information and amazingly many technical PIOs did not even know the details of road/footpath constructions. The authors analysed that JDA does not compile important informations at some central point and record management is not proper. The feudal attitude of officials also makes things worse. The focus of JDA is on widening of roads but they have no consideration for the pedestrians i.e. the people. The JDA seems to be obsessed with VIPs or car owners only. The applicant has a firm faith that the JDA is a prestigious organisation and its image must improve. It should really work for the residents of Jaipur and not for a few upper class people.

Acronyms/ Abbreviations

BRTS: Bus Rapid Transit Service, CIC: Central Information Commissioner, HQ: Headquarters, JDA: Jaipur Development Authority, JDC: Commissioner JDA, MLA: Member of the Legislative Assembly, MP: Member of Parliament, PIO: Public Information Officer, XEn: Executive Engineer

Introduction

Right to Information Act 2005 intends to bring transparency and accountability in the functioning of public authorities and to bind the authorities to manage the official record properly. If someone studies the organizations on these parameters, findings would be perhaps eye-opening, amazing and awesome. Here let us discuss an RTI case of Jaipur Development Authority (JDA) which is *"committed to working for the benefit of the citizens of Jaipur… and it is consistently striving to take Jaipur at higher levels of progress"*.[1]

For the benefit of citizens, the applicant[2] under the RTI Act tried to make a request for seeking information on the following points:

V.N.S. Bhatnagar, Centre for Development Communication, Jaipur
Nishant Kumar Ojha, Assistant Professor, Jaipur National University, Jaipur

1. www.jaipurjda.org, JDA at a Glance, accessed on 29.07.2013

1. Five years' details (2006-07 to 2011-12) of development of and amount spent on maintenance, upkeeping, broadening of roads, footpaths, foot over-bridges and underpasses.
2. Standard width of footpaths determined by JDA for the city.
3. Foot over-bridges built and their purposes whether to facilitate pedestrians or advertisers by providing ad space. Also the way JDA monitors service providers so that they may not stop the escalators at their whims or convenience.
4. Number of under-bridges built during the period (2006-07 to 2011-12)and details of walkable space provided for pedestrians and also number and details of under-bridges exclusively built for pedestrians.
5. Reasons for not allowing private buses to ply in BRTS corridor.
6. Information about the data regarding ratio of road space being used by pedestrians, bus commuters and car users if available with JDA, on the basis of which the JDA plans the construction activities of roads and other facilities in Jaipur City.

The purpose for seeking the information was very simple and clear that the people or residents of Jaipur city could know the facts behind widening of roads, widening or reducing footpaths, the use of road space by different categories of road users and to conclude whether justice is being done to people in the city.

Difficulties in seeking information and misinterpretation of the Act by officials

Seeking information by the citizens, from JDA which boasts of *"working for the benefits of the citizens of Jaipur…."* [3] happens to be very difficult. The applicant who is the citizen of Jaipur sent a messenger to file the application on 21.11.2012. He was directed to get the application marked by the advisor/consultant sitting in cabin number 3. There he was advised to prepare more than fifteen copies of the application alongwith the postal orders for registration fee and then to deposit them to all zonal public information officers separately. He tried to persuade the advisor that the applicant desires to seek information from JDA head office and not from any individual zone but of no avail. On 29.11.2012, again the same behavior was met. Finally on 7.12.2012 the advisor gave him a slip and asked to visit the window number 7. There the official again asked to clarify the number of the zone. On 14.12.2012 he met a senior officer sitting in room number 17 but he couldnot help him deposit the application. Thus it took almost a month but depositing the application was not possible. Ultimately on 21.12.2012 the applicant wrote a letter to the Commissioner JDA to direct the PIO of the JDA to entertain the application and furnish the information. Perhaps the JDC sent the copies of application to all zonal PIOs as there was no central PIO for JDA.

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2. Applicant: A.K.Ojha a resident of Jaipur
3. "www.jaipurjda.org", JDA at a Glance, accessed on 29.07.2013

Thereafter the game or show began. The PIO number 10 informed on 11.01.2013 that "the information sought is voluminous and will require a lot of labour". Therefore, he directed the applicant to appear in person and identify the information for disclosure. To this the applicant clarified the points on which he had sought the information e.g. information number IV – *the standard width of the footpath determined by JDA* and he also explained that the reply could be very brief like *the width determined is, on major roads... (this much)..., on colony lanes...(this much) ... etc.* He also clarified that he does not want any photocopy of any document which may increase the burden of work on them, he simply desired to seek the information available at some centralized point. Even then if it was ambiguous and beyond their comprehension he was ready to visit the office of the PIO provided he had gathered all the information in crude form, but he never got any reply. The PIO of zone 12 who happens to be an Executive Engineer wrote on 11.01.2013 that he was unable to identify the information regarding *how many roads were widened or constructed anew*. For identifying the roads he asked the applicant to appear before him. This was again surprising that like the applicant, the PIO or the XEn was also ignorant about the roads which were widened or built anew. Similarly the PIO and XEn of zone 4 also couldnot understand what information the applicant had sought, so he also asked him to appear before him and indentify the information demanded. How surprising it is that even the technocrats in JDA, what to talk of generalists, are unable to understand the technical nuances of construction, widening, standard-width of footpaths etc. The PIO cum XEn zone 11 was also unable to understand the information sought regarding construction and widening of roads in his jurisdiction. Replying to the directions of PIO number 4 and 11 to appear before him, he gave clarification pointwise in simple language and sought some suitable time for appearing but no reply was received. The PIOs of zones 1, 1A, 2,6,8,9,11,13A, 13B and 19 also followed the suit. Stereotype replies were sent by them that they were unable to identify the information from the record therefore they asked the applicant to appear before them. The PIOs numbering 2A and 15 informed that the zones are new ones therefore no information was available.

The PIO and XEn of zone 3 gave a strange reply that "in the format the information sought is not available and the provision to get the information typed and then provide, is not there in the Act, therefore, the information is nil." Perhaps what he meant was that RTI Act means only providing photocopies of the record. The applicant was puzzled to get this strange reply and he wrote to him that if there is no provision of getting information typed he could have given information in hand-written note. To this he gave the final reply that section 20 (f) of the RTI Act provides that the copies of such information or such available information in copies can only be provided. His ultimate emphasis was only on photo copies . To this the applicant made it clear that the section never says so. The objective of the Act is to bring transparency and accountability and the information which cannot be denied to MP or MLA shall not be denied to a person. The PIO cum XEn zone 7 informed that as per section 7(9) it is not possible to disclose information.Perhaps he was worried about the scarce resources available with JDA.

The two-three page typing/writing could have diverted the funds which could have been better perhaps used for construction activities. Who will buy the argument?

Information Received

PIO and XEns of zones 5,9,14 gave some information regarding road widening and footpath construction but as far as the standard width of footpath is concerned they were not aware of it and passed the buck saying it is related to technical cell. The applicant replied and requested the PIOs to kindly forward the application to the concerned officer for informing the width as per the spirit of RTI Act rather than simply saying that it relates to some other cell. The XEn of project 1 was also kind enough to send the information regarding BRTS corridor. He sent the guidelines in this regard and informed that mini-buses running on Jaipur roads cannot be allowed in the corridor because they do not fulfill the standards prescribed for running in the corridor.

Whatever information the applicant could gather reveals that:

1. JDA does not possess or compile information at some central point, otherwise they could have disclosed the information in one go rather than asking the applicant to contact dozens of PIOs. In all, the zonal officers wrote 27 letters to the applicant spending ₹ 517.00 on postage and except three officers others revealed nothing. Imagine how much precious time of the officers and the applicant was wasted for a very simple information which could have been computerized in technical, planning and accounts cells and retrieved. Details of development of roads, footpaths, foot overbridges and under-bridges could have been given by the technical cell. Standard width determined by JDA and available data regarding ratio of road spaces being used by pedestrians, car drivers, bus commuters etc. could have been disclosed by planning people.
2. The way PIOs gave information, it appears that the JDA could not develop an effective system of record management which was envisaged in section 4 of RTI Act 2005. The record has not been properly computerized and connected with internet or they would have told the applicant to access the site for desired information.
3. There is no central PIO for JDA head office. Zone-wise PIOs have been designated who do not care for head office information, nor they forward the application to the concerned PIO for disclosing information as per the spirit of the Act.
4. The attitude of most of the PIOs is not positive towards the Act, nor they appear to believe in facilitating the citizens. Most of the PIOs give stereotype reply that they could not understand the references, the information is very bulky or ambiguous so they directed the applicant to appear in person before them and identify the information. The feudal mindset of them costs heavily on the JDA in terms of time, money, official activities etc, thus hampering their productivity. Their positive attitude could save a lot and make them model officers. Why they prefer secrecy or show their ignorance about technical details, even though they themselves are

engineers is not clear. How they admit that they are not aware of these things such as footpaths, roads, over bridges, under passes, standard width of footpath etc is amazing.

5. The information reveals that the main focus of JDA is on widening of roads. The emphasis on widening or constructing new footpaths is minimal. Since detailed information could not be accessed the ratio of who uses most of the road space could not be arrived at. Only the PIO of zone 5 gave some account of spendings on footpaths. In five years he spent about ₹ 209.11 lacs on them. It appears that footpaths or providing facilities for pedestrians is not on the priority list of JDA, perhaps JDA has deleted or forgotten them. They want Jaipur just a city of car users only. That is why *"…..JDA has been working on widening all main roads, construction of overbridges, under bridges and flyovers to regulate the traffic on roads….." and "to provide them with quick and hassle-free service".*[4] Many zebra-crossings stand closed on both the ends thus providing no space for landing or leaving the crossings by the pedestrians. This is being done to beautify the roads and to give faster speed to larger luxury vehicles. Perhaps the policy makers and administrators feel that only through XUVs on roads running *'hassle-free'* Jaipur can be made a world class city. Pedestrians are poor and sometimes not in fashionable super branded garments and shoes, how can they beautify the city or make it a world class! If the vision of JDA is fulfilled as per their information and website, Jaipur will be the only city in the world for cars and cars only with no space for pedestrians, cycle Peddlers, handicapped and senior citizens.

   People appear to be not important for them as they (JDA) work only for cars, though they boast of working for citizens. Are they the sale promoters of cars or facilitators to citizens who may also prefer to walk or children who may like to run free after the school bell rings long or people who may like to go for morning/evening walks or athletes who may like to practise in the morning or evening for long cross-country races?

6. Though sufficient information on foot overbridges was not provided, after going through whatever information was available and visiting some foot overbridges it seems that they are more pro ad agencies as they have more covered area for placing ads which walkers may not like for security reasons. Similar is the story of underbridges. Proper information was not provided. The applicant tried to visit some underbridges in Malviya Nagar and other places and witnessed that rarely some space was provided for pedestrians. They were all for automobiles.

7. JDA's love for automobiles is a very strange fact. Why it is so is not very clear. Perhaps they are obsessed with the upper class VIPmania which leaves no space for common citizens, although the poor guys also pay taxes for the urban development. Because of this obsession they never got any survey done regarding the percentages of road space being used by various categories of road users like

4. www.jaipurjda.org , JDA at a glance, accessed on 29.07.2013

car users, bus commuters, pedestrians, cyclers etc. Had they got the data they could have provided that. Nor they determined any standard width of foot-paths for Jaipur city.

8. Section 4 of the RTI Act makes it very clear that while taking decisions affecting public the reasons and facts for doing so should be given. Unfortunately why JDA takes decisions such as widening of roads, making flyovers and underbridges for automobiles only is not very clear. In BRTS corridor they would not allow private buses which are also used by city bus commuters. What is the hidden objective behind it is not clear. Perhaps they are not low floor buses but they are allowed to stop anywhere on the roads or on other bus stops which are also made for low floor buses. The other reason for not allowing them is that they are not rapid driven buses, but the fact which residents of Jaipur know that, they are always running rapidly and also in a haste. JDA while supplying information could not make it clear that BRTS corridor was conceptualized for bus-commuters or for some particular brand of buses or government owned buses only.

9. The PIOs appear not properly trained with regard to RTI provisions. Because of this reason they try to misinterpret the provisions and insist upon that RTI Act means providing only the copies of the documents or that they are unable to comprehend the desired information and ask the applicant to appear in person to mark the information, all in the hope to get rid of such information seekers. This way they generate more wasteful work and make complaint to the government to do away with the Act which only troubles them and impedes their conservative way of working.

Learning Points

With this perspective following learning points do emerge. These may be helpful in improving the systems, provided our officials are open to suggestions and willing to mend. The points are:

1. The feudal mindset of officials need to change or it will generate more wasteful work. It is simply clear that the government is not going to scrap the law and the activists will always pursue and pressurize authorities to become transparent and accountable in democracy. How unfortunate it is that due to this egoist mindset the PIOs sometimes raise nonsensical issues e.g. in one other case one of the zonal commissioners of JDA asked the same applicant to send a copy of his identity card duly attested by the notary for verification of his identity, though he personally knew the applicant very well. The reason for this unnecessary exercise and wasting of time is beyond comprehension. This resistance should be avoided and the procedures should be made simple and people-friendly.

2. JDA has so many zonal PIOs but no central PIO to provide general information. The Public Authority should designate some officer to function as a general PIO for JDA head office information in addition to zonal PIOs. This PIO could receive the application and after collecting information from various

sections of JDA, should try to provide the information to applicants. This would save the valuable time of zonal PIOs.

3. JDA should designate some person as Record Management Officer whose responsibility should be to organize in campaign mode, the record properly as per the spirit of the RTI law. The record could be computerized and made available on website which may facilitate the information seekers. All important information could be uploaded to facilitate viewers.

4. Though JDA has arranged many workshops and training programmes for their officials but it appears that they have not impacted upon them positively. Rather officers have learnt certain crooked tips to avoid the disclosure e.g. in some cases the CIC had upheld the orders of PIOs to invite the applicant in cases where information sought was very bulky and ambiguous. Now this formula is being frequently used by almost all zonal PIOs which has increased their work load. They do it deliberately just to laugh at the applicants during tea times. JDA should arrange proper trainings on RTI law outside their campus so that they may be freed from the sadistic environment and be able to grasp something new and positive. In addition to officers, the subordinate staff must also be given such trainings, as it is the lower level functionaries who actually run the business. Their mindset requires to be changed.

5. JDA should have periodical introspection consultations on their vision, aims and objectives. Academics, activists and other people should be invited in such meetings so that JDA could take correctional steps because the JDA always says that it works for people but amazingly sans people. Many objectives need revision e.g. widening of roads solely for automobiles is the priority but pedestrians, school children, athletes and morning/evening walkers are also the citizens of Jaipur. They also need some attention but that is missing.

6. JDA should conduct surveys from time to time regarding what percent of people drive cars, how many use buses, how many walk etc and how much road space these categories of people cover when on road. For example if 60 persons are using a bus, how much road space one such person uses while travelling, on the other hand one or two persons using an XUV vehicle and how much road space one such person covers. After making such surveys JDA should decide for whom to work- for people at large or for some individuals. The possible standard width of footpaths on various roads/lanes in accordance to international norms should also be determined by planning people.

7. JDA should reconsider its policy regarding BRTS corridor. It should facilitate bus commuters and not the government owned buses only.

8. Foot overbridges should have more open areas for the security reasons. At present because of the vast covered space, women hesitate to pass through them.

9. Underpasses should be made pedestrian and children friendly.

10. Section 4 of RTI Act should be strictly complied. Reasons and facts should be notified whenever any new policy is framed or decision for people is taken in the spirit of the section. The purpose of the RTI Act 2005 is not to hinder the processes of the organization but to give a thrust to procedural reforms aiming at citizen–centricity, thus strengthening the democracy.

11. It can be a constant endeavour of JDA to provide suo motu information as envisaged in sec 4(2) of RTI Act, of various activities e.g. on construction site a board could be placed showing all details like budget specification of the work – if road the size, the thickness of soil.

    Grit consolidation, layer size of bitumen, process etc so that the passé by could verify the quality of the work. This may enhance the image of JDA.

12. Technocrats should also be made to undergo orientation programmes conducted periodically so as to update their technical knowledge and what is happening in other metros and what are the standard norms arrived at by Indian Road Congress or other such organizations for various construction works.

13. JDA should try to document best practices in the field of RTI and other areas. These could be properly published and circulated widely for people's knowledge. This may earn goodwill of citizens.

Conclusion

The applicant while narrating his story made it very clear that his purpose behind asking for information was not for personal gain or with malafide intention, rather he desired to draw out certain learning points from the information and suggest to improve the procedures. His firm faith was that JDA is a prestigious organization and its image must improve and this will happen only when in reality it works for majority of citizens and not for a few upper class people.

Revolutionary Growth of e-Commerce in Developing India

Neeta Sen

Abstract

From a buzzword to a current-day reality, e-commerce in India has been experiencing a remarkable growth, successfully changing the way people transact. People today can shop literally everywhere within minutes, be it their workstations or homes, and most importantly, at any time of the day at their leisure. The online market space in the country is burgeoning in terms of offerings ranging from travel, movies, hotel reservations and books to the likes of matrimonial services, electronic gadgets, fashion accessories and even groceries. To capitalize on the anticipated growth potential, a host of investors, including venture capital (VC) and private equity (PE) firms are closely eyeing opportunities in e-commerce start-ups. At the same time, the sector is witnessing a swathe of consolidation owing to various mergers and acquisitions. However, industry experts believe this is just the start of e-commerce wave in India. The growing penetration of technology facilitators such as Internet connections, broadband and third generation (3G) services, laptops, smart phones, tablets and dongles, coupled with increasing acceptance of the idea of virtual shopping, is set to drive the e-commerce system. The e-commerce story in India would surely witness a new world of digitalization in the coming decade, with a host of start-ups emerging to compete with existing players in order to draw benefits from the new and existing markets.

Acronyms/Abbreviations

3G: Third Generation, B2B: Business to Business, B2C: Business to Consumer, B2G: Business to Government, C2B: Consumer to Business, C2C: Consumer to Consumer, CAGR: Compound Annual Growth Rate, EDI: Electronic Data Interchange , FDI: Foreign Direct Investment, GDP: Gross Domestic Product, IAMAI: Internet and Mobile Association of India, ICT: Information and Communication Technology, PE: Private Equity, SMME: Small Medium and Micro Enterprises, UNCTAD: United Nations Conference on Trade and Development, VC: Venture Capital

Introduction

For a country such as India, one of the most important benefits of e-commerce is its potential to help a developing rural community to jump into the knowledge paradigm. The positive effects of e-commerce can be magnified beyond purely commercial growth to have a profound impact on all aspects of rural community. Most of the policy debates and proposals surrounding e-commerce are geared towards removing barriers and promoting opportunities for these new types of commercial activities to expand more rapidly. In light of the potential impact of e-commerce on our rural community, a final category of issues can be seen as focusing more directly on the benefits to be gained from e-commerce, particularly the benefits that developing countries might achieve with successful strategies.

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e-Commerce

The term electronic commerce or e-commerce consists of all business activities carried on with the use of electronic media, that is, computer network. It involves conducting business with the help of the electronic media, making use of the information technology such as Electronic Data Interchange (EDI). In simple words, electronic commerce involves buying and selling of goods and services over the World Wide Web. e-Commerce can be classified into five categories: business to business (B2B), business to consumer (B2C), consumer to business (C2B), consumer to consumer (or citizen to citizen) (C2C), and business to government (B2G) e-commerce.[1] The B2B e-commerce includes all inter organizational business transactions, whereas the dealings between business houses and consumers fall under the B2C category. Consumers can browse the websites of the sellers (business organizations) and select and buy the merchandise online. On the other hand, C2B is a business model in which consumers, that is, individuals, can advertise their products or services online, and the companies purchase them.[2] Online advertising sites such as Google Adsense, Commission Junction, and Amazon offer the opportunity for C2B e-commerce. C2C involves transactions between consumers, that is, individuals, facilitated by a third party, which charges a fee or commission. In this mode, a consumer posts an item for sale on a website offered by a third party, and other consumers bid to purchase it. The third party, however, does not take the responsibility of the quality of the product. e-Bay and Craigslist are the examples of this type of e-commerce. B2G is generally defined as the business between the companies and the public sector.[3] It involves the use of the Internet for public procurement, licensing procedures, and other government-related operations. It may be added that application of the Internet within an organization for streamlining processes, reducing friction, and slashing internal overhead costs is sometimes referred to as business to employee (B2E) application.[4] During the last few years, with the advent of 3G mobile phones, another type of e-commerce has come in practice which has been named as mobile commerce (m-commerce).[5] It involves buying or selling of goods or services through wireless technology, that is, handheld devices such as cellular phones or personal digital assistants.

e-Commerce growth at global level

In the developed countries, such as the United States, e-commerce has proliferated to such an extent that it is considered to be the most reliable, convenient, and price-effective mode of purchasing. The purchased products are delivered quickly, and in case the buyer is not satisfied with the product, he/she can get a refund or adjustment toward another purchase without any harassment. U.S. based firms also perceive "that there are no significant difficulties or barriers to doing business on the Internet."[6]

India is currently a fast-growing economy and offers a vast consumer market in the world. The United Nations Conference on Trade and Development (UNCTAD) publishes annually "The Information Economy Report" in which the current trends and major international policy issues regarding information and communication technologies and their use for and effect on, trade and development are analyzed. In the 2010 Report, the present Secretary General, Mr. BAN Ki-Moon reemphasizes, "new

technology-based solutions that did not exist when the Goals were endorsed can and should be leveraged to allow for rapid scaling up. The most important of these technologies involve use of mobile telephones, broadband Internet and other information and communications technologies."[7]

Internet usage globally has been on the rise while most of the growth has been reported from markets in Asia Pacific and Latin America. The chart below shows the growth in online population across regions from July 2011 to July 2012. The global online population as of July 2012 stands close to 1.5 billion users, growing at a rate of 7%.[8] The global m-Commerce market in 2012 reached $171.5bn and is expected to increase 360.0% to $617.0 bn by 2016 as market confidence and growing trust in the ease and security of mobile transactions support rapid growth.[9]

Unique Visitors (in millions)

Source: Assocham Organization

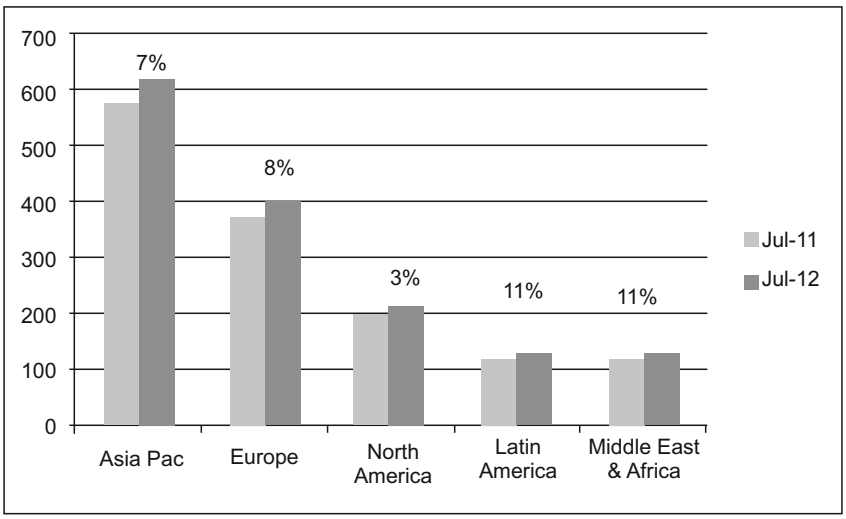

Figure 1 : The growth in online population across regions from July 2011 to July 2012

Asia pacific has added over 43 million users and is growing in line with the 7% worldwide growth rate. Europe and North America have grown at 8 % and 3 % respectively.[10] Latin America's online user base in the month of July 2012 stood at 134 million and grew from 120 million in July 2011. The online user growth has primarily been fueled with improved network infrastructure and growing need of online content consumption. With a growing user base, the engagement among online users has also grown in the last 12 months as time spent has increased over 5.4% per visitor and pages viewed has grown by 7% per visitor.[11]

e-Commerce growth in India

India is one of the Asian giants having fast growing economy with an average gross domestic product (GDP) greater than 7.0%. The low cost of the PC and the growing use of Internet has shown tremendous growth of e-commerce in India in recent years. The total digital commerce market in India was valued at INR 473.49

billion in December 2012 and is expected to grow by 33 percent to reach INR 629.67 billion by the end of 2013.[12] This is according to the latest Digital Commerce Report, by the Internet and Mobile Association of India (IAMAI) and IMRB International. According to the report, online travel industry has on an average grown by 32 percent from 149.53 billion in 2009 to INR 345.44 billion in 2012 and is estimated to grow by another 30 percent and be valued at INR 449.07 billion by the end of December 2013. The e-Tailing category has grown from INR 15.5 billion in the year 2009 to INR 64.54 billion in year 2012. This category is estimated to grow by 55 percent and cross INR 100 billion by the end of 2013. India has 3,311 e-commerce hubs, 1,267 rural hubs, 391 export hubs and 2,217 import hubs .[13]

Financial services market was valued at INR 28.86 billion in 2012 and is expected to grow by 25 percent and reach INR 36.07 billion by the end of year 2013. According to the report, classifieds market has seen a significant growth and has reached INR 23.54 billion in 2012. Classifieds as a category has grown with a compound annual growth rate (CAGR) of 45 percent from 2009 and is expected to grow by another 30 percent to INR 30.61 billion by 2013.[14]

Economic and Social impacts of e-Commerce

Growing Internet Penetration:

Growing internet penetration is providing an enormous opportunity for e-Commerce. The following table illustrates the trend of internet penetration in rural India:

Year	Claimed Users	Active Users	Growth in Claimed Users
Dec-08	5.5	2.2	–
Jun-09	5.9	3.7	6%
Dec-09	7.45	5.5	27%
Jun-10	10.4	8.5	42%
Dec-10	15.2	12.2	43%
Jun-11	21.4	17	40%
Dec-11	29.9	24	40%

Table 1: Internet Usage Pattern in Rural India
Source: The Internet & Mobile Association of India

The rapidly growing internet penetration opens the opportunities for e-commerce to expand geographically. The population of active internet users in rural India is projected to increase by 96% in 2011. It is projected to increase from 12.1 million in December 2010 to 24 million in 2011. India has been identified as the fastest growing online market during the same period, with a 41% rise in 2013. This is much higher than China (5%), Brazil (6%) and Russia (20%) .[15]

The mobile internet penetration is also growing very fast. The active mobile internet users are those who assess internet using their mobiles at least once a month. The population of active mobile internet users is expected to touch 35 million. According to the technology giant Cisco the global internet usage will quadruple between 2010 and 2015.

The Recent Trends in e-Commerce:

The growing impact of internet is also felt on the pattern of advertisement spendings by the corporate world. The share of internet is growing consistently. Companies are capitalizing on the social networking sites also for their recruitment, selection, product promotion and survey among customers. A survey on e-commerce transactions says India will have 30 million online buyers and consumers adapting to e-commerce sites by 2015 compared with the 2.5 million online buyers at present .[16]

Role of Government:

The Indian government has restricted foreign companies from selling their products in India through the online medium. This regulation safeguards Indian companies against competition from global leaders such as Amazon. The restriction is also extended to foreign retail companies that have entered India. However, in the longer term, Indian companies have to evolve and shield themselves not only from their Indian counterparts but also from the global e-Commerce giants as the government might allow FDI in the segment. Eyeing on the vast opportunity, Amazon has already entered the Indian market through Junglee.com. In addition, it has even got approval from the government to build large warehouses to stock third-party goods. Strategic moves such as these would support its expansion plans once FDI is allowed. Moreover, the government's plan to interlink every panchayat (village council) of the country through high-speed broadband service by 2014 would aid the sector's growth.[17] Also, government organization's increasing reliance on the e-commerce methodology for their money-related transactions would help the upward trend.

In spite of all, Government can play an important role in examining the economic and social impact of e-commerce technologies and promoting understanding and application of these technologies throughout Indian industries and communities:

1. Facilitating market access and business opportunities, especially for small, medium and micro enterprises (SMMEs) on a national and global scale.
2. Providing educational and skills development resources.
3. Supporting the rapid deployment of necessary infrastructure.
4. Facilitating the development of MPCCs as vibrant seeding points for community knowledge and wealth creation, above and beyond the provision of the latest ICTs.
5. Developing "model use" programs for the dissemination of government information and services using e-commerce platforms, e.g., for electronic tender processes.
6. Supporting necessary transitions in the labor force due to technological and industrial transformation.
7. Ensuring equity in the availability of opportunities and benefits in the context of the overall development of Indian rural community.

Economic Impacts:

1. Governments and especially businesses are confronted with an "adapt or die" scenario, particularly in developing countries. To fall behind in technology and innovation could widen the gap with wealthier, more advanced economies.
2. e-commerce presents unique opportunities for less developed countries to greatly expand their markets, both internally and externally. Externally, the Internet and other technologies may allow for low-cost international trade, even for small, local businesses. Internally, many groups of citizens who had been considered "marginalized" and "unbanked" may gain affordable access to financial services, and may thus participate more readily in all aspects of the economy.
3. Rural areas considered too costly or unprofitable for business development might increasingly become a focus for investment and market expansion and also for relocating corporate offices.
4. Development of microfinance institutions to provide financial services to the semi urban and rural areas.
5. e-learning and M-learning enhances the access of the educational institutions in remote areas.
6. e-governance initiatives increases access to information and thereby reducing corruption.
7. m-banking (Mobile banking) reduces the transaction cost of banking industry thereby increasing access to financial services through rapidly growing mobile market.
8. Micro, small and medium enterprises can leverage the technology to market their products globally.

Social Impacts:

1. Some of the intangible downside risks of increasingly "virtual" interaction within rural community include the possible "de-socialization" of individuals who have less and less direct contact with their peers, their co-workers and their community. This can extend to family relations as well, particularly if technology creates further imbalances between those who are "on-line", and those without access to these technologies. On the other hand, equitable deployment of infrastructure and educational resources could provide a means of maintaining and expanding family and communal ties that would otherwise be broken by distance and cost.
2. Other problem includes psychological and physical health-related effects of sedentary, computer based work environments. Early experience suggests that as this type of work (and social) activity expands, businesses and governments will have to consider broad-based means to offset health hazards with new policies and treatments.

3. e-commerce may offer the potential for shifting the balance of opportunity, wealth and social and political inclusion. As much as these trends can be beneficial to the majority of rural communities, they are also likely to bring unanticipated effects on cultural and social norms. Indigenous traditions that have so far survived the intrusion of modernity may be less resilient in the face of global networks and instantaneous communication. These types of impacts are just as significant as changes in bottom-line incomes, and can really only be "measured" by the persons whose lives are being changed by forces largely beyond their control.

4. Supporting MSMEs: Electronic commerce opportunities are valuable for giant corporations and small entrepreneurs alike. In the latter case, however, the technologies and market options available through e-commerce may foster a true revolution in the way business structures and relationships are organized. The prospect of establishing new micro, small, and medium enterprises (SMMEs) is greatly enhanced by the efficiencies available through information and communications technologies. A study by Google India showed that 57% of SME's used website as a sales channel and got direct leads from their websites. According to Internet and Mobile Association of India 73% of MSME's have their own websites. Importantly 99% of MSME's use online B2B market places to generate business.

Essential factors for continuous growth of E-commerce in India

- Customer Convenience: By providing cash on delivery payment option service to customers.
- Replacement guarantee: Should have offers like 30 day replacement guarantee to their customers.
- Reach: Enabling mobile capable sites and supporting m-Commerce services.
- Location based services: Since customers these days are always on the move, promote the right product at the time and location becomes an integral aspect.
- Multiple payment option: Cash on delivery, Standard credit cards, debit cards and bank payments option should be there.
- Right Content : Getting the right content and targeting customers with crisp and relevant information is of utmost importance to users on the move.
- Price comparison: Providers offering instant price comparison are highly popular amongst the price conscious customers.
- Shipment option: free and low cost shipment should be there. The convenience of collecting orders and returning home should be there.
- Logistical challenges: In India, the geographical spread throws logistical challenges. The kind of products being offered by providers should determine the logistics planning.

- Legal challenges: There should be legal requirement of generating invoices for online transactions.
- Quick service: Timely service provided by the company.
- Terms and conditions: T & C should be clear & realistic.
- Quality: The product quality should be same as shown on the portal.
- Customer Care Centre: A dedicated 24 x 7 customer care centre should be there.

Future of e-Commerce

According to a new study from the Center for Research in Electronic Commerce, this is such a dynamic field that every day is a new day in the world of e-commerce. We see a lot of things, and looking in the near future, e-Commerce will become the industrial revolution of the 21st century. Certainly see happening is the decline of the revenue-share business model, a hybrid form of multilevel marketing which is effecting new approach in network marketing that make sense to get new customers to try product and services. e-Business still has huge untapped potential and continues to grow robustly. Hosted providers have revenue-share pricing model. Most of the e-commerce and shopping-cart web development providers are focused on a more pure-play internet based solution. However, as the market consolidates, we think there will be more multi channel integration offerings.

e-Commerce in India has grown rapidly in the last 12 months. Retail growth has been fueled by aggressive marketing, consumer need and convenience to buy all products online. Comparison shopping has been on a growth but is still underserved compared to global averages. The need to compare and consume for online categories like travel, shopping etc. shows a similar consumer behavior in retail category in India. More and more consumers are expected to rely on online research of products for features and prices in the coming years.

According to the reports India will be the biggest B2C market of Asia by 2020.[18] Since 2010 the total Indian B2C e-commerce turnover has increased by 35% including goods and services. The growth will reach to USD 6.6 billion, a 35.1 % share of B2C ecommerce by 2020.[19]

Conclusion

Size of the total e-commerce market in India is estimated to expand at a compound annual growth rate (CAGR) of about 40.0 per cent during 2010–20 to USD200.0 billion. Likewise, India is expected to record the highest growth in the Asia Pacific region during 2012-2016.[20] The trend would shift with the online retail segment contributing equally to the total market size, considering it is expected to grow significantly in the coming years. It has been observed that Indian consumers have matured over the years and increased their acceptance for various payment approaches such as net banking and prepaid wallets in which these wallets will allow customers to store money in their wallets, and purchase goods and services offered through third party merchants. Companies from rural India have started

understanding the growth potential from this sector, and are accordingly incorporating e-commerce activities in their business models. Companies are working towards providing more online content in regional languages like Hindi, Marathi, Telugu or Tamil. Going forward, the rural population is well positioned to reap the benefits from the available low cost technology platforms, efficient logistics management, increasing vernacular content and secured payment modes. In the coming decade, we expect the sector to offer much more revolutionary practices such as transacting with the help of Mobile money, and having access to virtual trial rooms.

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Reflections on a Successful Community Conservation Programme in Haryana, India

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Abstract

In India, conservation of river ecosystems and its associated biodiversity is essential due to a growing human population and increased water demand. Conservation efforts at local scale may protect individual species from anthropogenic stressors and protect biodiversity. The present study is based on a community conservation programme in north India to protect river ecosystem and its surrounding faunal species. During December 2012, twenty two sites across the Thapana and Somb Rivers were sampled for in-river habitat characteristics and faunal species. In total, 12 fish, 5 mammalian, 2 reptilian, 5 odonate, 7 lepidopteran, and 79 avian species were recorded. Within community conserved sites, we found lower levels of riverine degradation and higher faunal diversity. Impacts to water quality, clearing of riparian vegetation and sand and boulder mining were the likely cause for degradation of riverine habitats and the loss of faunal species outside community conserved sites. This article highlights the importance of community conservation initiatives for the conservation of river ecosystems and associated biodiversity.

Acronyms/Abbreviations

CCP: Community conservation programme, CCS: Community conserved sites, FPAs: Fresh Water Protected Areas, NMM: Nadi Mitra Mandal

Introduction

India has a rich network of river systems flowing across its different biogeographic zones.[1] Unfortunately, with a rapidly growing population, a growth in urbanization and an increase in water demand, the country is witnessing wide-scale overexploitation of river ecosystems through water pollution, flow modification, destruction and degradation of habitats and stocking of exotic species to support the region's protein requirements.[2-4] Despite these threats, rivers' ecosystems here have not been able to muster the support as much as terrestrial habitats,[5] even with the presence of powerful legislations such as the Indian Water (Prevention and Control of Pollution) Act, 1974, the Water (Prevention and Control of Pollution) Cess Act, 1977 and the Environment (Protection) Act, 1986. In addition, no freshwater fish species are listed in the Schedules of Protected Species in the Wildlife (Protection) Act, 1972.[6]

Various river conservation approaches have been utilized and proposed across India, but with mixed results. River conservation policies have often not obtained the

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desired results, due to the ever-increasing demand for river resources and a top-down management practice.[7,8] Suggestion of setting up of Freshwater Protected Areas (FPAs) could provide the desired protection and possible social and economic benefits for local communities,[9-15] but are yet to be implemented. Finally the support from recreational angling communities.[16] as an angler's experience depends on the survival of their pursued fishes,[17] is still in its early stages. In view of the above threats, there is an urgent need to investigate other potential strategies. Engaging local communities through awareness of social and economic returns, cultural associations or religious beliefs[18] can produce the desired support and act as a supplementary conservation tool for rivers across India.[19-23]

In view of the above suggestion, the river and biodiversity conservation initiatives started by the villagers of Kanalsi in the north Indian State of Haryana was the focus of attention. Emphasis was placed on the rivers Thapana and Somb flowing near this village to investigate the community's conservation initiatives. The in-river habitat characteristics along with the avian, mammalian, reptilian, odonate, lepidopteran, and fish species associated with these rivers were recorded during December 2012. The objectives of this article are to (a) investigate the benefits of community conservation initiatives for the rivers and associated biodiversity; (b) record the presence of faunal species within/outside community conserved sites; and (c) identify and suggest possible preventive measures for any stressors causing disturbances within/outside such protected sites.

Background of the study area

Kanalsi is an agricultural village, near the city of Jagadhri in Yamuna Nagar district, located in the north Indian State of Haryana (27°39' to 30°35' N; 74°28' to 77°36'E). The area is renowned for stainless steel production and timber trading. The crops grown by the farmers here are sugarcane (Saccharum) and poplar trees (Populus). The river Somb meets river Yamuna downstream near Kanalsi village (Figure I). The river Thapana meets river Somb at Kanalsi and is in turn formed by the convergence of two tributaries: Thapana I and Thapana II. For this survey, rivers Somb and Thapana were divided into four sampling stations, i.e., (1) Somb River; (2) Thapana (Thapana I and Thapana II); (3) Thapana I; and (4) Thapana II. Within these four sampling stations and depending on accessibility, further 22 sampling sites were set up, i.e., (a) on river Somb, seven sampling sites (S_1 - S_7) were present: S_1 (meeting point of river Yamuna and Somb), S_2 (opposite Kanalsi village), S_3 (Fatehgarh), S_4 (upstream of Maher Majra), S_5 (Maher Majra), S_6 (purana ghat, Kanalsi) and S_7 (confluence of Somb and Thapana rivers); (b) sampling sites S_8 - S_{12} were present on river Thapana (Thapana I and Thapana II): S_8 (before Thapana meets river Somb), S_9 (near Mandoli), S_{10} (bridge-1, Mandoli), S_{11} (Mandoli-Thapana) and S_{12} (Dhampura); (c) sampling sites S_{13} - S_{18} were located on Thapana I: S_{13} (Gaajdinpur), S_{14} (Nawazpur), S_{15} (Haldhari, Nawazpur), S_{16} (Lakkad bridge), S_{17} (Lakkad) and S_{18} (Bhilpura); and (d) sampling sites S_{19} - S_{22} were located on Thapana II: S_{19} (Bichpari), S_{20} (Rampur), S_{21} (Haldari) and S_{22} (Jai Rampur Ghat).

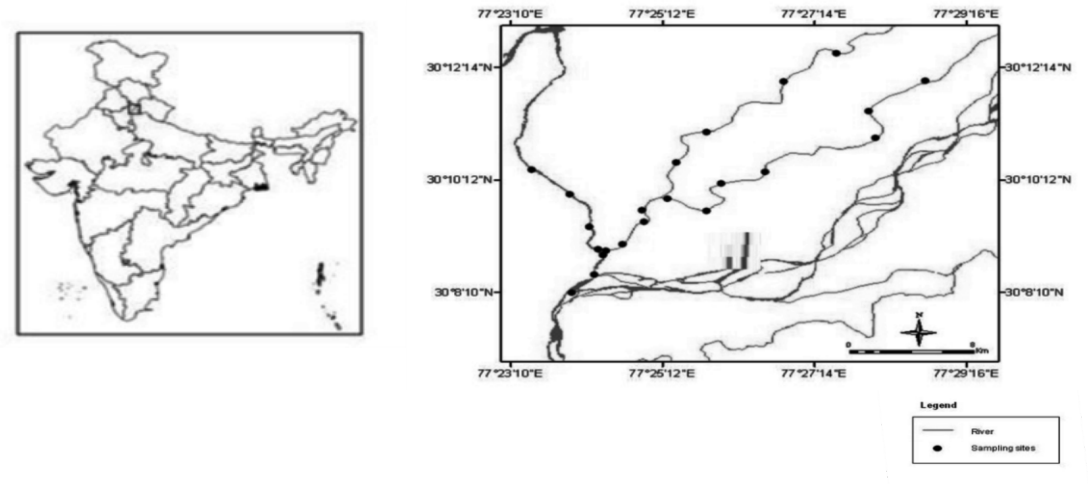

Figure 1: Map of the studied area

The coverage of the riparian zone, its canopy over the water surface and aquatic vegetation were recorded visually. Sampling occurred during a winter month (December) throughout the day (9am to 5pm). Fisher were sampled at each site using cast nets (mesh size: 4cm x 4cm; 3cm x 3cm), mosquito nets (mesh size 0.2cm x 0.2cm) and bait fishing using a fishing rod. Same efforts were used at all sites. Fishes caught were identified at the species level with the help of keys prescribed by Talwar & Jhingran (1991) and Jayaram (1999). The avian, mammalian, reptilian, odonate and lepidopteran species were assessed by photographing and recording individual species both during rest and in flight, using a Canon Power Shot SX210 IS 14.1MP, 14X optical zoom digital camera. All specimens were identified based on the latest publications by Subramanian (2005), Bombay Natural History Society (2008) and Grimmett et al. (2012). Both natural and anthropogenic threats were recorded at each sampling site.

Community Conservation Programme

The river and biodiversity conservation initiatives were started by the local members of the Nadi Mitra Mandal (NMM), Kanalsi grid, and encompassed stretches of the Thapana River. This initiative was overseen by PEACE Institute Charitable Trust, New Delhi in association with Thames Rivers Trust, United Kingdom. The aim was "to educate and involve the local communities based along the river to monitor and protect the river stretches; and develop new strategies which could be promoted to similar communities across the nation". Despite being based in an agricultural region, the people of Kanalsi have always been aware of the rich biodiversity of their area. *"You will not spot so many species of birds in just one day, anywhere in India"*, replied a proud respondent before the survey. *"We don't bother the animals; they don't bother us; and we both get on with our business"*, explained another respondent.

In total, 12 fish species were caught during the sampling period, 11 belonging to the family Cyprinidae and 1 to Belonidae. There were 5 mammalian species noted (5 families; 4 orders); with Nilgai *(Boselaphus tragocamelus)* being the most abundant

species recorded. Two reptilian species (2 families; 1 order) were documented. Five lepidopteran species (1 family; 1 order); and 7 odonate species (2 families; 1 order) were recorded. Seventy-nine avian species were noted down from the sampling sites. Of the avian species, River Lapwing *(Vanellus duvaucelii)*, a common resident, was near threatened; forty-nine species were common or locally common residents and 15 species were common or not common winter visitors.

Positive conservation approaches were visible around the community conserved sites, i.e., saplings of native trees could be spotted on the banks of the Thapana River. *"They will increase the forest cover one day for our grandchildren and will make the banks more stable"*, replied one respondent. Interestingly, a large portion of the Panchayat land near Thapana River was set aside from cultivation giving rise to a dense growth of scrubs and grasses. *"We are trying our best to keep this portion free of agriculture for the native birds"*, stated one respondent. This initiative was successful, as nesting sites of many endemic and migratory birds were spotted here. A 5 km stretch on the Thapana River near Kanalsi village was found to be rich in faunal species and one of the reasons was that the villagers at this site practiced organic farming and avoided dumping household wastes directly into the river. They also ensured that they did not farm close to the river banks. This had given rise to lush riparian growth of scrub and grasses here, which attracted winter migratory birds in large numbers and provided nesting habitats for local species. *"It is our mini-wetland"* remarked one respondent.

One of the necessary steps for a community conservation initiative to gather momentum and spread to nearby villages is mass awareness and the people of Kanalsi had ensured that this was the case. Visible sign boards were erected by the villagers clearly stating that the Thapana River was protected by the NMM members and requesting the locals not to fish and pollute the river. Throughout our sampling period on the Thapana and Somb Rivers, we were questioned about our work by passing-by villagers and were warned not to damage the rivers and the local biodiversity in any way due to our sampling techniques. *"Doesn't your cast net injure the fish during your sampling"*, inquired one villager. *"I hope you are not capturing the birds simply to take a photograph"*, warned another.

In comparison, stretches of Thapana and Somb Rivers outside the community conservation area suffered from various anthropogenic stressors. Local people from nearby villages were spotted using illegal fishing techniques on the Somb River. On both these rivers, there was clearing of riparian vegetation along the banks to make way for agricultural land sand and boulder mining was prevalent and negligible faunal species were recorded. Outside community conservation sites, there were presence of sugarcane and turmeric (Curcuma longa) fields close to the banks of these two rivers and large amounts of urea and other chemicals were being used on the crops. At one site, the agricultural fields had a system of parallel cuts to allow the drainage of excess water into the Somb River. This was particularly concerning as the crop chemicals could be transported into the river and be a possible reason for the choking of river stretches with aquatic vegetation. When asked about the damaging effects these

chemicals could have if they entered the river water, one of the villager responded, *"We just don't have the time to indulge in organic farming. The land is less fertile now and the output is less through organic farming"*. Various sources of pollution were also observed at non-conserved sites, i.e., dumping of dry waste material directly into the river; oil pollution from the washing of tractors and motorcycles; temporary bullock-carts crossing through river stretches; and frequent religious immersions. At another site, Thapana I River had been channelized by the villagers for irrigation purposes.

Conclusion

Both Somb and Thapana river systems support a large number of faunal species. The avian population across the sampling sites are in a very healthy condition as many nesting sites were observed during the survey. The river and biodiversity conservation programme started by the villagers of Kanalsi has been very successful, gained momentum and voluntarily recruited many interested individuals. Despite these benefits, both Thapana and Somb Rivers outside the community conserved sites are facing threats due to rapid urbanization and the ever-increasing demand from the agriculture sector to feed an increasing population. For the long term survival of these precious rivers and their faunal species outside community conserved areas, the following steps should be undertaken by villages based alongside these rivers: (a) mass awareness programme should be undertaken to educate village members about the benefits of rivers and the long-term effects of damaging such a vital ecosystem; (b) native trees should be grown along the Thapana and Somb Rivers for the stabilization of their banks and to provide habitats for local faunal species; (c)the removal of riparian vegetation and clearing of scrubs and grasses to make way for new agricultural land should be minimized; (d)indiscriminate use of chemicals in agricultural practices should be controlled; and (e) planting of poplar, sugarcane and turmeric plants should occur as further away from the river banks as possible.

For its effective implementation and success, future conservation plans should take into account community involvement based on trust, transparency and accountability[24,25] and address the local people in order to utilize their full cooperation.[26] Community level conservation of rivers and its associated biodiversity, like the one mentioned above, has been able to achieve the desired results because the plans were centred around the needs and concerns of the people of Kanalsi.[27] The time has come to recognize the importance of local participation for protecting and conserving river ecosystems in India.

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Annakshetra

- An Initiative to Save Food, Energy and the Environment

Dr. Ambika Nag and Surbhi Pareek

Abstract

With the growing economy of India, lifestyle changes have become evident in society. Every special moment of life is celebrated in a big way. When lavish parties are thrown by the rich, a large quantity of surplus food just goes to waste because food quantity is overestimated on most of the occasions. A country like India having about 37% of the population living below poverty line certainly cannot afford such a gross wastage of food. It is a matter of grave concern also due to the fact that more than 10% of these poor cannot even afford two square meals a day. Every bit of wasted food in a way contributes towards hunger. Not just this, wasting food is a waste of resources, water, labour and energy. Food rotting in landfills leads to methane production thus affecting our respiratory system and the environment. Food waste is a loss to economy as well.

A unique beginning has been made by ***Annakshetra,*** *an initiative of the* ***Centre for Development Communication (CDC), Jaipur*** *with the aim of minimizing food wastage. By effective channelization of the surplus food collected from weddings, parties, restaurants, temples or other donors to the needy local community, Annakshetra works on the 3R principle – Reduce, Reuse and Recycle. The programme aims to work towards Zero waste economy and sustainable environment.*

Annakshetra: An Introduction

After 1960, India witnessed transformation from being a food deficit country to a food surplus country but food waste management has still not been brought under focus. The scale of food wastage is growing very fast in India. According to the ministry of food processing, a whopping ` 58,000 crore worth of agriculture food items and cooked food gets wasted in weddings and ceremonies every year.

In the background of country's poverty, it is very crucial to bridge this gap. It is also important to utilise the leftover edible food instead of throwing it in landfills which in turn, may precipitate emission of green house gases in the atmosphere.

As per a new report by the International Food Policy Research Institute, Welthungerhilfe and Concern Worldwide, India ranks 65th out of 79 countries on the Global Hunger Index. The report has sharply criticized India for not moving fast enough in reducing malnourishment and has pointed out that its nutritional indicators are far worse than its economic indicators merit. Therefore, global resource challenges

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need to be addressed from a balanced perspective that includes bolstering effort to improve the supply of resources, but it must also mean better management of the resource demands, especially in reducing waste and improving efficiency.

Annakshetra was established in November 2010 by **Centre for Development Communication (CDC), Jaipur,** with the vision to position India as a zero food wastage economy by redeploying food resources in an efficient manner. The basic objective of Annakshetra is to generate community awareness through effective channelization of excess food collected from donors and delivered to the needy. Thus food wastage can be minimised. Its process involves collection of excess food from the donor sites, storage and testing of the food and thereafter distribution to people at the bottom of pyramid (labourers, waste workers, etc.), only if the food is found fit for human consumption.

Annakshetra makes use of the 3R model and suggests how waste management aggravates at later stages and can be minimized at the initial stages. 3R model is Reduce, Reuse and Recycle. Annakshetra runs awareness campaigns to prevent food wastage, i.e. to Reduce. If food is effectively reduced at the first stage, then not only is the food saved for a large part of the population but also harmful effects on the environment are prevented. Source reduction means buying less quantities of any kind of processed or unprocessed food products that may end up into garbage. Reuse is Annakshetra's recovery programme. It collects the high quality surplus food from sources and distributes among the hungry and poor. Annakshetra also motivates people including school children, to use small portions to reduce post-consumer waste also called "plate waste" or "table scraps". If the tasted food is not suitable for human consumption, it is sent for Recycle /Composting. By recycling, Annakshetra ensures that the bio-waste does not land into landfill sites thus preventing environmental damage and improving agricultural output by improving soil.

Annakshetra focuses at the first two stages of waste control i.e. source reduction and utilizing the pre-consumer waste to feed the hungry and poor. Effective waste control measures at the first two stages results in competent utilization of waste. As the waste moves towards the right ends of the chain, waste management becomes futile. Annakshetra covers entire Jaipur city within an area of 111.8 $km.^2$ The office is centrally located and on an average the vehicles travel a distance of 40-50 km/day and around 3000 km/month.

Annakshetra: the Journey

The aspect of reducing food wastage is normally ignored by most of the people. Very few are aware that it can play a major role in food sustainability. It is very important because on the one hand resources are mercilessly wasted and on other hand, hungry people are forced to take out their meals from the waste. Moved by the situation, Dr. Vivek S.Agrawal,Trustee Secretary, CDC decided to initiate Annakshetra. During the first six months, Annakshetra invested in enhancing its internal operational capacity through well planned and well structured organizational set-up with expert professionals. Presently Annakshetra foundation has eight trustees,

who meet fortnightly to discuss the issues and the way forward for the foundation. The Advisory board of Annakshetra has over 30 people from different field including corporate, academicians, politicians, civil servants among others. The entire funding of the project is being undertaken by CDC right from its inception. It started its journeywith hired vehicles but Annakshetra pickedup momentum next year by acquiring own vehicle and refrigerators. A leading automobile company also donated a vehicle to Annakshetra in 2012.

Annakshetra is a people's programme where each citizen is an Annadoot. Approximately **100000 persons** have been directly or indirectly benefitted so far from a network of 1500 donors consisting of restaurant owners, caterers and individuals called **Annadoots**. Annakshetra has served almost **half a million** meals upto February 2013. On receiving calls on its 24×7 Help Line 0141-3221267, Annakshetra van goes to the celebration site to collect food. After collection, the food is properly kept in refrigerators and served to the needy people.

Achievements of Annakshetra:

- *Total no. of meals served > 5,00,000*
- *Among beneficiaries: children = 25%, women=50%, elderly=15% and specially abled persons =2%.*
- *Nutritional value of per meal is 1200-1500 calorie served.*
- *Assuming cost @ ₹ 25 per meal, food worth ₹ 12,500,000 has been saved.*
- *More than 3 thousand tons of high quality food has been rescued.*
- *Carbon footprints caused by methane emissions from decomposition of food in landfills has been saved.*
- *Water footprints to produce this food have been saved.*

This year Annakshetra participated in UNEP's "Feeding the 5000 programme" on May 14, 2013 by organizing **"Annakshetra Mahabhoj Program"** (mass food distribution). Thanks to Annakshetra's awareness drive to donate left-over food from marriage parties in Jaipur on the occasion of Akshay Tritiya, one of the most auspicious wedding *muhurats* on May 13, 2013. The target was to collect food worth 5000 meals but more than 2.7 tons of high quality surplus food was collected with team efforts and almost 10,000 people were actually served. This event set an example that if food saved on a single day in a city can feed so many people, such efforts on daily basis could definitely help in tackling hunger in a big way. A number of donors have joined hands with Annakshetra comprising caterers (310), marriage gardens (105), sweet makers (145), Individuals (925) and temples (48).

The theme for this year's World Environment Day celebrations was Think. Eat. Save. It was an anti-food waste and food loss campaign. Annakshetra organised **"Workshops on Waste-Food Management"** in several schools of Jaipur city on the occasion of Environment Day. Children are the best messengers to society who may further spread the message to create a movement to save food. Mothers pack kids' lunch boxes with healthy food, but a significant amount (about 25% to 35%) of that food ends up in the trash. Therefore, it was thought necessary to create awareness among children to stop food-waste. The children were made aware about food wastage and

how they can control it and feed that to needy people with the help of Annakshetra. The feedback of students and teachers was tremendous. Students were amazed to know the facts regarding food waste and hunger. Teachers, Principals, and Directors of various schools acknowledged the efforts of Annakshetra and showed willingness to become a part of the project.

All the initiatives and activities of Annakshetra have been widely covered by National, State and Local level media such as print and electronic media. The Mahabhoj programme was particularly well covered by many local dailies and news channels. Mr. Nick Nuttall, spokesperson of UN Environment Program (UNEP) congratulated Annakshetra after successful completion of "Annakshetra Mahabhoj Programme" and said "this program was the strongest call for the third motto of UNEP that is Save. Annakshetra is not only distributing food to the poor and hungry but it is also setting an example to others."

The Annakshetra model is likely to be adopted by other states of the country. The senior program manager recently made presentations in Gujarat and New Delhi and some other states have also shown interest to learn from Annakshetra experience.

Annakshetra experiment has been successful in Jaipur. The project is growing by each passing day. But the task is not easy. Food storage during summer season, biological and chemical testing of collected food and storage of large volumes of food is a great challenge. Annakshetra plans to extend its base in future by identifying donor base and creating awareness on the issue, identifying beneficiaries location, establishing cold storage and testing lab, installing food reheating facilities and urging the government to pass legislation against food wastage. Annakshetra is working uniquely in its own way and aims to serve all localities of the city in near future. There are many challenges before it can further spread its wings. The successful implementation of Annakshetra has enthused CDC and all stakeholders to work with greater enthusiasm and zeal to address the problem of hunger and sustainable environment.

Conclusion

Success in delivering food waste reduction relies on the support of the whole food supply chain, local government, regulatory bodies, education sectors and trade associations. Annakshetra brings partners together for reducing the carbon and wider environmental impacts of the food waste. In a world where resources will become steadily more scarce, competitive and volatile, Annakshetra has taken the initiative to address food waste in a holistic way to minimize it at every step of food supply chain to create a sustainable model for "zero food waste".

Institute of Development Management (IDM)

Our Purpose

Institute of Development Management is established with the purpose of enhancing capacity, both individual and organizational, for creating social wealth through virtuous thoughts and actions.

Our Mission

The mission is to transform the way people envision and manage sustainable development at their immediate level.

Our Organization

Registered as a 'not for profit' Trust at Jaipur, India, the Institute of Development Management, anchored by a core team of professionals, functions as a boundaryless organization networked with wide range of experienced resource persons specializing in giving down-to-earth solutions for conceptualization, implementation, and management of social and economic development.

IDM is a knowledge sharing forum, contributing to global level debates about environment and sustainable development. It is open for all right thinking persons to share their views on contemporary developmental issues and enhance knowledge base that can prepare individuals and organizations to meet global challenges.

Our Thrust

Within the larger ambit of sustainable development, currently our thrust areas for capacity building are:

- Urban Environmental Services and Infrastructure
- Green Architecture and Urban Planning
- Health and Sanitation
- Education
- People's Empowerment
- Gender Justice
- Human Rights Concerns
- Indian Culture and Heritage
- Values and Ethic
- Managerial Competence

Our Activities

- Organizing Debates and Discussions on important local issues.
- Networking with Experts and organizing knowledge sharing forums
- Organizing Training Programmes
- Facilitating visits of students, research scholars, experts.
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