the magazine for
the contemporary teacher

TEACHER
PLUS

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Sustainability
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December 2011

New mindsets, new approaches

I write this from a small hotel overlooking the Brindavan Gardens in Mysore, a place that has formed the backdrop of many song-and-dance sequences in the cinema of the 1960s and 70s. The Gardens continue to attract many visitors who come to stroll along the flower-lined pathways and watch the dancing fountains that sparked the imaginations of so many choreographers in Tamil and Telugu movies. The Krishna Raja Sagar Dam towers over the Garden, and represents a feat of hydraulic engineering capability in its time. Sir Visweswaraiya, the architect of this and other dams across the country, has been celebrated as the country's "first engineer" and certainly, one must appreciate the vision that created those early infrastructure projects.

Walking across the bund and looking at the expanse of the Cauvery on one side and the massive chains that work the sluice gates on the other, one is struck by the scientific-technological imagination that could lead to such a structure. But at the same time, given our understanding of how such projects have done little to alleviate the poverty of already marginalized populations who had to give up lands and livelihoods to literally energise more privileged groups, one has to decry the lack of social imagination of the times. It's so easy to be carried away by the promise of the moment, particularly when the promise is underwritten by science and technology. It's so easy to look at the immediate gains and solutions to long-standing problems. It takes both a radical imagination and courage to instead stop and look at the underbelly of the promise, and see what it means in the long term. Who are the winners and losers here? How much do the losers lose? And what are we left with after a decade, two decades, of applying this new

solution? This calls for a new mindset, a new way of approaching problems and evaluating their solutions. Sustainability is no longer just a fashionable buzzword that a few ecologists and economists have to deal with. It is something that has to become a part of the fabric of daily life, embedded in the decisions we make everyday about using water, power, food and land. It has to become a part of our thinking and learning and doing.

This issue of *Teacher Plus*, in collaboration with Wipro's Earthian initiative, brings you a wide range of articles that look at various aspects of sustainability. As you might imagine, this is a very wide theme and touches practically every aspect of our lives, from the food we eat to the water we drink and bathe in and wash with, to the buses we take and the animals we share this planet with. It's about air, water, energy, and everything that makes use of these and other resources. So clearly, we haven't been able to do it all. There are significant gaps in our collection – the crucially important issue of water for instance, has not been addressed at length, nor have many other important issues related to health and well-being and sustainable development. But what we have put together is an impressive set of views and information from experts and practitioners that should begin a dialogue on sustainability. These articles may serve as interesting reading, as prompts to classroom discussion, as the basis of activity planning, or just as something to mull over individually or in groups in the staff room. And we trust you will find many other ways to engage with the issue using this as a starting point – do let us know what you think about this very important area and how you deal with it… as a teacher and as an individual.

Usha Raman

100 years ago there were about 10 natural disasters, each year now there's about 400.
If our earth gives up this soon, our end is nearer than imagined.

— Alankrita

Climate change

Biodiversity

Production and consumption

Cities and communities

Agriculture

Role of policies

Role of information
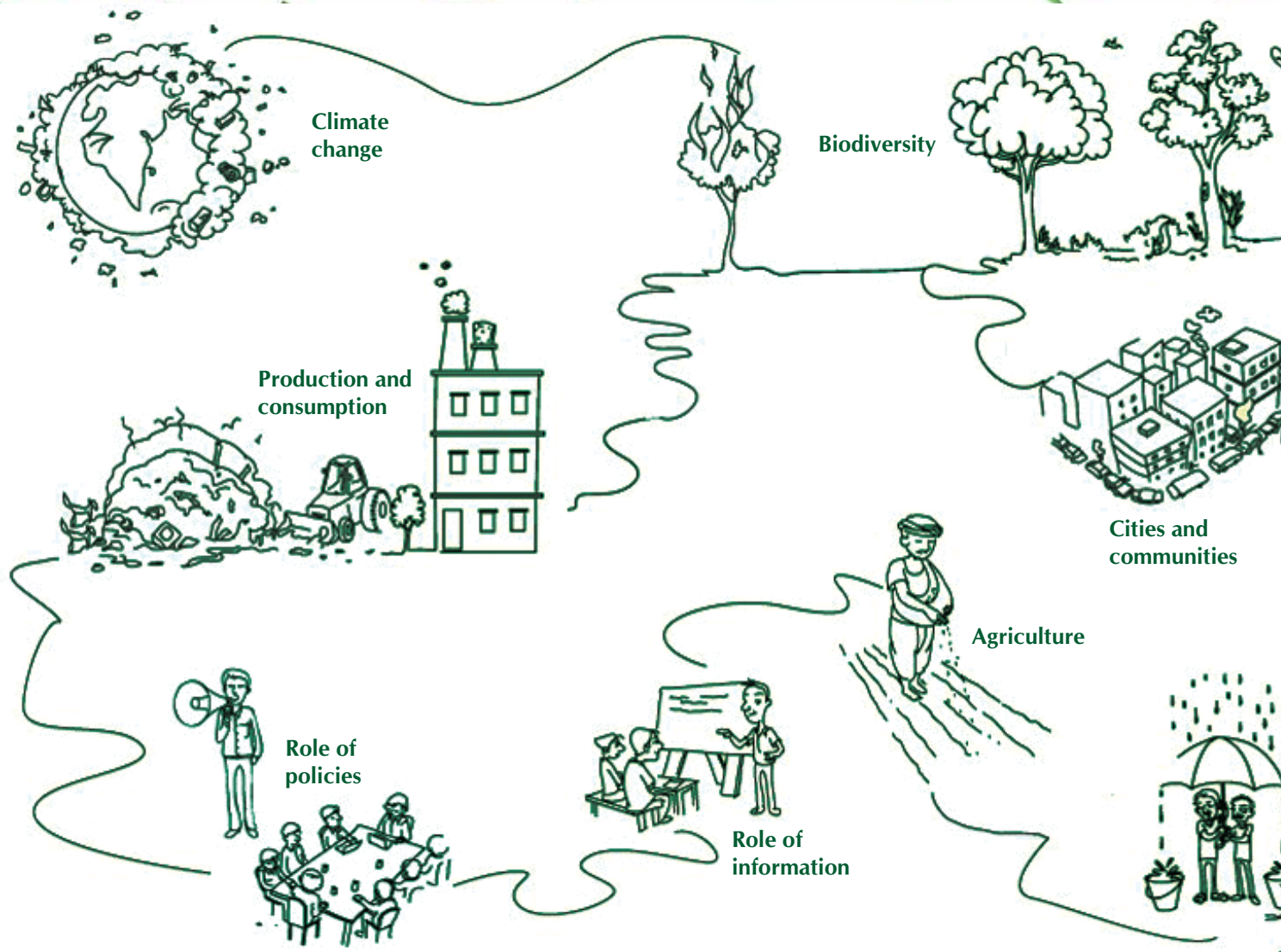
Thinking sustainability

Wipro Earthian Team

USTAINABILITY thinking has environmental, social, and economic dimensions. It is a way of looking at these issues in an integrated manner without straying from paying attention to either the human development problem or the value and constraints imposed by our environment.

This kind of thinking requires understanding, debate and action, especially in our educational institutions. At Wipro, we have endeavored to work on both the educational challenges in schools and colleges and on ecological sustainability issues within our organization and outside. From our work in these areas came this realization that sustainability issues require greater attention in schools and colleges. This was the genesis of the earthian program launched earlier this year.

The purpose of earthian
The vision of earthian is rooted in the challenging task that humanity faces of finding solutions to several sustainability issues – climate change, water scarcity, rapid urbanization, biodiversity loss – to name just a few. The fact that solutions will have to be found to these challenges even as we ensure balanced and inclusive economic growth will require an exceptional calibre of leadership from our future generations. Those in schools and colleges today will be our future policy makers, technocrats, administrators and educationists who will lead this change.

Our homes

Water

Program design

This program is positioned distinctly – both in structure and expected outcomes. In the first phase of the program, we asked teams to write critical and well reasoned essays on various themes – by looking at issues through the lens of different socio-economic contexts and exploring interrelatedness of issues. We had debates on what is the right medium of expression for schools and colleges. We thought writing, a skill that is increasingly marginalized in the present times, will engage multiple faculties and take them through the rigour, which one may find hard to see in other mediums – like a slide presentation, video, or collage.

Over 1700 institutes across the country registered to participate in the first edition of this program in 2011. Over the last few months, we have engaged with them through various forums. We have tried to reach out to teams through online and face to face mediums. Over 50 employees volunteered to mentor teams across the country. We also leveraged our access to schools and engineering/science colleges through our long running programs, namely, education partners with *Wipro Applying Thought In Schools* and *Mission10x*. We also created a short video for earthian – that received encouraging reviews. (http://tinyurl.com/cdtm2qo)

To get a drift of the approaches being taken, we invited teams to submit a brief before the main paper. We received over 1000 abstracts. In a majority of abstracts it was hard to find original material and the teams focused on technical detailing; some proposed that their one solution would solve the issue(s) and very few explored multiple dimensions of the problem. This interim feedback was sent to participating teams – not to treat this as a typical essay completion, but to treat it more like a painting – multi layered and original, universal but grounded. At the final count, we have received more than 800 entries, 60% of them from schools.

The best entries are being selected by an eminent jury comprising people with varied experience in academia, research, non-governmental organizations and business roles. Even though the evaluation criteria and selection process are in place – picking a few best entries will not be easy, as there is no single yardstick for measuring an understanding of sustainability. The selected teams will be awarded at a daylong forum in Jan 2012, which will see a mix of sessions and talks from people in the field of education and sustainability – along with a sprinkling of fun and infotainment programs.

Going from here

In the second phase, the selected institutes will be part of a long-term continuous engagement program – in many ways the core of earthian. We aim to work towards embedding sustainability into the education system through faculty programs, school activities and projects within the institute and community and other networking forums. The success of the program is in what we will be able to do in these areas. A long-term program of this nature will have to be supported and guided by like-minded partners and experts in these areas.

The earthian team is looking forward to working with partners, schools and colleges – to create an impact and sustain it. This is an annual program – the future editions will be launched every year in the February-March timeframe.

Going through the hundreds of papers written by schools and colleges dealing with these complex challenges has been a rewarding effort for us. It was fun and at times very insightful. Hope that in case your school hasn't participated this time, you could register a team in the 2012 edition and support and encourage sustainability thinking in your school.

For any queries write to < earthian. contact@wipro.com >.

One big jumble!

Kanchi Kohli

The author works and writes on social and environment issues and is based in New Delhi. <kanchikohli@gmail.com>.

THEY marched to celebrate their world. They walked so that their lives and cultures would not slip away from their grasp. They sang with a message to us all. Nearly 5000 fisherfolk, salt pan workers, pastoralists, and farmers of the Mundra coast in Kutch district in Gujarat embarked on a *padyatra* (footmarch) in August 2011 with an affirmative vision to *"Save the sea, Save the land, Save the environment"* of their region. Their call is important for us to understand because ecologically fragile and culturally vibrant places like Mundra

are juxtaposed at a very critical juncture of the environment and development debate in the country. As much as Mundra represents thriving livelihoods and a strong connect with India's coastline, it also attracts the custodians of India's industrial dream. Both, whether we like it or not might position themselves at ends that are unlikely to meet.

Our search for sustainability is poised bang in the middle of these scenarios, which seem to be testing human aspirations. Land, water, air, and many other elements of nature are not in a position to offer limitless visions of use. Yet, there are global lifestyle demands that continue to determine the world we have and continue to construct around us. It is as if no action of ours has an impact, and if it does, nature will fix it on its own. When communities living in harmony with their ecological homes, understanding the nuances of limits, stand up and ask uncomfortable questions, do we need to respond? Can we be dismissive about their pleas as if questions of disparity or resource crunches don't matter to us? Or is there nothing one can do as the problem is too large for us to comprehend, leave alone trying to be part of the solution? Each one of us, is contributing to the world we have created, one that is full of jumbles and contradictions that we set to resolve.

One can say that our world and we, within its day-to-day functioning, work on three logical premises – the first relates to how and where we *locate the problem*, second, *the nature of human denial* and third, *symbolism or as some would call it tokenism* (with a negative connotation). There are figures and statistics to prove what I am going to say next, but I choose not to throw them in with the argument. This is because the issue of sustainability needs to move beyond number crunching. It is not just about how much forest is lost or the number of units of energy we consume each day, it is whether or not we can come on the same page, how we attempt to understand the environmental crisis that is visible in many corners of life, of course if we choose to relate to it.

Let's begin with the first. Where is it that we see that the problem of environment degradation originates or draws its strength from? The land mass around us is fast diminishing, water wars are already agenda items of heated political debates and the world has warmed up to the idea of climate change. However, each one of us has our own perceptions of the reasons for the environmental problem, which is critical as our solutions will also lie in that very realm.

Power or electricity generation is one of the most difficult issues to deal with today. While cities and industrial centres are increasingly becoming energy guzzlers, rural areas and urban slums continue to live in relative darkness. Whenever a new thermal, hydro, or nuclear power project comes up for environmental approvals with the government, it carries with it an argument that it will resolve the power shortages that are being faced in cities, towns, and even villages. The environmental argument is then subsumed within this more important premise.

However, what one needs to comprehend is that the point of origin for defining the problem is that of shortage of electricity or power. It does not deal with the question of how much urban and semi-urban lifestyles are demanding or seeking to consume. It also fails to ask whether all the industries that require this power are creating products that are adding to the crisis or are making living sustainable. What will the construction of 17 hydro-electric projects on one river basin, or adding many more coal-based thermal power plants in an already critically polluted area do to the people living there?

Therefore, for each one of us, locating the problem of the environmental crisis is very crucial, be it in our homes or classrooms. One needs to also understand that it is one that cannot only be resolved by creating ecologically friendly air-conditioners, refrigerators, or light bulbs. It is about trying to strike a balance, and about realizing what is being lost in the bargain. The high altitude lakes and wetlands, alpine forests, riverine ecosystems, and rich tracts of multi-cropping agricultural lands are irreplaceable in our quest for power. Each project, whether based on coal or hydro, requires large tracts of land, which is currently what is ensuring that the Himalayas stand strong or the River Brahmaputra continues to flow. Each one of these ecosystems supports the myriad livelihoods that give us our grains, fruits, vegetables, or fish. Moreover, it is in their life, that the quality of ours remains.

If we do not attempt to relocate the problem to where it truly belongs, we are only going to be active witnesses to places like Singrauli. A region spread across the states of Uttar Pradesh and Madhya Pradesh has been considered to be the energy capital of India since the 1970s. A three-times displaced community living around three thermal power plants lives in 30x50 feet houses, with 16 hour power shortages every day and consumes drinking water from an area where ash from the power plant is dumped. Is this sustainable and desirable?

Our next point is one that relates to denial of two levels of the human mind. Level one is to acknowledge that I am part of the problem and level two, that I can also be the solution.

Two years ago, one of the prime locations in the city of New Delhi saw a photo exhibition highlighting the lives and cultures of the Dongria Kondh tribal community living in the serene and fragile landscape of Niyamgiri in the state of Odisha. At that point of time, these hills were on the verge of being mined for bauxite, even as the community protested and courts continued to hear arguments for and against mining of bauxite in the region. The photographers explained to the residents of the capital city, living far away from this reality, how our lifestyles were the reasons why Niyamgiri needed to be mined. The mining of bauxite, a photographer said, will be used to produce thin wrappers used to package food (like Tetrapacks) and chocolates for urban consumers.

This is ironic, he said, as there is an abundance of fresh food available in the markets. But, we often find ourselves at the shelves of the supermarket with trolleys full of "fresh frozen foods" rather than at the local vendor each day. Can food really be both fresh and frozen or packaged at the same time? Is this not a misnomer that we all fall for in our everyday consumptions, and when we do, there isn't place for Niyamgiri in our thinking.

While we all might have our reasons for choosing a certain lifestyle, are we ready to accept that it is our change of life scenarios that is having a ripple effect thousands of kilometres away. For urban dwellers, high electricity consuming shopping malls, which have increasingly become the hub of our interactions, entertainment, and shopping solutions, are at the cost of denudation not so far away. After all, raw material is required for the construction of these massive structures, right? Limestone gets mined from the pristine and fragile hilly regions in the country to

In jeopardy: The Dongria Kondh tribal community living in the serene landscape of the Niyamgiri hills.

be converted to cement. Marble used in most lavish buildings in big cities like Mumbai, Delhi, Chennai, Hyderabad, comes from mining in the hilly tracts like the Aravalli ecoregion. This extremely sensitive ecosystem is an important buffer between the desert and plain areas of the country and is critical to maintain the water balance in the water scarce state of Rajasthan. The denudation of the Aravallis has meant disturbing this ecological cycle, but do we know that?

The other side of denial relates to whether any action of ours can contribute to reducing the crisis if not completely resolving it. But are we willing to engage with that question at all, even if it means making our own homes energy efficient, eating fresh food, or stop using plastic bags? At another level trying to find out a bit more about the practices of a company whose products you are buying or investing in? Is it one of those that is ready to build a massive private port in Mundra or is not really bothered about the future of the Dongria Kondhs? Each little action can make a difference, even if it seems just a drop in the ocean.

But ironically, in our times, individual and collective action has taken a limited form of *symbolism*. This seems to have permeated to many an environmental solution often detracting one and all from the core set of issues. For instance, how is an energy guzzling advertising banner asking us to save the planet on Earth Day, a sign of an environmentally conscious society? Is merely seeking payment for an activity, which causes huge tract of forests to be lost, the sign of an environmentally conscious government? Will the climate crisis be any better if we decide to go and do our bit by watching a film on climate change in a shopping mall or a theatre, which is otherwise one of the contributors to the climate crisis in the first place?

In fact, what is interesting is also how advertising is playing on this human psyche. Not so far back, the television saw mobile service providers find a solution to the deforestation problem of the country. Was it a great idea, Sirji? The advertising propagated that the more one uses one's mobile phone for talking to people, sending them short and long messages, the less paper we will use to write letters to each other. But what this advertisement chose not to see was, where the real problem lay. Mobile phone technology works on batteries, charged by electricity. Secondary school textbooks tell us that electricity is generated through coal, hydro, or nuclear related technologies. Coal lying underneath India's richest forest tracts has to be extracted through mining if thermal power is to be produced. Each year, several hectares of forests are gone officially to produce the power we need for our electronic gadgetry. Hydro-power is no innocent ally, with river basins in the Himalayas and other ecologically fragile regions under tremendous stress due to construction. So, the more cell phones, the more electricity to charge, the more batteries to discard, and the less forest for us to breathe.
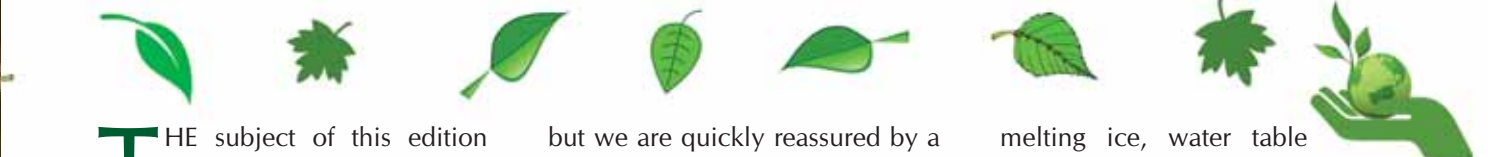
The world we live in is the one we have created for ourselves. It is one where the problem is a big jumble, and contradictions consume our actions and there are no easy answers. In many ways it will require us to return to our history, which taught us to know where our food and comforts came from. And at another level, it will need us to acknowledge to ourselves that the lives that we are increasingly creating for ourselves are highly energy-intensive based on a world that can thrive only on dislocating another. Otherwise, how can you deny that Mundra's port, Niyamgiri's mine and Himachal Pradesh's power generation cannot be environmentally benign *and* socially sustainable?

Why do we live unsustainably?

Clive Elwell

THE subject of this edition of the magazine is 'sustainability'. And yet does sustainability actually exist in our present society? It seems we have utterly failed to nurture and maintain the Earth, and a better title would be "unsustainability". Perhaps mankind has always lived this way, except for certain indigenous communities, which have been content just to survive, and have done so in harmony with nature. But mainstream civilization has always lived with an environmental credit card, has always 'borrowed' energy and resources from future generations.

It is clear that we have now reached the time when the debt is being called in. Growth, as we have known it, is no longer possible. Every living system on the planet is in decline, and the rate of decline is accelerating.

Some may ignore or deny this fact. If one's main source of information, one's sense of reality, comes from the television and mainstream media, one can be lulled to sleep a little longer. And when catching the bus to work, shopping in crowded markets, today can seem very like yesterday. The same terrible air, the same dirt and squalor …. but sometimes the mind takes one back to a scene 10 or 20 years ago, and there is a sudden realization that things really have changed.

And if we care to study the statistics, we find this subjective appraisal is backed by facts. Things actually are changing very rapidly indeed. 'Things' takes in so many different aspects of life, not just the physical environment, but the social environment, the political, the economic. Realizing this may send a momentary shiver of disturbance down our backs,

but we are quickly reassured by a chat with a friend over coffee, or the continuing domestic details at home – there is a feeling that nothing is really changing, and our lives will go on forever in the same patterns, the same taking things for granted. Of course we will get older, and eventually die, but our children will carry on in a similar way, good food, reasonable comfort, travel, holidays, maybe air travel, a certain feeling of security…

Except they won't. The time of big change has come. Not only in the lives of our children but our own. And we are not just talking about the environment. Things are breaking down on every level – socially, economically, politically. It can be seen in our education system, in the medical system. In people's physical and mental health…

As Chris Hedges[1] wrote recently, we are now living in a world where:

Doctors destroy health,
Lawyers destroy justice,
Universities destroy knowledge,
Government destroys freedom,
The Press destroys information,
Religion destroys morals,
and our Banks destroy the economy.

He was writing about the USA, but who can deny these things apply to India and the whole of the world? Have you seen those 'hockey stick' graphs'? The ones with time as a base line, a curve that is roughly flat for decades, or hundreds, or thousands of years and now is heading almost vertically upwards? The vertical axis may be population, carbon dioxide in the atmosphere, global average temperatures, acidification,

melting ice, water table depletion, loss of fertile top soil, depletion of oil reserves, extinction of species, increase in diabetes, cancer, obesity, depression – and so on almost indefinitely. Something BIG is happening, and it is happening NOW. It is very clear that the human situation, with the present trends, is – Simply Not Sustainable. Everything is pointing to an imminent and drastic collapse.

And those who vaguely think that technology or government will step in and save us are suffering unsustainable illusions.

So what to do? And what part is education playing, why is it producing human beings who are content to live in this destructive way, with no regard for the future of the planet, not caring about the sort of world they and their children are going to have to live in? Because – let us be simple – unsustainable means that we don't care about our children. We don't care what sort of chaos they are going to live in, the savage competition for resources, the health-destroying pollution, the violence, the utter lack of security.

So what to do? Faced with a world which is on fire, is there an intelligent response? And what to say to our children and students?[2] Dare we even broach the issue? Or is it simply too depressing and too hopeless? Yet to continue to teach, to impart the same old knowledge as if the children will inhabit a world that will not be too dissimilar to the one we were launched into, is clearly highly unrealistic, and irresponsible.

Can we continue to busy ourselves with distractions to escape from reality? To lose ourselves in entertainment, our personal

ambitions, the accumulation of wealth for our families? Soon we will see that "you can't eat your money". Denial of the facts has risen to such levels that climate scientists at the Australian National University have been assigned security protection after weeks of abusive e-mails and phone calls. Some scientists have even received death threats.[3]

* * * * *

Let us step back a moment, and ask: what has brought the human race to this impending doom? And is there a root cause for it all, one simple, underlying factor that we can understand, and perhaps help our students to understand? They too are confused, deeply disturbed, despairing of the future. Recently, I read this:

"I have never seen so many unhappy people before in my life," by a teacher in Canada, talking about the epidemic of suicide in students there.

Surely, it is not coincidence that so many crises are coming to a head at this point in man's history? Does this not point towards all the problems stemming from one central, basic issue? But it is a human trait to treat all problems as separate, to look for separate solutions. This approach has clearly failed.

The single factor, the central issue, surely, is the human self. The ego, the 'me', the 'I', that underpins all our actions and thoughts. This self has been in the human psyche for millennia, manipulating, working its damage, bringing about separation, division, greed. But now our advanced technology has given that self almost unlimited power of destruction; the incredibly powerful weaponry, the machines to wipe away whole forests, to remove mountain tops, to manipulate the very genetic structure of life itself.

The self denies love, denies right action. The crises we face are global in nature, and it is only by acting together that we can begin to solve them. But the self is intrinsically separative, it divides man from man.

Behind every destructive action lies a selfish human being. Someone who is corrupt, full of greed, who doesn't care about the results of his actions. And the same self corrupts simple human relationships, with its demand to dominate, possess, exploit another.

So it is the self that is the very essence of unsustainability. Real unsustainability lies in the present state of our consciousness. And if, as educators, we feel concerned – in a deep sense – with the children in our care, with their future, and the future of this planet, our home …. then this issue MUST lie at the heart of education. Everything else is peripheral. It is no use saying "Oh, but I am a geography teacher", or "I just teach the children maths, environmental science, and

so on". To remain in the rigid framework of specialization is to be a fragmented human being, and to nurture the children in fragmentation. It is fragmented human beings who are destroying the world, as they act from their isolation, with no sense of the whole.

Is it sustainable to raise children to compete with each other? To be brutally ambitious, avaricious, to condition their minds into wanting everlastingly more? To be concerned with themselves first of all? I think we need to ask if we, as teachers, are encouraging a sense of separation in students by emphasizing the ways of the self.

* * * * *

The only things that can truly sustain us are love and intelligence. By 'intelligence' I do not mean mere intellect, mere IQ – that is already nourished in the present regime, to the exclusion of feeling and sensitivity. Already we have quite enough knowledge, capacity, to solve all our technical problems but something else is lacking that we do not do it. There is no shortage of ideas on how "we could'' live sustainably – but ideas somehow do not become reality.

What is lacking is love and intelligence. What is needed is a change, a transformation, in human consciousness.

I am not suggesting of course that love and intelligence should simply be placed as items on the curriculum. But I am asking, can they infuse our consciousness, our actions? Can we at least see that only a transformation in human consciousness has any significance to the present world crisis? In actual fact there is only one crisis, and that is in human consciousness.

In investigating this, can we enquire along with our students? Because, only students with enquiring minds can become a danger to the established regime of corruption. Can we ask, for example:

If it is sustainable to pursue the activities of the self?

If it is sustainable to carry on thinking in our old patterns?

If it is sustainable to divide ourselves from others, by identifying with a race, a nation, a religious belief, some brand of politics?

And can we ask together: what does it mean to care for something that doesn't belong to the self?

And even more fundamentally, can we see that 'more' is the constant cry of the self? Can we see that to learn about ourselves, to understand all the ways of the self, is the only factor that can turn the human race around from the destructive path we are on?

Unless we actually see the absolute importance of undertaking this voyage of understanding and until as educators we find ways to take our students on the same voyage, we will continue to contribute to this unsustainable civilization, continue on our course to oblivion.

References
1. Chris Hedges – http://www.linktv.org/programs/chris-hedges-calling-all-rebels.
2. See my previous article in the May/June edition of *Teacher Plus*.
3. http://www.telegraph.co.uk/earth/environment/climatechange/8559313/Australian-climate-change-scientists-receive-death-threats-as-debate-heats-up.html.

Finally, here are some powerful resources you could use in the classroom:

"Life Ahead" and other books by J Krishnamurti

"Home" – a documentary film at: http://www.youtube.com/watch?v=jqxENMKaeCU

"What a way to go" a documentary film at: http://www.whatawaytogomovie.com/

The author is happy to enter into discussion on these issues. He has qualified in Education and has taught for some years. The limitations of the objectives of conventional education has made him experiment in various alternative schools. The most significant engagement, however has come from home learning with his own children. He can be reached at <clive.elwell@gmail.com>.

A few questions along the way to a sustainable future

Mounik Shankar Lahiri

The author is a graduate in economics with an active interest in sociology, economics and politics of social causality. He is also passionate about education, especially in the Indian context and is currently pursuing a Master in Business Laws from National Law School of India University, Bangalore. He can be reached at <themounik@yahoo.com>.

Why bother about sustainability?

THE old saying goes that it is not enough to provide a hungry man with fish to eat but he must also be taught how to fish, to ensure that he never goes hungry again. This rather simple saying is relevant as far as teaching and learning the basics of survival is concerned. But now it is being felt that it is not enough to teach the hungry man to fish but it is important to tell him 'how much' to fish. The obvious question is why should he be taught 'how much' and how does it make a difference? In the 21st century, it does make a difference. What we are going to explore now lies at the heart of the collective understanding of why 'how much' makes a difference.

We are increasingly faced with an overload of information about the need for environmental awareness and are not always sure what to make of it all. An important idea that lends a perspective to environmental consciousness is the concept of 'sustainability'. A subject dedicated to bringing about environmental consciousness finds its place in almost every possible school curriculum today. This tells us

that 'sustainability' is key to the long-term existence and continuation of life as we know it. But what our textbooks do not tell us is that 'sustainability' and its various implications do not affect every one equally. To delve deeper, we need to go back into history to gain some much desired perspective.

How can we contextualize the concept of sustainability in history and does it say anything about the carrying capacity of the planet?

Our ancestors inhabited this planet with a lot of resources but unaware of how to use these resources. A few thousand years later, the tables have turned. The march of civilization saw them learning one use after another and busting one myth after another.

In this march, natural resources, most of which are non-renewable, have played a crucial role. The industrial revolution was put into motion with the discovery of the steam engine, and all of the infrastructure, power and systems of communication of the Western world that is the model for development today has been largely through the unbridled and uncontrolled exploitation of hydrocarbons. What is established is that hydrocarbons, including coal, petroleum, oil, natural gas, and other sources of fuel, are integral to the model of development that we all subscribe to today. The evolution to the earlier saying about teaching a man how to fish, can be conceptualized in this context. Now it is increasingly being felt that it is not enough to know 'how to use' hydrocarbons but to know 'how much' of it to use as it is not in abundance. This is because the rate at which the reserves of fossil fuels accumulate on our planet is far less than the rate of current consumption.

An important concept to introduce at this stage is the 'carrying capacity' of the planet. Economists and ecologists alike find the concept of 'carrying capacity' central to the ability to sustain life and growth on this planet. Even though an ecologist and an economist are from different theoretical backgrounds, they agree that exploitation beyond the capacity of the planet to replenish consumption will lead to non-sustainability of present actions and affect the 'carrying capacity' of the planet. The notion of carrying capacity is not restricted to hydrocarbons alone but to all actions that affect sustainability like that of the need to preserve fresh water reserves and bio-diversity of the planet.

Therefore, what we are really saying is that an action is sustainable if, despite consuming a resource (mostly non-renewable) we can still expect to have enough future reserves for consumption almost indefinitely. This is rarely the case as the rate of accumulation of such reserves like coal, oil, petroleum, and natural gas, which is in the range of millions of years, is much much slower than the rate of consumption. These fossil fuels have remained the major sources of energy for the planet, especially with increased emphasis on thermal power and this has continued unabated since the first internal combustion engine in the 17th century.
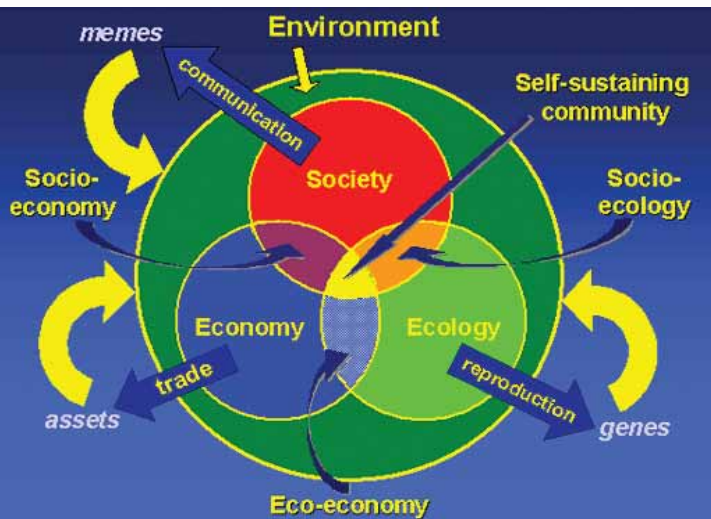
In the later part of the 18th century, the Industrial revolution which started in the United Kingdom, spread to Europe and North America, and spread unequally in pockets to some other regions geographically or historically. These pockets were the huge landmasses of Asia, Latin America, and Africa. Historically, the Western or the developed world evolved economically and socially through the exploitation of non-renewable resources. An important fact to remember is that almost all development and progress so far has been solely through the ability of humankind to harness hydrocarbons for fuelling such monumental engines of growth and development.

What are the various implications of connecting sustainability and development?

If we have to contextualize the notion of sustainability, we will conclude that sustainability is assigning the same amount of importance to our future needs and the needs of future generations as we do to our present needs. However, in trying to do so we must ensure that developing and underdeveloped regions of the world reach a stage of self-sufficiency. In most cases, a lot of physical infrastructure that is created through this process of development reduces the burden of future generations to create productive capacities of sustainability.

Is there an economic dimension to "sustainable development"?

It is only today that we hear of green technologies, are told to use other forms of energy and to sacrifice developmental needs to concerns for the future. There is no denying that green technologies are the way forward and especially renewable sources of energy should be harnessed. However, there is a huge economic and opportunity cost to the creation of the physical infrastructure that allows for such productive capacity. Hydrocarbons by far are the most inexpensive method to generate energy whether it is at large scale manufacturing units and thermal power generation centers or small scale combustion units.

David Ricardo, a notable economist analyzed the sustainability of reliance on exhaustible resources and found that prices of other commodities was directly proportional to the economic rent received on such non-augmentable resource. This is because under stable conditions, consumption would move to a progressive depletion of non-renewable resource. Today, in economic terms, inflation and prices of necessities such as everyday food items are dependent not solely on cost and quantity of cultivation, but on the price of diesel and petroleum. So, even though cereals and vegetables are more sustainable from an ecological point of view, reliance on non-renewable sources for transportation has a huge bearing on the final price to the consumer.

Can economic development be really sustainable? How can we work towards it?

Many paradigms provide operational definitions of sustainable development. The most sensible definition among them is the one which was propounded at the 2005 World Summit, which emphasized the need to reconcile environmental, social, and economic demands as the three pillars to the concept of sustainability. When the economic and social aspects are reconciled into the functional definition of sustainability, it empowers poorer regions of the world to believe in the legitimacy of pursuing the goal of development – economic and infrastructural through the measured use of non-renewable resource. This also implies that developed nations that have historically consumed a larger portion of natural resources have a greater responsibility to innovate and use alternative sources of energy.

It is imperative for students, teachers and the citizens of the country and the planet to see beyond the common rhetoric of the desirability to switch to renewable sources of energy and appreciate that there should not be a blanket understanding of sustainability as a concept. Different nations based on their place in the trajectory of development should be allowed differential access to hydrocarbons. It is paramount to be aware of the reason why poorer nations rely more heavily on non-renewable sources like coal and charcoal, that of it being more affordable with less fixed costs as compared to the setting up of generational units for renewable sources of energy.

It is thus the responsibility of all to ensure that a universally accepted definition of sustainability is not elusive and that the phrase "sustainable development" does not remain an oxymoron. It needs to be established that development can indeed be sustainable through a common and differentiated responsibility of underdeveloped, developing, and developed nations.

Is this all that there is to know about sustainability and sustainable development?

Not at all. Please understand that this by no means is an exhaustive exploration of the subject but the purpose of this article shall be best served if students and teachers are able to take a critical stance on the subject and weave developmental and social concerns into the concern for the environment. They by no means should be thought to be mutually exclusive.

Where can we look for more information?

The number one source for information on the subject is the Internet, but it needs to be explored very critically. An important source of information for teachers is http://www.naaee.net//

Notable publications include:
1. *An Introduction to Sustainable Development by Peter Rogers, Kazi Jalal, & John Boyd.*
2. *Wallace, Bill (200)5, Becoming part of the solution.*
3. *2005 World Summit Outcome Document, World Health Organization.*
4. *Adams, W.M. (2006), The Future of Sustainability: Re-thinking Environment and Development in the Twenty-first Century.*
5. *Dasgupta, P. (2007), The idea of Sustainable Development, Sustainability Science.*

What is education for?

David W Orr

We are accustomed to thinking of learning as good in and of itself. But as environmental educator David Orr reminds us, our education up till now has in some ways created a monster. This essay is adapted from his commencement address to the graduating class of 1990 at Arkansas College. It prompted many to wonder why such speeches are made at the end, rather than the beginning, of the collegiate experience.

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Six myths about the foundations of modern education, and six new principles to replace them.

IF today is a typical day on planet Earth, we will lose 116 square miles of rainforest, or about an acre a second. We will lose another 72 square miles to encroaching deserts, as a result of human mismanagement and overpopulation. We will lose 40 to 100 species, and no one knows whether the number is 40 or 100. Today the human population will increase by 250,000. And today we will add 2,700 tons of chlorofluorocarbons to the atmosphere and 15 million tons of carbon. Tonight, the Earth will be a little hotter, its waters more acidic, and the fabric of life more threadbare.

The truth is that many things on which your future health and prosperity depend are in dire jeopardy: climate stability, the resilience and productivity of natural systems, the beauty of the natural world, and biological diversity.

It is worth noting that this is not the work of ignorant people. It is, rather, largely the result of work by people

with BAs, BSs, LLBs, MBAs, and PhDs. Elie Wiesel made a similar point to the Global Forum in Moscow when he said that the designers and perpetrators of the Holocaust were the heirs of Kant and Goethe. In most respects, the Germans were the best educated people on Earth, but their education did not serve as an adequate barrier to barbarity. What was wrong with their education? In Wiesel's words: "It emphasized theories instead of values, concepts rather than human beings, abstraction rather than consciousness, answers instead of questions, ideology and efficiency rather than conscience."

The same could be said of the way our education has prepared us to think about the natural world. It is a matter of no small consequence that the only people who have lived sustainably on the planet for any length of time could not read, or, like the Amish, do not make a fetish of reading. My point is simply that education is no guarantee of decency, prudence, or wisdom. More of the same kind of education will only compound our problems. This is not an argument for ignorance, but rather a statement that the worth of education must now be measured against the standards of decency

and human survival – the issues now looming so large before us in the decade of the 1990s and beyond. It is not education that will save us, but education of a certain kind.

Sane means, mad ends

What went wrong with contemporary culture and with education? There is some insight in literature: Christopher Marlowe's Faust, who trades his soul for knowledge and power; Mary Shelley's Dr. Frankenstein, who refuses to take responsibility for his creation; Herman Melville's Captain Ahab, who says "All my means are sane, my motive and object mad." In these characters we encounter the essence of the modern drive to dominate nature.

Historically, Francis Bacon's proposed union between knowledge and power foreshadows the contemporary alliance between government, business, and knowledge that has wrought so much mischief. Galileo's separation of the intellect foreshadows the dominance of the analytical mind over that part given to creativity, humor, and wholeness. And in Descartes' epistemology, one finds the roots of the radical separation of self and object. Together these three laid the foundations for modern education, foundations now enshrined in myths we have come to accept without question. Let me suggest six.

First, there is the myth that ignorance is a solvable problem. Ignorance is not a solvable problem, but rather an inescapable part of the human condition. The advance of knowledge always carries with it the advance of some form of ignorance. In 1930, after Thomas Midgely Jr. discovered Chlorofluorocarbons (CFCs), what had previously been a piece of trivial ignorance became a critical, life-threatening gap in the human understanding of the biosphere. No one thought to ask, "what does this substance do to what?" until the early 1970s and by 1990, CFCs had created a general thinning of the ozone layer worldwide. With the discovery of CFCs knowledge increased; but like the circumference of an expanding circle, ignorance grew as well.

A **second** myth is that with enough knowledge and technology we can manage planet Earth. "Managing the planet" has a nice ring to it. It appeals to our fascination with digital readouts, computers, buttons, and dials. But, the complexity of Earth and its life systems can never be safely managed. The ecology of the top inch of topsoil is still largely unknown, as is its relationship to the larger systems of the biosphere.

What might be managed is us: human desires, economies, politics, and communities. But, our attention is caught by those things that avoid the hard choices implied by politics, morality, ethics, and common sense. It makes far better sense to reshape ourselves to fit a finite planet than to attempt to reshape the planet to fit our infinite wants.

A **third** myth is that knowledge is increasing and by implication human goodness. There is an information explosion going on, by which I mean a rapid increase of data, words, and paper. But this explosion should not be taken for an increase in knowledge and wisdom, which cannot so easily be measured. What can be said truthfully is that some knowledge is increasing while other kinds of knowledge are being lost. David Ehrenfeld, Professor of Biology in the School of Environmental and Biological Sciences, Rutgers University, New Jersey, has pointed
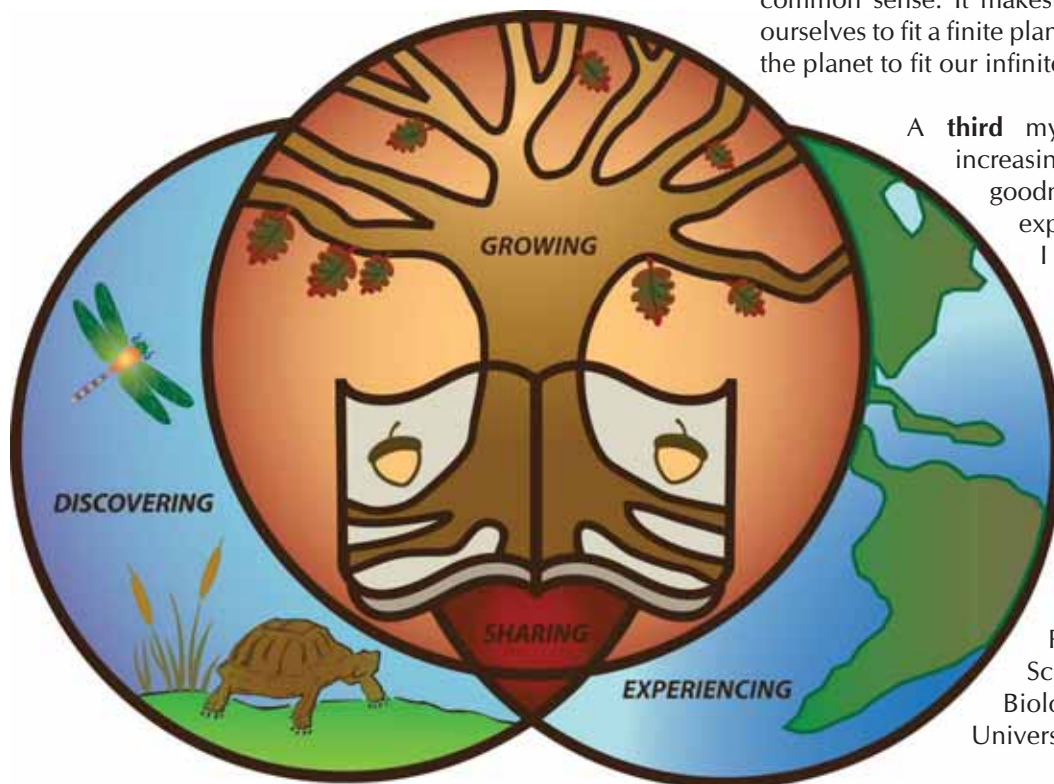
out that biology departments no longer hire faculty in such areas as systematics, taxonomy, or ornithology. In other words, important knowledge is being lost because of the recent overemphasis on molecular biology and genetic engineering, which are more lucrative, but not more important, areas of inquiry. We still lack the science of land health that Aldo Leopold called for half a century ago.

It is not just knowledge in certain areas that we're losing, but vernacular knowledge as well, by which I mean the knowledge that people have of their places. In the words of Barry Lopez:

"(I am) forced to the realization that something strange, if not dangerous, is afoot. Year by year the number of people with firsthand experience in the land dwindles. Rural populations continue to shift to the cities.... In the wake of this loss of personal and local knowledge, the knowledge from which a real geography is derived, the knowledge on which a country must ultimately stand, has come something hard to define but I think sinister and unsettling."

In the confusion of data with knowledge is a deeper mistake that learning will make us better people. But learning, as Loren Eiseley once said, is endless and "In itself it will never make us ethical (people)." Ultimately, it may be the knowledge of the good that is most threatened by all of our other advances. All things considered, it is possible that we are becoming more ignorant of the things we must know to live well and sustainably on the Earth.

A **fourth** myth of higher education is that we can adequately restore that which we have dismantled. In the modern curriculum, we have fragmented the world into bits and pieces called disciplines and subdisciplines. As a result, after 12 or 16 or 20 years of education, most students graduate without any broad integrated sense of the unity of things. The consequences for their personhood and for the planet are large. For example, we routinely produce economists who lack the most rudimentary knowledge of ecology. This explains why our national accounting systems do not subtract the costs of biotic impoverishment, soil erosion, poisons in the air or water, and resource depletion from gross national product. We add the price of the sale of a bushel of wheat to GNP while forgetting to subtract the three bushels of topsoil lost in its production. As a result of incomplete education, we've fooled ourselves into thinking that we are much richer than we are.

Fifth, there is a myth that the purpose of education is that of giving you the means for upward mobility and success. Thomas Merton once identified this as the "mass production of people literally unfit for anything except to take part in an elaborate and completely artificial charade." When asked to write about his own success, Merton responded by saying that "if it so happened that I had once written a best seller, this was a pure accident, due to inattention and naiveté, and I would take very good care never to do the same again." His advice to students was to "be anything you like, be madmen, drunks, and bastards of every shape and form, but at all costs avoid one thing: success."

The plain fact is that the planet does not need more "successful" people. But it does desperately need more peacemakers, healers, restorers, storytellers, and lovers of every shape and form. It needs people who live well in their places. It needs people of moral courage willing to join the fight to make the world habitable and humane. And these needs have little to do with success as our culture has defined it.

Finally, there is a myth that our culture represents the pinnacle of human achievement: we alone are modern, technological, and developed. This, of course, represents cultural arrogance of the worst sort, and a gross misreading of history and anthropology. Recently, this view has taken the form that we won the cold war and that the triumph of capitalism over communism is complete. Communism failed because it produced too little at too high a cost. But capitalism has also failed because it produces too much, shares too little, also at too high a cost to our children and grandchildren. Communism failed as an ascetic morality. Capitalism failed because it destroys morality altogether. This is not the happy world that any number of feckless advertisers and politicians describe. We have built a world of sybaritic wealth for a few and Calcuttan poverty for a growing underclass. At its worst, it is a world of crack on the streets, insensate violence, anomie, and the most desperate kind of poverty. The fact is that we live in a disintegrating culture. In the words of Ron Miller, editor of Holistic Review:

"Our culture does not nourish that which is best or noblest in the human spirit. It does not cultivate vision, imagination, or aesthetic or spiritual sensitivity. It does not encourage gentleness, generosity, caring, or compassion. Increasingly in the late 20th century, the economic-technocratic-statist worldview has become a

monstrous destroyer of what is loving and life-affirming in the human soul."

What education must be for

Measured against the agenda of human survival, how might we rethink education? Let me suggest six principles.

First, all education is environmental education. By what is included or excluded we teach students that they are part of or apart from the natural world. To teach economics, for example, without reference to the laws of thermodynamics or those of ecology is to teach a fundamentally important ecological lesson: that physics and ecology have nothing to do with the economy. That just happens to be dead wrong. The same is true throughout all of the curriculum.

A **second** principle comes from the Greek concept of *paideia*. The goal of education is not mastery of subject matter, but of one's person. Subject matter is simply the tool. Much as one would use a hammer and chisel to carve a block of marble, one uses ideas and knowledge to forge one's own personhood. For the most part, we labor under a confusion of ends and means, thinking that the goal of education is to stuff all kinds of facts, techniques, methods, and information into the student's mind, regardless of how and with what effect it will be used. The Greeks knew better.

Third, I would like to propose that knowledge carries with it the responsibility to see that it is well used in the world. The results of a great deal of contemporary research bear resemblance to those foreshadowed by Mary Shelley: monsters of technology and its byproducts for which no one takes responsibility or is even expected to take responsibility. Whose responsibility is Love Canal? Chernobyl? Ozone depletion? The Valdez oil spill? Each of these tragedies was possible because of knowledge created for which no one was ultimately responsible. This may finally come to be seen for what I think it is: a problem of scale. Knowledge of how to do vast and risky things has far outrun our ability to use it responsibly. Some

of it cannot be used responsibly, which is to say safely and to consistently good purposes.

Fourth, we cannot say that we know something until we understand the effects of this knowledge on real people and their communities. I grew up near Youngstown, Ohio, which was largely destroyed by corporate decisions to "disinvest" in the economy of the region. In this case MBAs, educated in the tools of leveraged buyouts, tax breaks, and capital mobility have done what no invading army could do: they destroyed an American city with total impunity on behalf of something called the "bottom line." But the bottom line for society includes other costs,

those of unemployment, crime, higher divorce rates, alcoholism, child abuse, lost savings, and wrecked lives. In this instance what was taught in the business schools and economics departments did not include the value of good communities or the human costs of a narrow destructive economic rationality that valued efficiency and economic abstractions above people and community.

My **fifth** principle follows and is drawn from William Blake. It has to do with the importance of "minute particulars" and the power of examples over words. Students hear about global responsibility while being educated in institutions that often invest their financial weight in the most irresponsible things. The lessons being taught are those of hypocrisy and ultimately
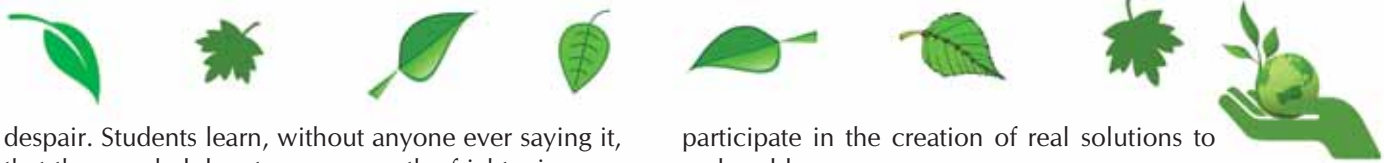
despair. Students learn, without anyone ever saying it, that they are helpless to overcome the frightening gap between ideals and reality. What is desperately needed are faculty and administrators who provide role models of integrity, care, thoughtfulness, and institutions that are capable of embodying ideals wholly and completely in all of their operations.

Finally, I would like to propose that the way learning occurs is as important as the content of particular courses. Process is important for learning. Courses taught as lecture courses tend to induce passivity. Indoor classes create the illusion that learning only occurs inside four walls isolated from what students call without apparent irony the "real world." Dissecting frogs in biology classes teaches lessons about nature that no one would verbally profess. Campus architecture is crystallized pedagogy that often reinforces passivity, monologue, domination, and artificiality. My point is simply that students are being taught in various and subtle ways beyond the content of courses.

An assignment for the campus

If education is to be measured against the standard of sustainability, what can be done? I would like to make four proposals. First, I would like to propose that you engage in a campus-wide dialogue about the way you conduct your business as educators. Does four years here make your graduates better planetary citizens or does it make them, in Wendell Berry's words, "itinerant professional vandals"? Does this college contribute to the development of a sustainable regional economy or, in the name of efficiency, to the processes of destruction?

My second suggestion is to examine resource flows on this campus: food, energy, water, materials, and waste. Faculty and students should together study the wells, mines, farms, feedlots, and forests that supply the campus as well as the dumps where you send your waste. Collectively, begin a process of finding ways to shift the buying power of this institution to support better alternatives that do less environmental damage, lower carbon dioxide emissions, reduce use of toxic substances, promote energy efficiency and the use of solar energy, help to build a sustainable regional economy, cut long-term costs, and provide an example to other institutions. The results of these studies should be woven into the curriculum as interdisplinary courses, seminars, lectures, and research. No student should graduate without understanding how to analyze resource flows and without the opportunity to participate in the creation of real solutions to real problems.

Third, re-examaine how your endowment works. Is it invested according to the Valdez principles? Is it invested in companies doing responsible things that the world needs? Can some part of it be invested locally to help leverage energy efficiency and the evolution of a sustainable economy throughout the region?

Finally, I propose that you set a goal of ecological literacy for all of your students. No student should graduate from this or any other educational institution without a basic comprehension of:

- the laws of thermodynamics
- the basic principles of ecology
- carrying capacity
- energetics
- least-cost, end-use analysis
- how to live well in a place
- limits of technology
- appropriate scale
- sustainable agriculture and forestry
- steady-state economics
- environmental ethics

Do graduates of this college, in Aldo Leopold's words, know that "they are only cogs in an ecological mechanism, such that if they will work with that mechanism, their mental wealth and material wealth can expand indefinitely (and) if they refuse to work with it, it will ultimately grind them to dust." Leopold asked, "If education does not teach us these things, then what is education for?"

Renewable energy
Twelve questions to prepare for

Sreekumar N and Ashwin Gambhir

The authors are from Prayas Energy Group, a Pune-based voluntary organization working on energy policy. Sreekumar N is an Electrical engineer with 25 years of experience in energy policy and interest in school science education. Ashwin Gambhir is a Senior Research Associate. He works on policy and regulatory issues with regard to renewable energy along with options for climate change mitigation.

IN January 2011, the United Nations Secretary-General, Ban Ki-Moon, declared that 2012 will be the International Year for Sustainable Energy for All. He called for "a global clean energy revolution – a revolution that makes energy available and affordable for all", adding that this was essential for minimizing climate risks, reducing poverty and improving global health, empowering women and meeting the Millennium Development Goals, for global economic growth, peace and security, and the health of the planet.

On the eve of the International Year for Sustainable Energy for All, more than 130 crore people worldwide (one-fifth of humanity) have no access to electricity, and 270 crore people (two-fifth of humanity) rely on traditional biomass for cooking. Nearly twenty lakh women and children, die prematurely every year (that is four every minute) due to illnesses that are a result of indoor air pollution caused by cooking. The energy sector is the single biggest contributor to climate change accounting for 60 per cent of global greenhouse gas emissions. The stated goal of the international community is to meet three objectives by 2030, namely ensuring universal access to modern energy services, doubling the rate of improvement in energy efficiency, and doubling the share of renewable energy in the global energy mix.

It is in this context that we are thinking aloud on renewable energy. We begin with trying to understand energy, put renewable energy in context and move on to understanding its different aspects. The end use efficiency, which strictly does not belong to the field of renewable energy, is also covered, since a unit of energy saved is equal to one and half to three times energy produced. We end with some ideas for action for you, your family, class, and the school.

1. What is energy?

To quote E F Schumacher, the economist thinker, famous for his book, 'Small is beautiful – Economics as if people mattered: *There is no substitute for energy. The whole edifice of modern society is built upon it... It is not "just another commodity" but the pre-condition of all commodities, a basic factor equal with air, water, and earth*. A science teacher would define energy as the ability to work. Energy is measured in Joules and exists in many forms. Energy cannot be created or destroyed, but can be transformed. At least some energy is lost during such transformations, typically as heat. The energy industry is one of the biggest in the world in terms of investment and turn over. It has strong linkages with development, climate change as well as related products like fertilizer, plastic, and textile.

2. What about India's energy supply and consumption?

Energy supply is grouped into commercial and non-commercial sources. Non-commercial implies the absence of formal markets
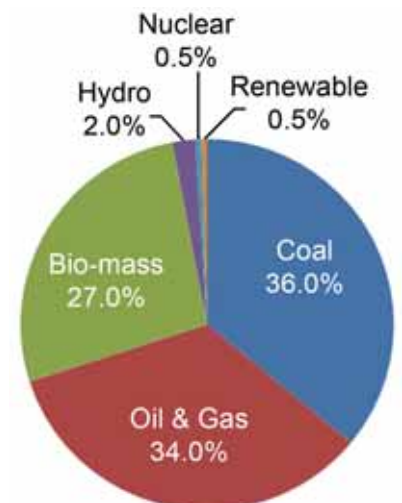

Figure 1: Energy supply mix

2012 and beyond

and covers firewood, agriculture waste, and dung (this group is called bio-mass) and muscle power (of humans and animals). This is largely a renewable resource. Many may not know that 27 per cent of the total energy supply in the country is from bio-mass and that nearly 70 per cent of our population depend on it for cooking. The remaining energy supply is through commercial energy, which includes coal (36%), oil and gas (34%), hydroelectricity (2%), nuclear electricity (0.5%) and renewable electricity (0.5%). Figures in bracket give the percentage contribution to the total energy production. One can see that coal is the most important source of energy, followed by oil and gas, then by bio-mass. Coal and oil and gas are fossil fuels, which are formed by decomposition of buried organisms. Renewables here include electricity generation using renewable sources.
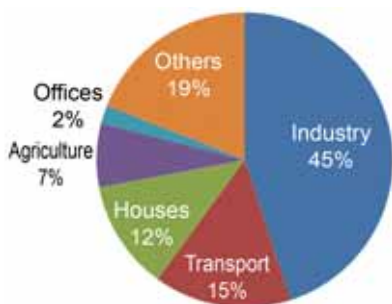

Figure 2: Commercial energy use

Non-commercial energy is largely used in houses for cooking. Commercial energy is used by industry (45%), transport (15%), houses (12%), agriculture (7%) offices (2%) and others (19%).

Industry is the highest consumer of commercial energy.

3. Can we go on producing and consuming energy like this?

No we cannot, because of two reasons. The first is that fuel supply is fast depleting. Second is that the irreversible impact of energy sector on ecology, including climate change, has nearly reached a dangerous breakdown situation. India imports 80% of its oil requirements and the frequent rise in prices is an indication of shortages to come. Petrol price has gone up nearly 2.5 times in the last 10 years and 6 times in the last 20 years. The price of fossil fuels will only keep going up. India produces coal, but local production is not sufficient to meet the country's demand and hence it has started importing coal.

More serious than the price rise is the hard truth that the world is going to run out of these fossil fuels – oil and gas in the next 40 years and coal in the next 100 years. It is not only these, we are going to run out of many resources soon, since we have been consuming much more than what the earth can support – in fact one and half times. In addition to this impending resource crisis, energy production using fossil fuels is a cause of pollution and there is the challenge of climate change. As we have seen, energy is the biggest contributor to greenhouse gas emissions, with coal-based power generation leading the list. We need to drastically change the

way we currently produce and consume energy. We must look for alternative sources of energy and more importantly, reduce our consumption.

4. What is renewable energy and why is it important today?

Renewable energy is called renewable because the sources harnessed to create energy replenish themselves within a reasonably short period of time (months or years, not centuries). These sources of energy include water, wind, sun, biomass, and heat from the Earth's interior. Fossil fuels (coal, oil and gas) are not renewable since they take millions of years to form. Nuclear is not renewable, since the supply of Uranium is limited to around 100 years. Hydro-electric stations are renewable, but most consider only small hydro-electric stations (having capacities of less than 25, 000 kilo Watts) as renewable, since they are small and do not have much adverse impact on ecology or people's livelihood. Renewable energy is the solution when fossil fuels become scarce or for those located in remote areas.

The use of a high percentage of bio-mass for cooking is typically considered a sign of under-development, for as the household income increases, they start using fuels like kerosene and LPG. But in the long run, those using renewable energy like bio-mass and muscle power will have the last laugh when the world runs out of fossil fuel. Renewable energy is

important also because, in cases like small hydro, solar and wind based power projects, there is no pollution during the production of energy. Compared to the massive

country are lit using renewable energy and there are 45 lakh bio-gas plants used for cooking.

Globally, 3.5% of electricity

generates 20% of its electricity from renewable sources.

6. What are the challenges to renewable energy? What is the future?

The challenges to renewable energy are high cost, intermittency, and its distributed nature. Because of these challenges, renewable energy today contributes only to a small share of energy production. Compared to the fossil fuel based options, renewable energy is 2-5 times costly. The typical costs for generating one unit of electricity are: coal based power: Rs. 3-4/unit, wind: Rs.3.5-4.5/unit, bio-mass: Rs.4-5.5/unit, small hydro: Rs.3-5/unit and solar: Rs.12-14/unit. Renewable electricity is intermittent since its generation depends on weather conditions. They can be set up only in few favourable locations (where bio-mass, water flow, sunlight or wind is abundantly available) and cannot be transported like fossil fuel. But this distributed nature is also an advantage since the renewable energy project can be small, located close to the place of use and even in remote locations. This eliminates the need to transport energy over long distances, which costs a lot of money and is a cause for energy loss.

Photos courtesy: Sreekumar N and Ashwin Gambhir

Figure 3: The world of renewables around us – solar cooker, bio-gas plant, drying red chilli and clothes in the sun, street light powered by hybrid wind-solar system

fossil fuel based power projects, they have much less impact on ecology and livelihoods.

5. How much renewable energy is produced in India and in the World?

Bio-mass accounts for 27% of India's energy supply and is largely renewable. Electricity is generated using wind, small hydro, solar, bio-mass based systems and contributes 5% of the total electricity produced. The proportion of renewable energy based electricity generation has been increasing at a fast pace and has gone up by 13 times in the last decade. For comparison, during the same period, the total electricity generation capacity (from all sources) went up 1.6 times. Around 8000 villages in the

production is through renewable energy. More than 100 countries have policies to promote renewable energy. Its share in electricity generation has been growing and is expected to reach 15-25% by 2020. Germany
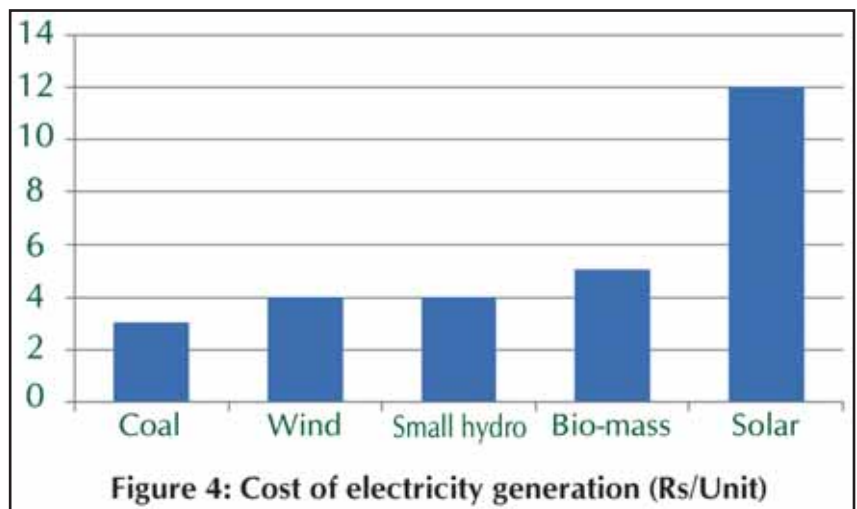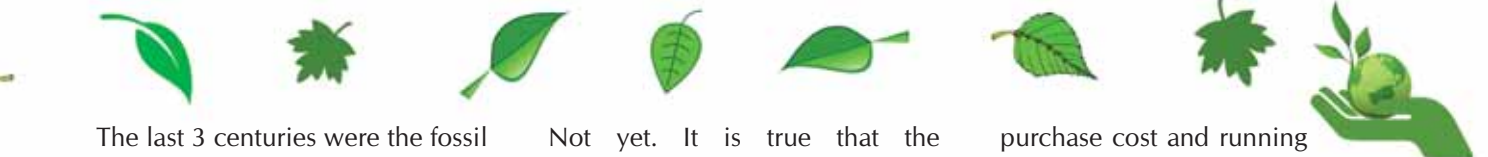

Figure 4: Cost of electricity generation (Rs/Unit)

The last 3 centuries were the fossil fuel era, but the next generation will belong to the renewables. Technology innovations and policy changes are expected to bring down the prices and increase the share of renewable energy. The cost of solar electricity is half of what it was 10 years ago and is expected to match that of coal based electricity in the next 10 years. Programs like the National Solar Mission will provide the required support.

7. Is renewable energy free? Is it only for villages and the poor?

No, renewable energy is not free, though wind, sunlight, flowing water and bio-mass are freely and abundantly available. Bio-mass takes time to gather and hence has a cost, though it may not be purchased in the market. Setting up a renewable power plant or a solar cooker costs money, which has to be recovered during its finite life time of around 20 years. To illustrate: the cost of power generation by a wind plant in a year consists of the operational costs to manage the plant (like salaries) and an annual portion of the investment cost (this is like the rent for a house).

It is not correct to assume that renewable energy is only for the villages and the poor. It is true that the rural population depend on bio-mass as the main source of energy and that many small renewable systems cater to the villages. But today many large wind, small hydro and bio-mass based electricity generating stations are connected to the electricity grid and thus supply power to all consumers. Solar water heating systems are used in urban houses, hospitals, and hotels.

8. If renewable energy is so good, then why can't we do away with all the others?

Not yet. It is true that the percentage of renewable energy in total energy supply is increasing in India and all over the world. But the prices have to come down and technology has to stabilize so that there is more capacity and spread. Since many renewable sources are intermittent (wind, solar, tides), it is best to complement renewable with non-renewable sources. Thus, a mix of renewable and non-renewable sources will be used till the world runs out of fossil fuels.

9. What is end use efficiency? Do we need energy or energy service?

End use efficiency is reducing the use of energy at the user's end, without reducing comfort. Examples are: using a high efficiency cook stove, using a vehicle with better mileage, using LED/CFL light in place of incandescent bulb or efficient refrigerator in place of an in-efficient one. To understand this better, it is important to understand two ideas: energy service and life time cost.

Energy service is the service provided by energy. What people need is energy service and not the energy per se. One needs lighting in the rooms, which could be provided by sunlight or efficient bulbs – one does not always need electricity. One needs hot water and airy rooms, not electric geyser or fans. One needs smoke free kitchens to cook food as fast as possible. The key to end use efficiency is identifying the energy service that is required and finding the most efficient way of providing it.

The lifetime cost of an energy consuming equipment is the total cost the user has to pay for the use of that equipment in its lifetime. This will have a one-time

purchase cost and running cost, which has to be paid all through its life time. For an air conditioner, life time cost will be the cost of purchase, the cost of electricity bills and the cost of periodic maintenance over its life time, which is around 10-15 years, will be the running cost. Inefficient equipment typically has low purchase cost but high running cost and hence higher life time cost, compared to an efficient alternative. Purchase decisions should be made based on life time cost and not one time cost.

10. Do end use efficiency measures really ever work?

Yes they do, though they do not always come free and require conscious efforts. Implementing end use efficiency to gain electricity mega watts (negative watts) costs only half of what it costs to set up new generation. Waste and misuse can be reduced by changes in habit, which do not cost money. Changing the temperature setting of air conditioners to comfort level, optimizing re-heating of food or using the stairs instead of lifts are simple acts that anyone can do. Bringing down the consumption level of processed products (water, clothes, paper, plastic or processed food) by using only what is needed, rather than basing it on affordability, advertisement, fashion or other factors will help a lot.

The potential for savings is high in many areas and there are examples from all over the world where it has worked. Efficiency of cooking stove can be increased from the current low of 10% to 20% at a low cost. In case of household appliances like refrigerators, TVs and fans, 40-50% improvement in efficiency is possible by using super-efficient appliances available in the market. Environmentally conscious

building design can significantly reduce energy use and be very economically effective. Factories and offices too can save significant amounts through use of efficient equipment. An innovative end use efficiency program was the Akshay Prakash Yojana implemented in Maharashtra in 2006. This was a joint effort of the electricity distribution company and rural consumers. Consumers voluntarily agreed to discard inefficient appliances like electric stoves, to use electric pumps only during night time and to collectively prevent electricity theft. In return, the company provided longer hours of power supply to the village. A saving of 1000 Mega Watts was recorded across the State due to this.

11. All that is fine. What can I do tomorrow?

First thing to do is to take stock to see how much energy you use and to explore what could be done to reduce it and shift some of them to renewable options. You can see what is happening in your house – how much you pay for energy – for lighting, water heating, weather comfort using fans, coolers or air conditioners (electricity bill), transport (bus pass, auto-rickshaw, petrol/diesel), cooking (gas, kerosene), water pumping, lift, etc.

There are many ways in which you can save energy. You can start with what you can do and improve as you go on this journey. The important thing is to begin! Start by walking when you can, using public transport, cycling, switching off unwanted lights, not leaving appliances on stand-by (that could consume 5-20% of what they usually consume and stand-by power consumption could be 2-3% of the total consumption in a home) and exploring renewable energy

options like solar water heater for your home. The Bureau of Energy Efficiency has implemented energy efficiency labels for appliances like refrigerators, air conditioners, electric geysers, and TVs. When you purchase an appliance, choose the one with higher efficiency, as indicated by the labelling.

▶ Collect electricity bills for the past 12 months. Note the monthly consumption (in units) and the bill amount. Prepare a graph showing both these across the year. There would be a correlation between consumption and the bill.

▶ Note down a list of all the electrical appliances in your home and check their power rating (either in Watts or kilo Watts, given on the label). Estimate the approximate number of hours in a day that each appliance is functioning to infer how much electricity is being used. Multiply the power rating in kilo Watts by the number of hours to arrive at the electricity used, in units (1000 W = 1 kilo Watt). Does this figure tally with what is given in the electricity bill?

▶ Practice energy saving tips for a month and check if there is any change in your electricity bill.

12. What can my class and school do?

The class can consolidate home experiences and study the differences across homes. Does the electricity bill depend on the size of the home? What is the main reason for high bills? Using data from different students, prepare a graph showing the consumption and the bill. Is it a straight line?

At the school level, study can involve the energy use for different

activities (water supply, lights, fans, air conditioning, transport, etc.), and end use efficiency options. With an energy meter, power (in Watts) and energy consumption (in kilo Watt hours or units) can be measured for different activities to identify the high consumption equipment. In most offices, air conditioners account for 60-70% of the electricity bill. You can visit an energy efficient building or an old monument to appreciate natural air conditioning and lighting.
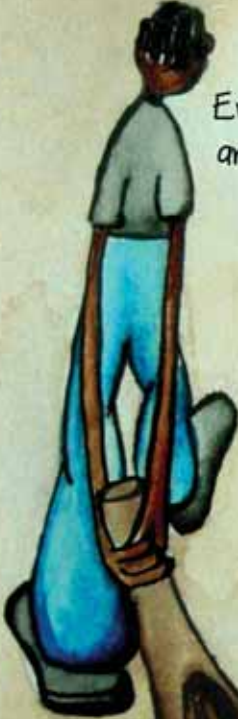
You can ask someone working on renewable energy or end use efficiency to demonstrate or speak to teachers and students. This can lead to a project on renewable energy or end use efficiency like making a box type solar cooker or a solar water heater. This can also lead to a debate in class on the challenges of renewable energy.

For additional information, you could refer to the following.

1. Energy Matters: A School Energy Education Guide, Centre for Environment Education, Ahmedabad, 2000 (Gives an over view and many ideas for activities)

2. Web site of the Ministry of New and Renewable Energy (has information on renewable energy in India): http://www.mnre.gov.in/

3. Web site of the Bureau of Energy Efficiency (has information on energy efficiency appliances, and tips for energy saving): http://www.beeindia.in

4. Energy Kids for teachers – Web site of US Energy Information Administration (has information and activities): http://205.254.135.24/kids/energy.cfm?page=6

Every minute about 50 acres of rain forest are destroyed and some 25 species become extinct!

LAND BOUGHT
FOR CONSTRUCTION
OF LUXURIOUS MALL

— Alankrita

Thinking about and responding to Climate Change

Why and how should we care?

Sharachchandra Lele

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WHEN I give an introductory lecture on environmental issues to a general audience, I often begin by asking people to list out the most pressing environmental problems. I then take the phrases tossed out, such as 'deforestation', 'water scarcity', 'air pollution', 'ozone hole', or 'biodiversity loss', and organize them into two contrasting groups: 'resource scarcity' versus 'pollution', or 'Southern (developing)' versus 'Northern (developed)', or 'empty-stomach' and 'full-stomach'. I then go on to discuss how these categories are useful, as they highlight different perspectives on the 'environmental crisis', but are also limited, as developing countries such as India are hit by both kinds of problems.

I have been doing this exercise off and on for more than 20 years now, with audiences in Indian colleges and American universities, with students, teachers and activists. One trend I have noticed is the increasing 'northernization' of Indian audiences: so ozone, biodiversity and climate change pop up immediately in the list, while water scarcity and firewood

scarcity are mentioned much later (if at all). And of course, there is a phenomenal rise in the prominence of 'climate change' in the list – these days it is often the first one to be mentioned. A third tendency is to use CO_2 emissions and air pollution interchangeably, and to think of tree planting as a panacea for all environmental ills. With the Indian 'mindspace' being increasingly colonized by concerns and ideas emanating from a 'globalized' (read 'westernized') media that also believes in over-simplifying issues, are we in danger of forgetting the more pressing and still unsolved issues closer home? Is climate change really an important problem for Indians to focus on? Why or in what way? And are we thinking about it rigorously enough?

The science of climate change
At the core of what we currently call Climate Change (CC) is the greenhouse effect. This effect originates from the fact that certain gases (primarily CO_2, water vapour and methane) absorb (and re-radiate) infra-red radiation emanating from the Earth's surface, thereby trapping some of the heat that would otherwise have escaped.

Note that in the absence of the atmosphere and the greenhouse gases (GHGs) in particular, the Earth's temperate would have been -17°C, making life on earth impossible. Thus, GHGs have a crucial positive role in our lives.* The basics of the greenhouse effect are depicted in Figure. A vast amount of information is now available on this subject,
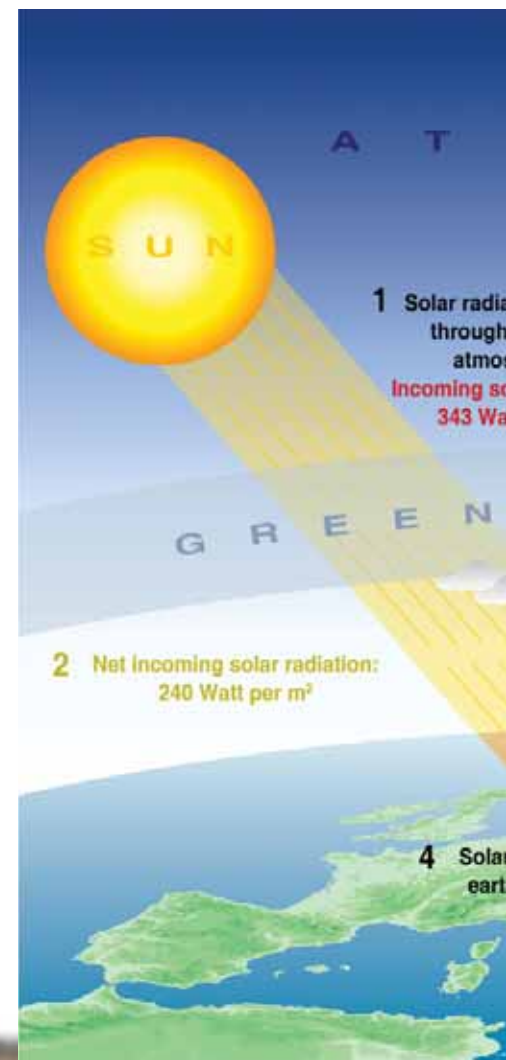
*Note that the term 'greenhouse' effect is slightly misleading: greenhouses that are used to grow vegetables in cold climates stay warm because they trap the air and prevent it moving up after heating up (convection), not by blocking outgoing radiation.

including www.ipcc.org http://climatechangeeducation.org/science/index.html.

There are many reasons why this climatic balance could shift. Sunspots increase solar radiation periodically, typically every 11 years. Changes in the earth's orbit (distance from the sun), axial tilt and precession that occur on cycles of about 12,000 to 100,000 years have been the cause of periodic ice ages in the past. The current CC problem, however, originates from an unprecedented increase in certain GHGs, particularly in CO_2 and methane. CO_2 concentrations in the world's atmosphere have risen from a 'pre-industrial' level of about 250 parts per million (ppm) to 380 ppm today. This increase has taken place since the 1800s, and can only be the result of human activities, primarily the burning of fossil fuels (coal, petroleum, natural gas) and to some extent deforestation. It has also been shown that although some of the CO_2 emitted since the 1800s has been absorbed in the oceans, the rest is accumulating in the atmosphere.
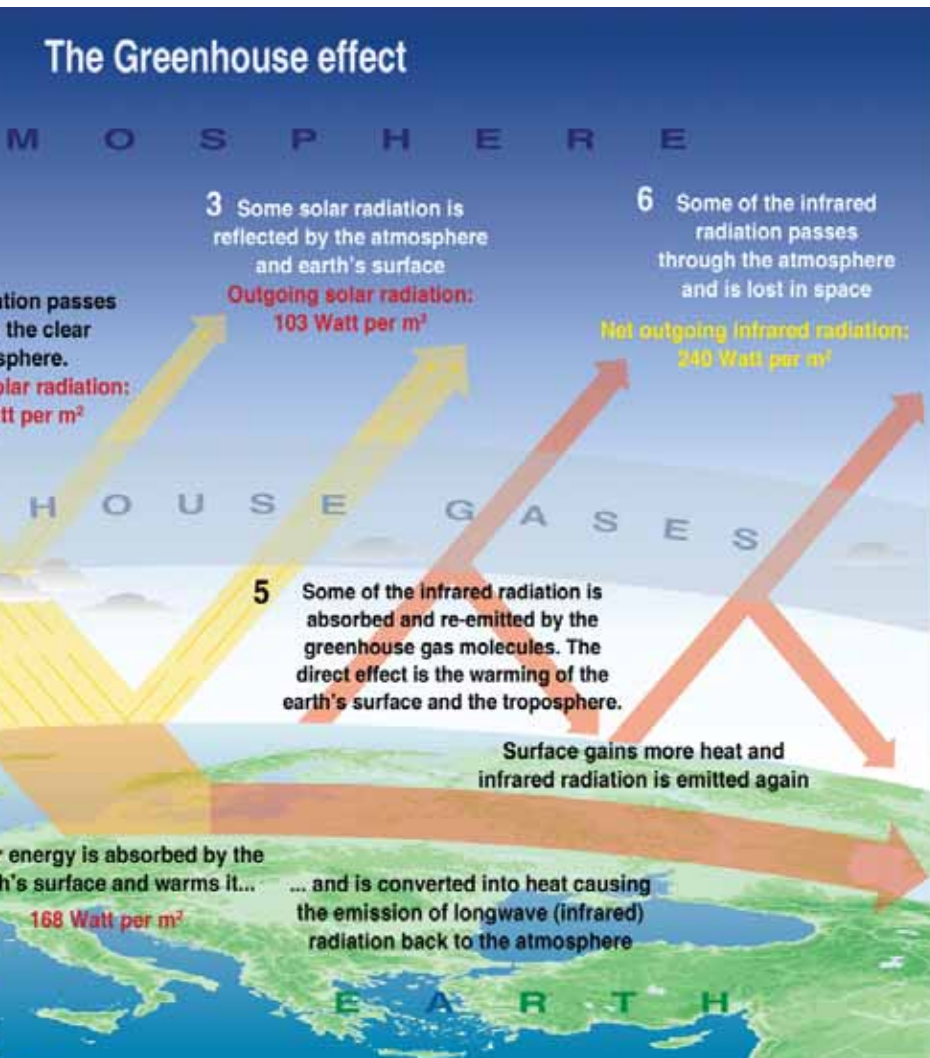
Scientists have used a fascinating array of data and methods of analysis, and come to the same conclusion: that the global temperature is increasing, that it is strongly linked to increases in CO_2 in the atmosphere, and that this increase is caused by humans (see http://www2.sunysuffolk.edu/mandias/global_warming/). Yet one finds right-wing US-based think tanks such as the Liberty Institute holding seminars across the world, arguing that the climate is not really warming up, or if it is warming up that is because of sunspot cycles or other natural phenomena and not because of fossil fuel use, and in any case the climate system will re-adjust easily. Teachers at all levels need to educate themselves about these glib arguments and their flaws.

Almost equally problematic is the misconception about what role 'trees' can play in reducing CC. Trees sequester carbon as they grow, but stop sequestering beyond a point, and all the sequestered carbon is released back as CO_2 (or worse, methane) when the tree dies and decays. For tree planting to play a net positive role, an area that did not earlier have trees must be planted and then kept tree covered *in perpetuity*. Even then, one tree may only sequester a few kilograms of carbon per year, so one needs to plant (and maintain) a lot of trees (say 1 hectare with 1000 trees) *each year* to offset just the emissions of 1 average Indian. Imagine how much land we would require to offset the emissions of the 10 million richest Indians, not to mention the 200 million Indian middle class?

Why is it a problem?
One might wonder why a 1°C increase in average global temperatures would be such a cause for concern. Wouldn't many cold countries welcome such a change? And even in India, what does 1° matter when we are already roasting in 45° heat in some parts? Indeed, in the early days of discussion on climate change, several temperate countries such as Russia felt it might benefit them. However,

The Greenhouse effect

A T M O S P H E R E

3 Some solar radiation is reflected by the atmosphere and earth's surface
Outgoing solar radiation: 103 Watt per m²

6 Some of the infrared radiation passes through the atmosphere and is lost in space
Net outgoing infrared radiation: 240 Watt per m²

...tion passes ...the clear ...sphere.
...lar radiation: ...tt per m²

G R E E N H O U S E G A S E S

5 Some of the infrared radiation is absorbed and re-emitted by the greenhouse gas molecules. The direct effect is the warming of the earth's surface and the troposphere.

Surface gains more heat and infrared radiation is emitted again

...r energy is absorbed by the ...h's surface and warms it...
168 Watt per m²

... and is converted into heat causing the emission of longwave (infrared) radiation back to the atmosphere

E A R T H

the Earth's climate system is so complex that we have now realized the repercussions are multiple and could cascade into something dramatic. For instance, where glaciers are just at freezing, one degree can cause them to melt permanently and that ice on land will end up as water in the oceans. A negligible addition, did you say? Well, firstly, glaciers and snow cover in the Himalayas ensure that winter snowfall feeds the Indo-Gangetic plain in the summer. Secondly, a small amount of warming might make entire ice sheets slip off the Antarctic land mass into the oceans, raising sea levels by several metres. Thirdly, too much fresh water entering the Atlantic suddenly may change salinity levels, and stall the Gulf Stream, which brings warm water from near the equator to northern Europe. Fourthly, declining snow cover globally may reduce the Earth's whiteness and therefore its ability to reflect sunlight (called albedo) to lead to further warming. Similar complexities and feedbacks abound in many other parts of the climate system, which is why scientists now use the term climate change, and not global warming. (see http://www.democracynow.org/2008/7/3/global_disruption_more_accurately_describes_climate).

Moreover, the impacts are very unevenly distributed, and poor tropical countries are likely to be worse hit than many others. While initially it was thought that climate change might benefit India through increased rainfall, it has now become clear that the impacts are going to be quite negative. The melting of Himalayan glaciers has now been well established by our own ISRO. A country like India with large areas of rainfed agriculture that depend upon the monsoon rains is extremely vulnerable to unpredictable changes in the monsoon – and rainfed farmers are already amongst the poorest in rural areas. Moreover, India has a long and densely populated coastline, which could be dramatically affected by sea-level rise. Small island nations could even drown completely! The

Melting Himalayan glaciers

capacity of developing countries to adjust or adapt to climate change is also much lower: a person in the USA might simply crank up the air-conditioning, but what does a person living in a slum and already vulnerable to summertime heat-waves do?

Who caused it? Who should fix it?

At one level, assigning responsibility for causing climate change should be very straightforward. CO_2 is the major GHG, and fossil fuel burning has been the major source of CO_2 in the past two centuries. The industrial revolution was powered by fossil fuels – initially coal and then petroleum and natural gas. Thus, all artefacts and users of those artefacts that came out of this revolution are party to CC: cars, trucks and trains, coal-fired power plants and air-conditioners that draw power from them, steel mills and cement factories, LPG-based cooking, and so on. Even traditional lifestyles can cause some CO_2 emissions: for instance, if firewood use leads to permanent deforestation, or when forests are replaced by pastures. It should then be obvious that the bulk of the responsibility lies with industrialized societies and therefore with heavily industrialized countries. Since the 1800s, industrialized countries, containing about 1/5th of the world's population, have contributed 2/3rd of the total CO_2 emitted globally. Even today, in spite of all the growth that has taken place in China and India, more than 50% of the annual global emissions of CO_2 still come from developed countries. Most important, if one factors in the population that is emitting this CO_2, India's emissions are below 2 tCO_2eq/capita/year while those of the USA are at 24 and

the European Union as a whole is above 10. Yet, there are many controversies in the international debate on responsibility.

Firstly, GHGs differ in their effectiveness in blocking infra-red radiation, and also linger in the atmosphere for different periods of time, so the net impact of emitting one additional molecule of a GHG in terms of its contribution to trapping radiation varies. For instance, a molecule of methane is much more effective than a molecule of CO_2, but CO_2 stays much longer in the atmosphere. For a meaningful discussion on human contributions to climate change, scientists have to come up with a common measure, which is called Global Warming Potential of each GHG. The definition of GWP is necessarily somewhat arbitrary, especially in terms of what time frame is considered. Using a short time frame in this calculation pushes more blame on methane-emitting developing countries than longer time frames, as the Delhi-based Centre for Science and Environment pointed out early on (see http://www.indiaenvironmentportal.org.in/books/global-warming-unequal-world-case-environmental-colonialism and a host of other excellent analyses at www.cseindia.org). After much controversy, countries have agreed to use a 100-year time frame to calculate CO_2 'equivalence' of methane and other GHGs (which leads to the unit 'tonnes of CO_2eq').

Secondly, should historic emissions be considered in assigning responsibility? Many of us living in India, having suffered the colonial yoke, would say 'yes' for a variety of reasons: those who benefited from industrialization

should also be willing to pay its cost. Moreover, industrial countries did not just 'happen' to get industrialized first, much of their industry was fuelled by resources extracted from colonies. The poverty in developing countries can be traced substantially to colonialism. And surely, each person has a right to a minimum quality of life, to some 'survival emissions'. So emissions per capita (either current or cumulative) seems a much more just measure of responsibility than simply emissions per country.

On the other hand, industrial countries argue that they cannot be held responsible for emitting CO_2 when it was not known to be a pollutant. The only international agreement reached so far on climate change (the Kyoto Protocol) also ignored historic responsibility and asked for minuscule reductions in emissions from the top industrialized countries. Even suggestions that equal rights per capita be enforced gradually, allowing large emitters time to reduce their carbon footprint, has not met with agreement. Some even argue that being located in temperate regions, developed countries have a right to more emission because they need to stay warm, forgetting that by the same argument, Indians would be demanding huge emission rights for staying cool in a hot climate! Calls for industrialized countries to provide financial and technological support to developing countries in return for writing off any historical climate debt have of course fallen on deaf ears. Indeed, the USA in particular did not even sign the Kyoto protocol and is working actively to subvert any agreement that will require them to seriously reduce their domestic emissions.

Instead, they have tried to target China and India as being part of the biggest emitters (which is largely an artefact of their large populations). Thus, no reasonably fair global agreement on CC seems to be in sight. (see www. ecoequty.org for more details).

And there is of course the debate over what constitutes a 'sustainable level of emissions'. Given the enormous uncertainties about how climate might change over the next (say) 100 years, what effects it will have, and to what extent in the long run (say 500 years) the climate system will equilibrate and absorb current GHG emissions, the answer to this question varies tremendously. Should we try to limit temperature change to less than 2°C? How much time do we have to do this? What does this mean in terms of how much we can emit between now and then? And then of course how should this 'carbon space' be allocated across countries or regions or communities? There appears to be a loose consensus amongst many scientists that a temperature rise about 2°C may cause 'runaway' climate change with possibly catastrophic impacts, and further, to do this requires containing global GHG concentrations to under ~450ppm (or CO_2 under 400). But even these estimates may turn out to be over-optimistic.

Engaging with CC
CC is thus a peculiar problem: it is truly global in the sense that virtually everyone contributes to it, and virtually every one is affected by it. This requires genuine global cooperation – we can do nothing to unilaterally solve or even make a dent in the problem. Even if India were to completely stop using fossil fuels tomorrow, our glaciers

would continue to melt and our coast would still get inundated. The major responsibility for mitigation lies with developed countries, as also the need to help developing countries to adapt or 'climate-proof' themselves to a small degree. And yet, developed countries (particularly the USA, Canada, Australia, Japan, and Russia) have refused to accept any significant part of this responsibility. Any international negotiation seems to lead to more pressure on us to 'start cutting back', but hardly any commensurate efforts from the major emitters. Moreover, these emitters want to 'outsource' whatever little emission reduction they promise by paying for (say) planting trees in India. And many governments, including the Indian government, are jumping at these 'carbon trade' deals without insisting on an overall fair agreement on who is required to reduce how much.

How then does an Indian citizen respond to CC? Should we call it a 'Northern conspiracy to keep us underdeveloped' and simply ignore it, and pursue our economic dream? Should we get scared by the impending CC impacts and put pressure on our government to sign any deal that will lead to softening the blow? Should we look at it cynically as a great opportunity to make some money planting trees or rather to channel money to state forest departments to fill the same old holes with new saplings? Should we use it as an excuse to build more Koodankulam-type nuclear power plants and brush aside their environmental risks because they are supposedly 'carbon-neutral'? Should we preach the 'plant-more-trees' mantra to our children while we all sit in front of TVs and get brainwashed into consuming

more cars, more gadgets and more air travel to 'eco-tourism' destinations around the world?

Probably none of these approaches will make sense to a thinking person. It is true that most Indians are below any reasonable estimate of 'sustainable per capita emissions'. But it is also true that we, as a country and a society, have adopted the same model as the developed countries: industrialization and consumerism to drive economic growth. We are already seeing the environmental impacts of this model – declining water levels, polluted air, and displaced people. Climate change should be seen as the last straw on the camel's back, a wake-up call that should make us question the model we have blindly adopted. Calculating one's carbon emissions may not be the most relevant thing to do to improve our local environment or to soften our indirect footprint on the lives of tribal and other communities in India's hinterland. But because carbon calculations are relatively simple (see, e.g., http://www.cleanindia.org/carbon/ ClimateChange.htm), and because carbon emissions are strongly correlated with other kinds of resource use, they provide us an entry point into looking at our lifestyles and the systems of governance that promote them.

India's growing energy disparity

Social innovation – need of the hour

Harish Hande

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A majority of the world's 1.6 billion un-electrified population lives in India. More than half of the women and children who die in the world because of indoor air pollution are Indians. These statistics are not being presented for shock value but to put reality right up front. It also puts the 8-9% growth of India into perspective. Now let me throw out one last statistic for the reader – at least 500 million people in India survive on one dollar or less per day. Most, if not all, are the very people who do not enjoy the benefits of energy services that most of us in urban India and rest of the world take for granted.

The growing disparity in energy consumption, which has resulted in the increasing divide between the rich and the poor is socially, economically, and environmentally unsustainable for India. Repeated studies around the world show that maps of conflict zones and maps of energy and economic poverty overlap. Educated Indians – and those we are responsible for educating – should take note of these problems rather than sweeping them under the carpet or believing that market forces and market capital will provide the solutions. Market forces and market capital have never in history solved the basic needs of the poor, in any country.

Photos courtesy: SELCO INDIA

Poverty, a major threat

The greatest threat to India and the world today is poverty. It is a major threat to social sustainability – the basic fabric of the eco-system needed for all businesses to flourish. Dig deep and one will realize that lack of access to reliable energy is critical to pulling people out of poverty. Access to energy means education, economic development, cleaner living conditions – all aspects many of us Indians take for granted.

To alleviate poverty, one needs to increase income. To increase incomes, one needs to create income-generating activities in the un-served areas. Most income-generating activities require access to reliable energy. Contrary to popular economics and policies, it is not advisable to wait for centralized energy solutions to provide that particular economic impetus. Inefficiencies, hidden subsidies, poor implementation and lack of transparency have never been properly factored while comparing centralized versus decentralized energy options. Also, one needs to factor in the loss to the world's overall well-being on not providing the poor with reliable energy. The result is very evident – the large numbers of poor have remained poor with no options of avenues for increasing their income or their quality of life. The cost is not only enormous but is often neglected.

Today are we, the educated Indians, hiding behind the poor? Are we not subsidizing ourselves by enjoying the services of the poor, in the name of providing them with employment, e.g., maid servants, drivers, etc? Many companies are defending their strategies

as inclusiveness by producing 'cheap' products. The justification of inclusion here is that by buying the cheap products, the poor are indirectly contributing towards payment of their salaries.

India can call itself a potential superpower and a leader only when its responsible citizens truly include all its marginalized. This would happen when the poor become employers and business owners themselves. Inclusiveness is when the rich also start buying from the poor. Today many of the solutions and supply chains are one-way traffic, from the rich to the poor. The only traffic that goes the other way (poor to the rich) is money!

Today, India stands at the crossroads. It wants to be a superpower and a force in the world. It has a wonderful chance to be a leader by being the solution provider of the world: innovative sustainable solutions to eradicate poverty in a sustainable manner.

The need, taking into consideration the population and energy diversity of India, is social entrepreneurs and social enterprises. Social entrepreneurs and enterprises provide sustainable solutions where typical market and government solutions have failed. Let me explain.

To provide energy access to the poor, a complete ecosystem needs to be built. The sustainable ecosystem consists of the poor as clients and owners, customized solutions, innovations in business and financial models (many of them do not exist today) and pro-poor policies. Let us again look at the needs and their enormity –

a) There are huge populations in greatest need of energy services and incomes.

b) The poor are not currently being served by the industrial energy model, the opportunities for disruptive innovation are likely to be the greatest here, meaning that there will be more development AND climate co-benefits from interventions aimed at these groups.

c) The bottom of the pyramid has the potential to provide enormous scalability for appropriately designed innovations. Here, sustainable scaling means replication – thus laying more importance to site-specific solutions (technology, finance, culture, etc). A traditional definition of scale might just take away the freedom of choice for the poor.

These solutions can only be provided by enterprises that not only concentrate on shareholders as their

Income generation also ensures their ability to pay for access to energy.

◆ There is a need for setting up training institutes where generalized broadbased technical skills is provided.

◆ Involving local financial institutions, to create targeted financing, to finance energy products and technologies.

How this can be done?
There is a need to completely shift the very traditional market thought process of innovation by:

a) Completely designing, from bottom up, need-based products (for income generation) and not concentrate only on redesigning existing products in order to sell it to the poor.

primary stakeholders or quarterly results as their goals. There are proven sustainable models (financially and socially) and processes that link sustainable energies to poverty alleviation. Social enterprises have a deeper understanding of the local economy and explore innovative ways in which energy generation can be coupled with better livelihoods that are locally relevant and feasible: inclusive in the true sense. This would mean that all the stakeholders are equal – the end-users, employees, management, board, and the shareholders.

What needs to be done?
To provide better rural energy and access to the poor, the following need to be addressed.

◆ Focus on need-based value product options using sustainable energy.

◆ By creating stable supply chains for poor households to access energy, like clean cooking. Providing these is very critical and will ensure energy equity.

◆ Energy access should be linked with productive end use that will uplift the income of the poor families.

b) Creating new segment-based financing (matching the cash flows of the poor) and NOT fitting existing financial products that were designed for the rich.

c) Creating reverse market linkages (encouraging the poor to be a part of the formal economy) and NOT always creating a supply chain that flows from the rich to the poor.

d) Thinking about the poor as partners and not as beneficiaries.

India, as a nation, was born on the mantra of decentralization. Even for providing energy access it should look at decentralized energy, decentralized solutions, decentralized enterprises and decentralized eco-systems: for which we need more social entrepreneurs and social enterprises. All these are fundamentals of creating a strong nation and a leader of sustainable alleviation of poverty. India has the necessary tools to demonstrate models of linking sustainable energy to poverty alleviation that could be easily replicated in Africa, South America, Iraq, and Afghanistan etc: Now, my fellow Indians, it is the time to prove it.

Green thinking

Ask the children to come up with lists of inequities relating to resource generation and utilization. They could do a simple mapping exercise where they look at the number of electrical or energy-utilizing items in their homes and interview someone from a different socio-economic category to get the same information from them. What, in their minds, is a fair allocation of such resources? What does inclusion mean from an energy-policy standpoint?

Sustainable development – an oxymoron

Sagar Dhara

The author belongs to the most rapacious predator tribe that ever stalked the earth – humans, and to a net destructive discipline – engineering, that has to take more than a fair share of the responsibility for bringing earth and human society to tipping points. If you still want to write to him, his email is <sagdhara@gmail.com>.

D EVELOPMENT implies energy use. But fossil fuels, which meet 85% of the world's commercial energy needs are running out as we have overdrawn energy from nature primarily to serve the greed of developed countries and the rich. No other viable alternative energy sources are currently in a position to replace fossil fuels. Sustainability implies reducing energy consumption. Sustainable development, today's catch-phrase, is an oxymoron[1]. For sustainable living, we need to reduce our energy consumption by at least 40%, move towards energy equity and replace today's dominant global outlook of "Gain maximization for a few with" by "Risk minimization for all."

Energy is central to development

In an interaction with some engineering college students some months ago, I asked my young friends what they thought was the relationship between human development and engineering sciences. The responses broadly defined development as 'upgrading' entities such as land, infrastructure, city spaces, markets, etc. For example, land development meant upgrading the utility of land.

We stayed with that understanding and I posed my next question, "What factors affect upgrades the most?" After some discussion, the dialogue isolated two factors – knowledge and energy use. Knowledge of what? Of energy conversion.

We felt that we had made a good beginning, so we decided to continue the dialogue. After I posed each question, the students provided various answers and there was heated discussion before we arrived at a consensus.

Why is energy so very central for development? Because no physical, chemical, geological, and biological transformation is possible without energy expenditure. For example, plants grow using sunlight, transport happens using some form of energy – animate, fossil fuels, wind or water, continents and seas are shaped by geo-thermal energy, goods and services are produced expending energy.

Energy in history
Now the discussion was getting interesting. Historically, what were the energy sources that humans used? Humans have always been solar farmers, i.e., they used solar energy, either directly or indirectly to fulfill their needs.

From the time the Cro-Magnon man made his appearance 50,000 years ago till the time agriculture was invented 10,000 years ago, humans have used their muscle power and biomass as energy sources. Domestic animals were used for the purposes of transport. Animate energy (human and animal energy) is a product of sunlight. Plants use it to convert atmospheric carbon dioxide (CO_2) into biomass.

Animals and humans are dependent either on plants or herbivores for their energy intake.

Fossil fuels (coal, oil, gas) began to be used 500 years ago and have gradually replaced biomass and animate energy as the primary energy source to power human society. Fossil fuels are products of ancient sunlight as they were formed by the Earth exerting pressure and temperature on dead plants and animals from the Carboniferous period (300 million years ago). Today, we use 12,000 million tones of oil equivalent (toe is the energy in one tone of oil), 85% of which is from fossil fuels.

Energy consumption has grown by leaps and bounds between when humans were primitives and now. Every major technological shift in human civilization has more than doubled per capita energy consumption. Per capita energy consumption grew slow till the industrial revolution, after which it exploded. A third of the energy consumed in the last two centuries was consumed in just the last two decades. Today, each of us consumes more than 100 times the energy that our ancestors did.
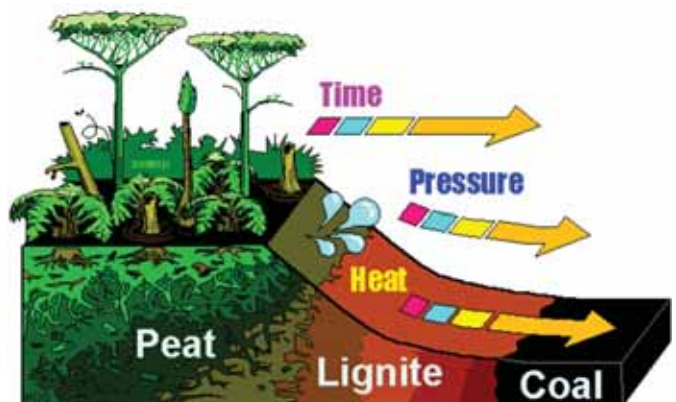
Energy overdrawl

In recent times we have overdrawn on the Earth's capacity to deliver energy and natural resources and the Earth is groaning in its attempt to meet our demands. We now require 1.5 Earths in order to satiate our energy needs. We have dipped into the Earth's natural capital rather than live off its interest. For example, rather than using only rainfall for agriculture, we use increasing amounts of groundwater, thus lowering groundwater levels each year. Rampant environmental degradation (pollution, freshwater depletion, etc) around the world and global warming are manifestations of this.

At this point one student interjected, "But isn't oil getting over?" True. This is called peak oil, i.e., global oil production is peaking around now as new oil finds have been few and far between in the last 3-4 decades, and gas will also peak in a couple of decades.

Are there alternative energy sources?

"What about coal?" Yes, the world has coal reserves to last another century or so. But if coal replaced current oil and gas consumption, global warming will occur even faster. For every toe yield from each fuel, CO_2 emissions from burning coal is two times more than that from burning oil and two and half times that of burning gas[2].

What about other energy sources that can replace fossil fuels? There are only two noteworthy ones – green and nuclear energies. Unfortunately, neither of them is capable of replacing fossil fuels. Green energies have a 0.5-2.5 EROEI[3], whereas fossil fuels have a 20-80 EROI. The significantly higher energy density of fossil fuels allows them to yield more energy for every unit of energy invested in harvesting them. Moreover, the environmental costs (cost of injury to human health, crops, forests, water bodies, etc) of fossil fuels are not considered, making them

seem very cheap. As for nuclear power plants, there is only sufficient uranium ore to power the current nuclear reactors for 80 years more. Moreover, they have intractable safety and waste disposal problems.

Sustainable development is an oxymoron

By now my audience, even the skeptics, had really got into the discussion. One boy quipped, "But humans are very creative. I am sure we will come up with something to beat the problem." A girl immediately asked him if he believed in world peace, to which he said he did. "How come we have not come up with any worthwhile solution for wars in the last 10,000 years of human civilization?" No answer to that. Someone else chipped in, "Or for that matter for hunger and poverty despite all the high tech we have that takes us to the moon and beyond."
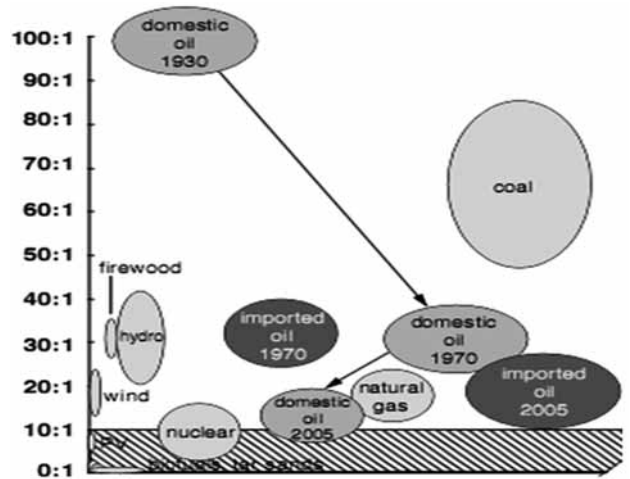
I then posed another question, "What is sustainable living?" The students made a serious attempt to define sustainable living and after a while the group veered around to the collective understanding that sustainable living meant that we must not overdraw on the Earth's resources.

What is overdrawl, and how do we measure it? Now that was a tough one and nobody could come up with a good definition, so I offered a way around by giving them economist Herman Daly's definition of sustainability, *"The rate of use of renewable resources should not exceed their regeneration, the rate of use of non-renewable resources should not exceed the rate at which sustainable renewable substitutes are developed, and the rate pollution emission should not exceed the assimilative capacity of the environment."*

This definition did not deal with overdrawl or how to measure it, but it posed another question, "Who is

responsible for overdrawl?" Pat came the answer from several quarters. Increase in global population was responsible for overdrawl. And where is population growth happening? In developing countries.

But is this argument supported by facts? Certainly not! It is not population growth in developing countries that is responsible for overdrawl but the increase in consumption by the developed countries and the rich in different countries.

Per capita primary energy consumption

Region	ToE/yr
Central Africa	0.34
Northern Africa	0.69
Southern Africa	1.18
Australia-New Zealand	5.56
Central Asia	3.43
NW Pacific + East Asia	1.28
South Asia	0.49
SE Asia	0.73
Central Europe	1.81
Eastern Europe	3.49
Western Europe	3.86
Caribbean	1.11
Meso America	1.29
South America	1.13
North America	8.08
Arabian Peninsula	3.62
Mashriq	1.23

Year	Per cent income		
	Richest 25%	Middle 50%	Poorest 25%
1860	58%	30%	12%
1913	69%	25%	6%
1960	72%	25%	3%
	Richest 20%	Middle 60%	Poorest 20%
2000	74%	24%	2%

Per capita energy consumption and CO_2 emission are good ways to measure human consumption. The average per capita annual energy consumption is a little over 1.7 toe/yr for the world as a whole, for North America it is 8.1 toe/yr, Western Europe 4 toe/yr, Central Africa 0.3 toe/yr, South America 1.1

2005 World Consumption Cartogram
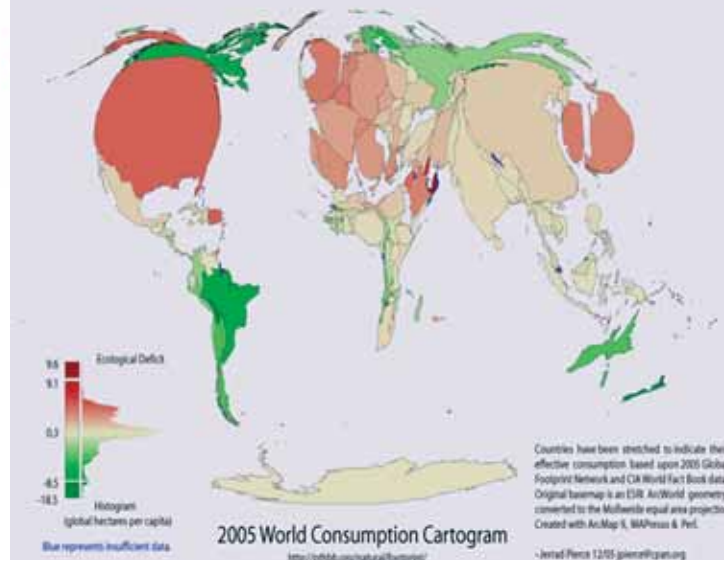
toe/yr, South Asia 0.5 toe/yr, and India 0.4 toe/yr. Clearly, it is people in the developing countries that are consuming significantly more than those in the developing countries.

Developed countries have been responsible for 78% of CO_2 emissions since the beginning of the industrial revolution. And the gap between the developed and developing nations and that between the rich and the poor is growing.

Quite clearly, Daly's prescription for sustainability is a step forward, but is inadequate as it does not address the cause for overdrawl, i.e., consumption of developed countries and the rich in all countries.

At this stage, one bright young student put two and two together and asked a really fundamental question, "Isn't sustainable development an oxymoron?" Why? Because development implies more energy use. But sustainability implies reducing our gross energy use as all indicators show that we have overdrawn energy and other natural resources. I agreed. The buzz-phrase, *sustainable development, is an oxymoron*. You cannot have sustainability and development, as understood today, at the same time.

The Brundtland report made sustainable development a buzz-phrase 25 years ago. The report defined sustainable development as, *"Development that meets the needs of the present without compromising the ability of future generations to meet their own needs."*

The definition makes two very important points. First, it talks about human needs and not wants. Needs are food, clothing, and housing and not luxury items. Second, it gives equal importance to meeting the needs of current and future generations. However, the

definition fails to stress on the equity of entitlement to energy and other natural resources between people, i.e., it does not tackle the root cause of overdrawl.

Sustainable living

I suggested to my audience that to arrive at a reasonably satisfactory definition of sustainable living, we have to add to Daly and Brundtlands' definition. They agreed. After much struggle, they did not get very far, so I decided to step in and offer my understanding.

Sustainable living requires that:

- The sustenance needs of the present generation are without compromising the ability of future generations to meet their sustenance needs.

- The rate of use of renewable resources should not exceed their regeneration, the rate of use of non-renewable resources should not exceed the rate at which sustainable renewable substitutes are developed, and the rate pollution emission should not exceed the assimilative capacity of the environment.

- There is equity of entitlement to energy and other natural resources for all people, and to achieve that it is essential to treat all energy resources (energy sources, energy converters, energy conveyors and storage devices) as common property rather than as private property, except where the energy resource is purely for personal use to meet sustenance needs. These entitlements will have to take into account nature's needs for these resources as nature is the maker and owner of these resources, not humans.

This definition required a complete re-think in the way we relate to nature and to each other. To drive that point home, I told them the story of a survey we had conducted as engineering students in the Indian Institute of Technology, Mumbai in the early 1970s. The respondents comprised everyone from the senior faculty, including the Deputy Director of the institute, to the first year students. We asked them what differentiated technology from engineering. The junior students, as expected, could not come up with meaningful answers, but to our surprise, neither could the faculty.

Engineering dealt with the science and art of applying energy to raw materials to obtain products and services. Engineering is a science and art that helps execute the upgrade necessary for human society to *develop*.

Technology does the same thing but in a given social context. Engineering deals with the science that goes into the design and production of goods and services. Technology deals more with the applications that engineering science can be used for. For example, when we talk about today's transport technologies, we refer to planes, trains, buses, horses, camels, and donkeys. No matter how unsophisticated the horses, camels and donkeys may be, they are still widely used and appropriate for the class of people and region where they are used for transporting people and goods.

This survey told us something. Practitioners of a discipline often did not understand the role they played on a larger canvas. I now asked my young friends that if their engineering education had basically taught them to use energy to transform nature into goods and services, what good is this knowledge if there is going to be less energy in future? Had their college ever told them how to help the Earth recover its potential to deliver energy? My young friends were astounded and were at a loss for words for a full two minutes.

Global policies for sustainable living

The implications of my definition of sustainable living are far-reaching. It implies that human society must change its outlook from "*Gain maximization for a few*" – an outlook that has been predominant since the times of ancient slave societies 5,000 years ago – to "*Risk minimization for all.*" The latter is what all living creatures, except humans, do to live in harmony with nature. They take only as much energy and resources from nature as is required for their sustenance. Only humans take more than what is required for their sustenance as they possess what other living beings lack, i.e., the ability to create knowledge of energy conversion, and hence have been able to increase their energy drawls throughout history till today.

Effecting this outlook shift requires two programmes to be put into place:
- *Powering down global energy to about 40% of the current energy consumption of 12,000 million toe/ year and in future relying primarily on the sun, the only reliable long-term energy source we can tap safely.*
  Powering down implies getting rid of extravaganzas like space exploration programmes, standing armies (they consume ~10% of global energy consumption currently) and national borders.

• *Move towards energy equity*.

For the sake of argument, if we were to power down our energy use to 5,000 million toe/year and distribute it equally amongst the world's 7 billion people, each of us would get ∼0.7 toe (current global average is 1.7 toe/year), or about the same as the average per capita energy consumption prevalent during the 17th century. Is a decent living possible with this energy consumption? Yes, because modern technology is more efficient than before. A family of four can afford to live in a decent-sized home with a fridge, an oven, a music system, mobile phones for all and eat well, but cannot afford to have air conditioners and private vehicles.

At 0.7 toe/year, an Indian can double her energy consumption over current average levels. But for that to happen, the Americans must reduce their consumption by 90% and Europeans by 80%. That is a real challenge. How do we convince the Americans and the Europeans (and the rich in all countries) that if human society is to survive and live in peace, they need to change their way of life and reduce their energy consumption? This is what today's youth will have to think about.

We will also have to have a universal risk standard for all risks – natural and man made – for all humans, which must be fixed and implemented. This implies that some areas that have higher risks, for example, cyclone prone areas, will require higher investments to reduce risk to the residents there.

Local action for sustainable living
We should not wait for that perfect society to come into existence at some point in future to start implementing community level programmes that can move us towards sustainable living. Wherever possible, we need to reduce energy and material use and move towards energy equity.

People in different parts of the world have started in small ways on this journey. Some have discarded private transport, others have started living in collectives, do organic farming, grow community forests, and yet others are using solar cookers and have installed photo voltaic panels on their roofs to power their homes.

Such efforts are essentially individual initiatives and cannot solve the social problems of energy overdrawl and energy inequity. But such initiatives, in a practical way, challenge the ideology of "Gain maximization

for all", which engenders unsustainable living. More than a thousand words, it is such actions that will help us re-configure our relationship with nature and with one another to usher a sustainable and equitable society.

References
1. An oxymoron is a figure of speech that combines contradictory terms.
2. CO_2 emissions for 1 toe energy yield from different fuels in India: coal-6.7 T CO_2, oil-3.4 T CO_2, gas-2.5 T CO_2.
3. EROEI is Energy released for energy invested. An EROEI of 20 indicates that one unit of energy is required to explore, mine, refine and deliver 20 units of energy. A negative EROEI, as is the case with some bio-fuels, means that more energy has to go into making and delivering them that the energy they will yield. A low EROEI makes the energy source unattractive.

What's on

National Conference on Mathematics
Tata Institute of Fundamental Research
Mumbai, India

Dates: January 20-22, 2012
Venue: Homi Bhabha Centre for Science Education

The Homi Bhabha Centre For Science Education is organizing a National Conference – National Initiative in Mathematics Education in January 20-22, 2012 in Mumbai. The National Initiative on Mathematics Education (NIME 2011-12) includes a set of regional conferences on mathematics education and a national conference. These conferences aim at providing a broad and representative platform for initiatives in mathematics education at various levels. The proceedings of these conferences will form inputs to a report on the status and the future of mathematics education in India. The report will be a part of the National Presentation by India at the International Congress of Mathematics Education (ICME-12) to be held in Korea in July 2012.

We invite teachers, educators, mathematicians and mathematics education researchers to participate in the conference by submitting a paper.

For details you may please visit:
http://www.hbcse.tifr.res.in/nimenc

The new facts of life

Fritjof Capra

A discussion of the interrelations between food, health, and the environment is extremely topical today. Rising food prices together with the price of oil and a series of so-called "natural" catastrophes dominate the news every day. At the same time, there is confusion. Why are world food prices increasing so quickly and dramatically? Why is world hunger rising after a long steady decline? What do food prices have to do with the price of oil? Why is it so important to grow food locally and organically? In this brief talk, I shall try to show that a full understanding of these issues requires a new ecological understanding of life (a new "ecological literacy") as well as a new kind of "systemic" thinking – thinking in terms of relationships, patterns, and context.

Indeed, over the last 25 years, a new understanding of life has emerged at the forefront of science. I want to illustrate this new understanding by asking the age-old question, what is life? What's the difference between a rock and a plant, animal, or microorganism? To understand the nature of life, it is not enough to understand DNA, proteins, and the other molecular structures that are the building blocks of living organisms, because these structures also exist in dead organisms, for example, in a dead piece of wood or bone.
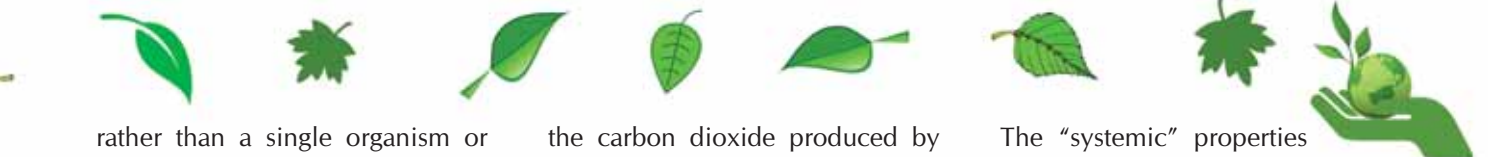
The difference between a living organism and a dead organism lies in the basic process of life – in what sages and poets throughout the ages have called the "breath of life." In modern scientific language, this process of life is called "metabolism." It is the ceaseless flow of energy and matter through a network of chemical reactions, which enables a living organism to continually generate, repair, and perpetuate itself. In other words, metabolism involves the intake, digestion, and transformation of food.

Metabolism is the central characteristic of biological life. But understanding metabolism is not enough to understand life. When we study the structures, metabolic processes, and evolution of the myriads of species on the planet, we notice that the outstanding characteristic of our biosphere is that it has sustained life for billions of years. How does the Earth do that? How does nature sustain life?

Ecological literacy

To understand how nature sustains life, we need to move from biology to ecology, because sustained life is a property of an ecosystem

rather than a single organism or species. Over billions of years of evolution, the Earth's ecosystems have evolved certain principles of organization to sustain the web of life. Knowledge of these principles of organization, or principles of ecology, is what we mean by "ecological literacy."

In the coming decades, the survival of humanity will depend on our ecological literacy – our ability to understand the basic principles of ecology and to live accordingly. This means that ecoliteracy must become a critical skill for politicians, business leaders, and professionals in all spheres, and should be the most important part of education at all levels – from primary and secondary schools to colleges, universities, and the continuing education and training of professionals.

We need to teach our children, our students, and our corporate and political leaders, the fundamental facts of life – that one species' waste is another species' food; that matter cycles continually through the web of life; that the energy driving the ecological cycles flows from the sun; that diversity assures resilience; that life, from its beginning more than three billion years ago, did not take over the planet by combat but by networking.

All these principles of ecology are closely interrelated. They are just different aspects of a single fundamental pattern of organization that has enabled nature to sustain life for billions of years. In a nutshell: nature sustains life by creating and nurturing communities. No individual organism can exist in isolation. Animals depend on the photosynthesis of plants for their energy needs; plants depend on

the carbon dioxide produced by animals, as well as on the nitrogen fixed by bacteria at their roots; and together plants, animals, and microorganisms regulate the entire biosphere and maintain the conditions conducive to life.

Sustainability, then, is not an individual property but a property of an entire web of relationships. It involves a whole community. This is the lesson we need to learn from nature. The way to sustain life is to build and nurture community. A sustainable human community interacts with other communities – human and non-human – in ways that enable them to live and develop according to their nature. Sustainability does not mean that things do not change. It is a dynamic process of co-evolution rather than a static state.

Systems thinking

The fact that ecological sustainability is a property of a web of relationships means that in order to understand it properly, in order to become ecologically literate, we need to learn how to think in terms of relationships, in terms of interconnections, patterns, context. In science, this type of thinking is known as systemic thinking or "systems thinking." It is crucial for understanding ecology, because ecology – derived from the Greek word oikos ("household") – is the science of relationships among the various members of the Earth Household.

Systems thinking emerged from a series of interdisciplinary dialogues among biologists, psychologists, and ecologists, in the 1920s and '30s. In all these fields, scientists realized that a living system – organism, ecosystem, or social system – is an integrated whole whose properties cannot be reduced to those of smaller parts.

The "systemic" properties are properties of the whole, which none of its parts have. So, systems thinking involves a shift of perspective from the parts to the whole. The early systems thinkers coined the phrase, "The whole is more than the sum of its parts."

What exactly does this mean? In what sense is the whole more than the sum of its parts? The answer is: relationships. All the essential properties of a living system depend on the relationships among the system's components. Systems thinking means thinking in terms of relationships. Understanding life requires a shift of focus from objects to relationships.

For example, each species in an ecosystem helps sustain the entire food web. If one species is decimated by some natural catastrophe, the ecosystem will still be resilient if there are other species that can fulfill similar functions. In other words, the stability of an ecosystem depends on its biodiversity, on the complexity of its network of relationships. This is how we can understand stability and resilience by understanding the relationships within the ecosystem.

Understanding relationships is not easy for us, because it is something that goes counter to the traditional scientific enterprise in Western culture. In science, we have been told, things need to be measured and weighed. But relationships cannot be measured and weighed; relationships need to be mapped. So there is another shift: from measuring to mapping.

In biology, a recent dramatic example of this shift happened in the Human Genome Project. Scientists became acutely aware that, in order to understand the

functioning of genes it is not enough to know their sequence on the DNA; we need to be able to also map their mutual relationships and interactions.

When you map relationships, you will find certain configurations that occur repeatedly. This is a pattern. Networks, cycles, feedback loops, are examples of patterns of organization that are characteristic of life. Systems thinking involves a shift of perspective from contents to patterns.

I also want to emphasize that mapping relationships and studying patterns is a qualitative approach. Systems thinking implies a shift from quantity to quality. A pattern is not a list of numbers but a visual image.The study of relationships concerns not only the relationships among the system's components, but also those between the system as a whole and surrounding larger systems. Relationships between the system and its environment are what we mean by context.

For example, the shape of a plant, or the colors of a bird, depend on their environment – on the

vegetation, climate, etc. – and also on the evolutionary history of the species, on the historical context. Systems thinking is always contextual thinking. It implies a shift from objective knowledge to contextual knowledge.

Finally, we need to understand that living form is more than a shape, more than a static configuration of components in a whole. There is a continual flow of matter through a living system, while its form is maintained; there is development, and there is evolution. The understanding of living structure is linked to the understanding of metabolic and developmental processes. So, systems thinking includes a shift of emphasis from structure to process.

All these are really ways of saying the same thing. Systems thinking means a shift of perception from material objects and structures to the non-material processes and patterns of organization that represent the essence of life.

Current world problems

Once we become ecologically literate, once we understand the processes and patterns

of relationships that enable ecosystems to sustain life, we will also understand the many ways in which our human civilization, especially since the Industrial Revolution, has ignored these ecological patterns and processes and has interfered with them. And we will realize that these interferences are the fundamental causes of many of our current world problems.

It is now becoming evident that the problems of our time cannot be understood in isolation. They are systemic problems, which are all interconnected and interdependent. A detailed and masterful documentations of the fundamental inter-connectedness of world problems is the new book by Lester Brown, *Plan B* (Norton, 2008). Brown, founder of the Worldwatch Institute, demonstrates in this book with impeccable clarity how the vicious circle of demographic pressure and poverty leads to the depletion of resources – falling water tables, wells going dry, shrinking forests, collapsing fisheries, eroding soils, grasslands turning into desert, and so on – and how this resource depletion, exacerbated by climate change, produces failing states whose governments can no longer provide security for their citizens, some of whom in sheer desperation turn to terrorism.

When you read this book, you will understand how virtually all our environmental problems are threats to our food security – falling water tables; increasing conversion of cropland to non-farm uses; more extreme climate events, such as heat waves, droughts, and floods; and, most recently, increasing diversion of grains to biofuel.

A critical factor in all this is the fact that world oil production is

reaching its peak. This means that, from now, oil production will begin to decrease worldwide, extraction of the remaining oil will be more costly, and hence the price of oil will continue to rise. Most affected will be the oil-intensive segments of the global economy, in particular the automobile, food, and airline industries.

The search for alternative energy sources has led to increased production of ethanol and other biofuels, especially in the United States, Brazil, and China. And since the fuel-value of grain is higher on the markets than its food-value, more grain is diverted from food to producing fuels. At the same time, the price of grain is moving toward the oil-equivalent value. This is one of the main reasons for the sharp rise of food prices. Another reason, is that a petrochemical, mechanized, and centralized system of agriculture is highly dependent on oil and will produce more expensive food as the price of oil increases. Indeed, industrial farming uses 10 times more energy than sustainable, organic farming.

The fact that the price of grain is now keyed to the price of oil is only possible because our global economic system has no ethical dimension. In such a system, the question, "Shall we use grain to fuel cars or to feed people?" has a clear answer. The market says, "Let's fuel the cars."

This is more perverse in view of the fact that 20 percent of our grain harvest will supply less than 4 percent of automotive fuel. Indeed, the entire ethanol production in this country could easily be replaced by raising average fuel efficiency by 20 percent (i.e. from 21 mpg to 25
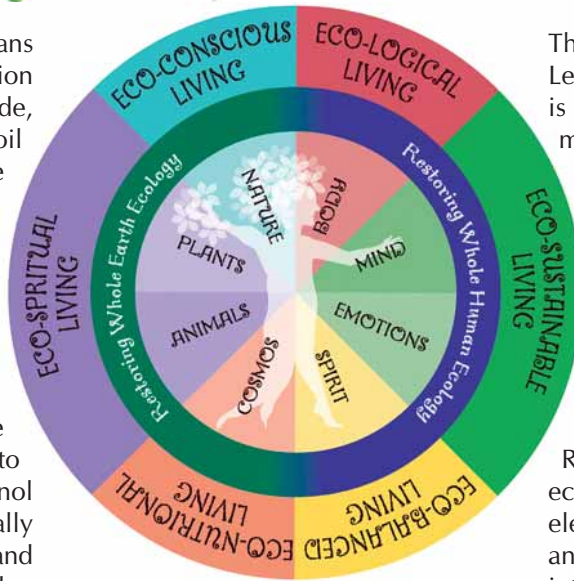
mpg), which is nothing, given the technologies available today.

The sharp increase in grain prices has wreaked havoc in the world's grain markets, and world hunger is now on the rise after a steady decline. In addition, increased fuel consumption accelerates global warming, which results in crop losses in heat waves that make crops wither, and from the loss of glaciers that feed rivers essential to irrigation. When we think systemically and understand how all these processes are interrelated, we realize that the vehicles we drive, and other consumer choices we make, have a major impact on the food supply to large populations in Asia and Africa.

All these problems, ultimately, must be seen as different facets of one single crisis, which is a crisis of perception. It derives from the fact that most people in our society, and especially our political and corporate leaders, subscribe to the concepts of an outdated worldview, a perception of reality inadequate for dealing with our overpopulated, globally interconnected world.

The main message of Lester Brown's *Plan B*, is that there are solutions to the major problems of our time; some of them even simple. But they require a radical shift in our perceptions, our thinking, our values. And, indeed, we are at the beginning of a fundamental change of worldview, a change of paradigms as radical as the Copernican Revolution. Systems thinking and ecological literacy are two key elements of the new paradigm, and helpful for understanding the interconnections between food, health, and the environment, but also for understanding the profound transformation that is needed globally for humanity to survive.

Forests and tribals

Sujatha Padmanabhan

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ONE of the biggest controversies over who owns natural resources has to do with the competing rights of tribal communities to their forest homelands and the perceived need to protect the animals within those forests. Add to this the insatiable appetite for forest wealth to fuel industrial growth, and you have an explosive situation. This article discusses the history of forest rights activism and the way in which the state has dealt with these rights.

The year 2006 was momentous for tribal rights issues in India. The Government passed the "Scheduled Tribes and Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006", or Forest Rights Act (FRA), as it is commonly referred to. The Act sought to redress injustices that tribal and forest dwelling communities had faced in relation to their access to forests and forest produce since colonial rule. Under the British, vast tracts of forests came under the management of the colonial rulers, and forest dwelling people lost much or all of their rights to these areas.

The various stages that the Forest Rights Bill went through before it got passed saw some of the fiercest debates in our country. Conservationists with strong wildlife concerns made doomsday predictions of forest destruction if the Bill were to be passed. Human rights activists favoured the Bill as they felt it would at least partly set right the gross injustices that some of the poorest sections of society have had to face.

This historic Act came into force on December 31, 2007. It recognizes individual and community rights

Photos: Ashish Kothari

over forest land of people who could prove that they had lived on or had been cultivating the land prior to December 2005. The Act also recognizes their rights to use, manage, and protect forest resources.

History of forests in India: a peep

It may be difficult to envisage that India once had huge swathes of forests that have practically vanished. For example, seals from the Indus valley civilization depict large mammals like the rhinoceros, elephant, and tiger. The latter two mammals require huge forest tracts, which suggest that the Indus plain was once a forested habitat. Over the centuries, India's forest cover started to diminish largely for agricultural expansion. Despite this, it is evident that India still had good forest cover even across the north Indian plains. In the 7th century CE, the Chinese traveller Hieun-Tsang described the forests that he traversed as being so thick that it made travel through them difficult.

Up to the late medieval and Mughal period, systems of community property resources were largely intact. Accordingly, forest land (as well as grazing lands, water bodies and so on) were controlled and managed at the village level. These systems were based on deep ecological knowledge and cultural values that were oriented towards conservation of natural resources as well as their sustainable use.

Hemalkasa adivasis demonstrate against big dams that could drown their forests and villages in Gadchiroli, Maharashtra.

Under British rule, forests were cut down on a large scale for the creation of plantations, to supply timber to the railways and to the British navy and to export timber. British policy and forest legislation ensured that the management of the forests came under their jurisdiction, thereby replacing common property resource systems by state owned ones. After Independence, government control of forests continued and laws that were enacted unfortunately did not take into consideration the fact that many local communities depended on forest resources for their subsistence.

India's forests today

According to the Forest Survey of India's 2003 report, 20.55% of the country's geographical area is covered with forests. Of this, about 12% is dense forest cover and about 7% is open forest cover. Forests are believed to contain the largest diversity of terrestrial species in the world. In India, the tropical rain forests of the Western Ghats and the North East have the greatest biodiversity and with a high rate of endemism (plant and animal species found only here and nowhere else in the world). Both these regions figure in the list of biodiversity hotspots in the world!

Communities and forest conservation

It is estimated that there are over 67 million tribal people in India, with the majority of them living in forested and hilly areas. They depend on the forests for resources like fuel, fodder, medicinal herbs, non-timber forest produce (e.g. honey, lac, broom grass), fish and other aquatic produce and so on. Many tribal families may collect some of the non-timber forest produce for sale in nearby markets. Forests also support millions of non-forest dwellers who are non-tribal, as well as some pastoral nomadic communities.

Tribal and other forest-dwelling communities have deep cultural, spiritual, and livelihood links with the forests around them. So many of the forests in India are held sacred despite the fact that over the years many have been threatened by development projects, increasing population and cultural change. Sacred groves and sites still exist in many states, which have preserved remnant populations of rare and endemic species, sometimes in their original and undisturbed form, which have been wiped out elsewhere. In general, such areas are quite small (sometimes only a handful of trees), but there are also large ones like the Mawphlang Sacred Grove in Meghalaya which covers 75 hectares. In fact, researchers from the North East Hill University have recorded 79 sacred groves in Meghalaya, ranging in size from .01 to 1200 ha!

In Nagaland, several dozen villages have, over the last decade or two, conserved natural ecosystems as forest or wildlife reserves, the latter dedicated exclusively or predominantly to wildlife conservation. One of the biggest is the Khonoma Tragopan Wildlife Sanctuary, spread over 20 sq km, where hunting and resource extraction is completely prohibited. Given the indiscriminate hunting that this state has witnessed in the last three decades, these efforts are crucial in giving Nagaland's unique biodiversity a renewed lease on life.

In states like Orissa, Andhra Pradesh, Uttarakhand, and Maharashtra, tens of thousands hectares have been regenerated and/or protected by village communities. This is usually on their own (including in many cases by setting up all-women forest protection teams as at Dengejheri village in Orissa), through government-recognized programmes like Van Panchayats in Uttarakhand or occasionally through government-supported programmes like joint forest management. The biodiversity value of these forests is considerable, including several threatened animal and plant species.

Protected areas and conservation
A major thrust to wildlife conservation in India was through the promulgation of the Wild Life Protection

Community members and guards at Sendenyu Wildlife Reserve, Nagaland.

Act in 1972 (WLPA). It allowed the government to notify areas as "protected" and restrict human activities within them. The number and spread of protected areas, meant specifically for the conservation of wildlife, significantly increased (from about 100 in the early 1970s to 657 in 2008). This, along with the fact that the Act had legal sanctions against hunting and illegal trade of endangered wildlife species, gave India's wildlife a much needed chance to survive.

However, the WLPA has alienated local people living in some protected areas and has also caused conflict with the forest department officials. Till 2002, the Wild Life Protection Act provided for two kinds of Protected Areas (PAs), Wildlife Sanctuaries (WLS) and National Parks (NP). While by law, certain human uses can be allowed in a WLS, no human use is allowed in a NP.

There are at least 2.5 to 3 million people living in protected areas today, many whose rights to the forests that they once used or had free access to have been either taken away totally or curtailed. There have been conflicts when villages were forced to relocate outside national parks (a situation that can be difficult for a community that may not even have the necessary skills to survive outside a forest) and when the government banned the collection of non-timber forest produce (resulting in a sudden loss of livelihood).

An amendment made to the WLPA in 2006 allowed for the declaration of critical tiger habitats, with the objective of making these inviolate spaces. Even though the relocation from such areas is to be done voluntarily and on mutually agreed terms and conditions, there is still fear and mistrust on the part of local communities. Recently, the Soliga tribal community that resides in the Biligiri Rangaswamy Temple Sanctuary (BRTS) in Karnataka, protested a move by the State Government to declare BRTS a tiger reserve. Even though the government rehabilitation package from a tiger reserve involves a sum of Rs.10 lakhs (this is more than what is offered for relocation out of non-tiger reserves and is considered an attractive enough amount to make local people want to move out!), the Soligas have decided to present the State Government a "community based tiger conservation" model. They have indicated their unwillingness to move out, and argue that their presence within BRTS over centuries had not led to tiger numbers declining. On the contrary, tiger numbers have gone up, and long-term research done by ATREE, a Bangalore based organization, has shown sustainable extraction of some of the non-timber forest produce that they collect.

Forest loss

The high rate of deforestation and the diversion of forest land that was taking place for industrial and agricultural activities lead to the enactment of the Forest (Conservation) Act 1980 (FCA). The FCA was enacted with the objective of conserving India's forests. The Act made it compulsory for state governments and other authorities to obtain central government permission for diversion of forest land for non-forest purposes as well as de-reservation of forest lands.

It has been estimated that between 1920 and 1990, the forest cover in Western Ghats decreased by as much as 40%! Forests are being diverted for various development projects like mining, hydel power projects, roads, and large industrial projects. Information received from the Ministry of Environment and Forests through an RTI application, has revealed that 11,37,686.70 hectares of forest land was diverted for non-forest use between 1980 and 2009. The RTI further revealed that one-fourth of the diverted forest land was done between 2004 and 2009! It is such alarming statistics that make conservationists view the FCA as a diversion Act rather than a conservation one!

A stipulation that was brought about by the FCA was a system of compensating for forest diversion. The compensation is done in two ways: a scheme for compensatory afforestation must be made and the company that requires the forest land is required to pay a certain amount of money for the diversion of the forest.

While some may see this as a justifiable way to acquire forest land and also see it as inevitable in the path towards a double digit growth figure for the nation, it

Bauhinia leaves used to make plates.

reduces forests to a commodity that can be traded and to which a monetary value could be put. The amounts that are charged could vary from 10.43 lakhs to 4.38 lakhs per hectare, depending on a variety of factors such as the kind of forests, value of timber, fuelwood, and so on. Such a view is in sharp contrast to the relationship that many tribal communities, who have lived in forested regions for generations and who also bear the consequences of forest diversion, have with forests.

Diversion of forest land is an issue that is increasingly seeing protests by local communities. A recent example that caught media attention was the protest by the Dongaria Kondh adivasis against proposed bauxite mining by Vedanta, a giant multinational corporation. The mining would have destroyed the forested Niyamgiri hills, which the tribe holds as sacred.

The Chipko Movement protested handing over of forests to industry in some Himalayan villages, back in the 1970s. Today, about three decades later, we have an opportunity in the Forest Rights Act to set right some of the issues that tribal forest dwelling communities have faced: issues of user rights over forest resources and those of governance over these areas. Coupled with rights it will be important to facilitate secure livelihoods, education, health, and other facilities, for there have also been rapid changes in communities and they naturally have developmental aspirations. The last few years has shown that the implementation of the Act has been slow and with many gaps almost throughout the country. Only time will tell whether the Act will be implemented in the right spirit, will actually conserve the forests that are remaining and undo the historic injustice that tribal and other forest dwelling communities have faced.

Think about the following!

► Should Protected Areas be inviolate areas free of human presence?

► How do urban lifestyles and increasing consumerism impact our forests?

► Should tourism be allowed to continue in Protected Areas if local communities are asked to move out?

► Should forests be managed jointly by the government and local communities who live in them?

► Should forests be sacrificed in order to attain double digit growth rates?

► How should one deal with tribal hunting practices?

Ecological footprints on the beach

Naveen Namboothri

OCEANS and humans

The ocean has been an integral part of the culture and history of humankind for centuries. It has fascinated humans and inspired many adventurous expeditions in the past to explore what lies beyond the horizon. Later, the curiosity shifted to what lay below these vast expanses of water. The creatures of the ocean have inspired the imagination of many mythical and folk stories and sparked the curiosity of early natural philosophers, including Aristotle. This curiosity in understanding nature and its processes better, led to naturalists finding a place in expeditions. The famous expeditions of the HMS Beagle to the islands of Galapagos lead to the theories on evolution through natural selection by Charles Darwin. However, few know about his immense contributions to marine biology, the most prominent being his theory on the formation of modern coral reefs that were based on observations made from the HMS Beagle.

Life as we know it today originated in the oceans more than 3.5 billion years ago and life here is much older than on land. More than seventy percentage of the earth's surface is covered by water from the world oceans, making it a "blue planet". Oceans also control climate on a global and local scale. The Indian monsoon, for instance, originates as moisture laden winds in the Indian Ocean, and the entire economic and ecologic sustenance of the country is strongly interlinked with the regularities of the monsoon. In the Atlantic, warm surface currents that are generated at the equator and moved by the trade-winds, travel long distances between continental land-masses, carrying warmth to the otherwise inhospitable countries of northern Europe. The oceans, its fringing beaches, splendid

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Photo: Naveen Namboothri

diversity in its ecosystems such as the spectacular coral reefs, have appealed to the artistic and aesthetic inclinations of the humankind for centuries. While these are benefits and services that cannot be valued in economic terms, oceans are also an important and reliable source of nutrition and livelihood for millions across the globe and have direct implications on the economic prosperity of coastal countries.

Early explorations
Despite having such direct implications on the survival of mankind, our understanding of oceans and its functioning is still rudimentary. Don Walsh, one of the two intrepid explorers who reached the deepest part of our oceans (at 10916 metres!), succinctly puts the message through. He says, "More people have walked on the moon than have been to the deepest place in the ocean!" Our explorations of the marine ecosystems are still largely restricted to a few kilometers off the

coast and most of the vast expanses of deep waters are yet to be explored and documented. In an ambitious 650 million dollar project involving many of the world's leading marine biological centres from more than 80 countries, about 2700 scientists came together to compile the diversity, distribution and abundance of marine life on this planet. In the past ten years, more than 2600 new species have been identified and named and a few thousands are waiting to be confirmed. The studies also led to the discovery of many previously unknown habitats and ecosystems and helped compile a list of 250,000 marine species and proposed another 750,000 are yet to be discovered.

Sustained unsustainable practices – the declining global fishery
While on the one hand, the recent decade is witnessing the discovery of many new species, on the other it is also seeing the extirpation of a lot more. For centuries

it was believed that the resources of the oceans cannot be depleted because of their sheer size and that they can be forever used as a reservoir for the wastes we produce. Humans, however, in ways that only they can, have been very successful in depleting most of the large fish resources of the sea and have managed to pollute large tracts of coastal and oceanic waters rendering them unsafe even for swimming. Many large marine species such as some whale, turtle species, and dugongs are severely threatened. Though not seen in the same light, fishing is an equivalent to hunting on land. A shark in a reef plays the same role in its ecosystem as does a tiger or a lion in the forest, that of the top-predator. However, hunting a shark does not necessarily evoke the same reactions as hunting a tiger or a lion. This paradigm lies at the core of fishing being promoted as an industry or as any other economic activity.

The increasing demand for seafood globally in the past few decades and improved fishing and transporting technologies have now ensured that most of the prime fishing grounds have been thoroughly fished out. Before the industrialization era, fishing was mostly restricted to subsistence-fishery because of technological limitations in accessing fishing grounds and in processing and transportation technologies. Technological advancements during the industrial revolution trickled down to the fishing sector and large fleets of mechanized boats, efficient nets and better processing and transportation technologies were introduced to various parts of the world. The Food and Agricultural Organisation (FAO) in 2004 reported four million fishing vessels plying in the oceans of the world and this excludes many of the smaller indigenous and artisanal fishing boats. Seafood markets in developing countries like India shifted from local to international markets.

These technological advances improved food-security and livelihoods of many millions, albeit temporarily. Total fish catch improved substantially with increasing effort and global fish catch rates sky-rocketed from 20 million metric tones in the 1950s to 110 million metric tones in 1994. However, recent trends in commercial fishing from many parts of the world reveal that despite increasing efforts invested in catching fish, the total catch is decreasing, a clear indication that fishing has crossed the sustainability threshold and has become unsustainable at current rates. Another environmental ramification of fishing is the removal of non-target species by fishing practices like shrimp trawling that removes a substantial amount of non-target species along with the shrimps. They scour the ocean bottom with large nets that entangle and damage all kinds of organisms that live on the ocean floor. Most of these organisms are not of market value and are discarded. In recent years, these non-target species are increasingly used as protein supplement in the poultry industries and have a market value of their own, thereby increasing the impacts of fishing on the marine ecosystems.

Photos: A Murugan

Global warming and its effects

While fishing and pollution are issues that pertain to the natural resources of the oceans that degrade it on a local scale, there are other factors operating on a global scale that threaten the health of our oceans. Oceans, as mentioned earlier, play an important role in controlling the Earth's climate by interacting variously with the land and the atmosphere. Global warming is affecting these delicately balanced interactions leading to large-scale shifts in global weather patterns. Prolonged warming of the surface waters of the oceans (known as the El-Nino) are known to cause "mass-bleaching" of corals that often lead to mass death of coral reefs. Left to themselves coral reefs are known to recover from such occasional bleaching events, however, many scientists feel that El-Nino episodes are becoming more regular and intense.

Rising sea levels and increasing intensities of storms render people who live on the coast vulnerable. The beach and the adjoining property are prime sites for tourism and industrial development activities, which are more often than not unplanned and unscientific. Environmentally, unsustainable coastal constructions such as seawalls, groynes, break waters, etc., lead to increased coastal erosion exacerbating the vulnerability of these regions.

Oceans of hope

Conservation biology, a branch of biology that specifically focuses on the effects of human beings on the environment is a science on which most environmental management decisions are based. Current day conservation biology has a very strong terrestrial focus. Conserving and managing the marine ecosystems require an entirely different approach and understanding, as they do not follow the same processes as on land. A few fundamental differences being that marine systems are demographically open, extremely dynamic and that the fundamental units of sustaining life are different from those of the terrestrial. Most of the marine organisms propagate as larvae (tiny off-springs) that can drift in water for long distances (a few thousand kilometers in some cases!) along with the currents. In the absence of obvious barriers, they may travel vast distances before establishing themselves. Thus, even if a local population is extirpated due to any natural or man-made cause, there is always an opportunity for larvae from elsewhere to replenish these sites.

Marine ecosystems are also extremely variable because their productivity is very dynamic. While plants are the autotrophs on land, forming the base of the food chain on which life is sustained, phytoplankton are their equivalents in the sea. Compared to plants that live for months to centuries, phytoplankton are extremely short-lived (a few hours) microscopic algae and their densities fluctuate considerably based on the local hydrodynamics, nutrient levels, and quality of water. Fluctuations in the water, therefore, have immediate and direct effects on local phytoplankton productivity and for life-forms higher up in the food chain. Therefore, unlike the wildlife sanctuaries on

land, one cannot designate boundaries in the sea and protect certain habitats and expect it to do well all the time. Managing marine resources requires a thorough understanding of how different populations are connected, understanding important aspects of their biology and behaviour and of the local hydrodynamics and productivity patterns.

These fundamental differences make marine ecosystems extremely dynamic and resilient. Resilience is considered as the ability of a system to return to its original state and function in the aftermath of a disturbance. However, many anthropogenic disturbances, such as fishing or pollution that act locally stress the ecosystems, thereby undermining the ability of these ecosystems to recover from such sudden shocks. If these local anthropogenic pressures on marine ecosystems can be controlled or managed, they have been shown to recover successfully.

There is much more to know about the ocean than what we already know. What we do know is that survival and sustenance of our oceans is under imminent risk from the influences of humans at both local and global scales. It is critical that we understand and acknowledge the severity of the problem. While many of the terrestrial ecosystems have degraded beyond hopes of recovery, there is still hope for marine ecosystems.

The way forward
There are many ways in which students and teachers can learn about our coastal and marine wealth, spread the word about the various threats they face and contribute to the well-being of our oceans. However, one needs to know the system and the issues better in order to act. There are a few information/activity books on coastal and marine ecosystems that have come up in recent years and target teachers, students of various age groups and enthusiasts. Some notable ones are –

a. The Turtle Story by Kartik Shanker and Maya Ramaswamy – a picture story book that takes us through the life of a young olive ridley turtle.

b. Sand In My Hands by CMP, ATREE and Handesign (freely downloadable at http://www.dakshin.org/9) – is an interactive activity book for children and teachers.

c. Treasured Islands by Sunita Rao – is an environmental handbook for teachers of the Andaman and Nicobar Islands.

d. Centre for Environment Education has published a teachers manual on the ecological wealth and environmental issues of the Gulf of Mannar Biosphere Reserve.

e. Children's perception of the Environment by Hoon, Kavinde and Sriskanthan – is a teachers toolkit for investigating coastal and marine ecosystems in Asia (http://www.icran.org/pdf/CPE%20Teacher's%20 TK%20English.pdf).

f. Marine Life in India by B.F. Chhapgar, Oxford University Press – provides a glimpse of the marine life of India and is an excellent introduction for those interested in marine biology.

Yet, there is no better teacher than a trip to the coast itself where there is so much to see and learn. The various kinds of shells and remains of animals on the beach, a visit to the nearest fish landing centre can give you an idea of what lives in these waters. On many of these beaches, you may see fishermen sitting and mending their nets on the beach. With centuries of living and growing up adjacent to the sea, they are treasure troves of knowledge and striking up a conversation with one of them can be an enriching experience. Teachers should also try and facilitate educational trips to places such as the Andaman and Nicobar islands where one gets to snorkel in some of the most spectacular coral reefs, squelch through the dense and impregnable mangroves, see how life teems in small tidal pools, how hermit crabs pull each other out for getting hold of the best shell around or see how seemingly dead creatures actually fight like champions for space on rocks.
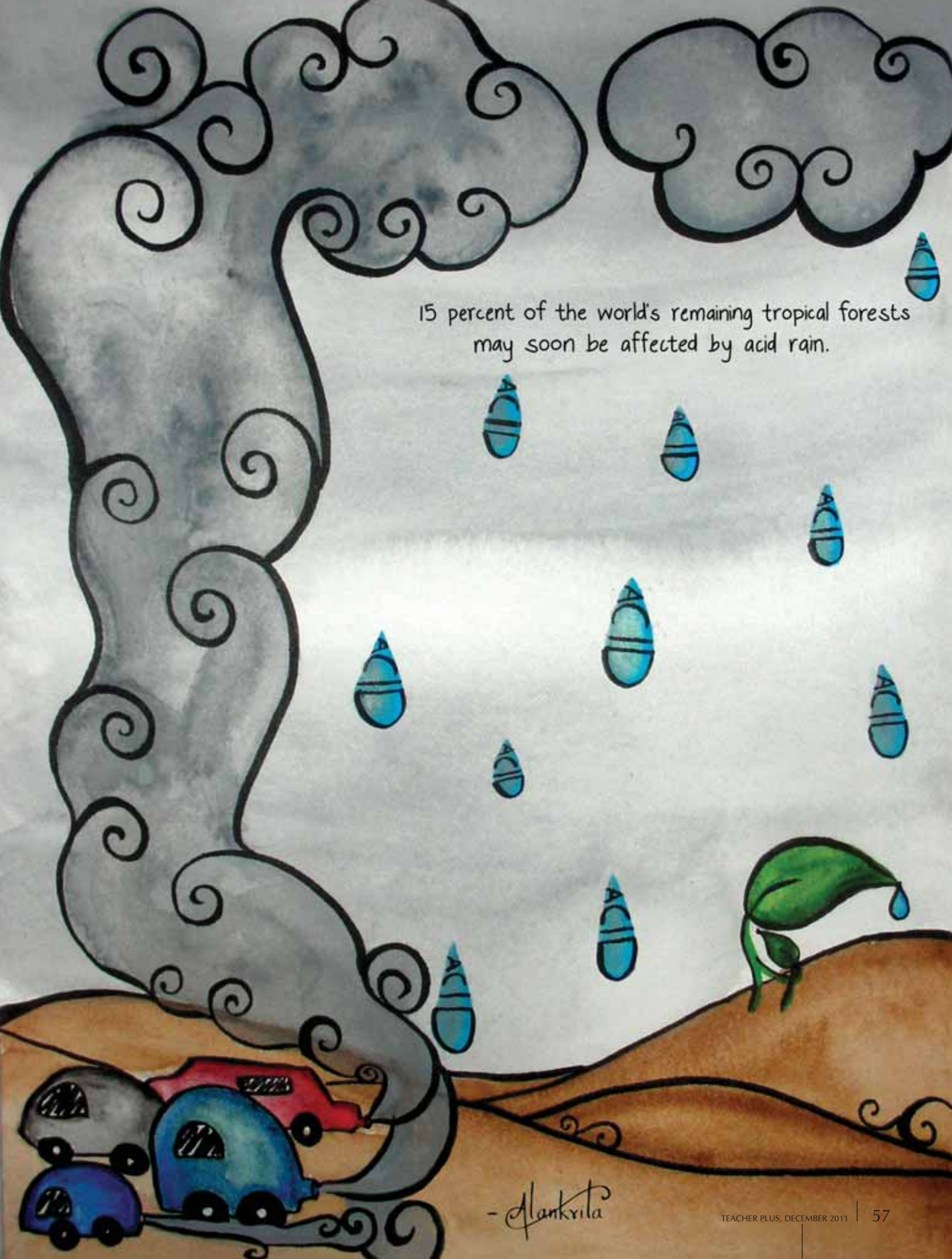
15 percent of the world's remaining tropical forests may soon be affected by acid rain.

— Alankrita

Reviving water bodies

R Rajamani

WATER bodies are sources where water is stored or from which water flows. The dictionary describes water bodies as "seas, rivers, lakes and streams". By an extension, water bodies should include reservoirs, ponds, tanks, springs, wells, waterfalls, and groundwater reservoirs or aquifers. There are other sources that store water as well but are not so well known or talked about. These include marshes, swamps, mangroves, snow, limestone formations or caves, rocks and even some plants, trees or roots that store rain or groundwater. Mountains and hills are storehouses of water. Many rivers originate from them (e.g., the Himalayas, Western and Eastern Ghats, Aravallis, Vindhya, etc.) Arctic and Antarctic snow caps and similar caps on mountains like the Himalayas, Alps, and Pyrenees and even icebergs are potential sources of water. These are sources of drinking water for human beings, animals, and birds or for irrigation, washing or bathing, swimming, sailing, for use in power and industrial plants, farms, fishing, and navigational modes of transport of goods and living beings. Their effect on micro and macro climate, especially in tropical settings is immense. An example from the oceans is the El Nino effect that influences the monsoon rains. They also form a valuable part of the evaporation cycle of rains,

storages, and flows. Taps, showers, bathtubs, and tankers are not water bodies but are at the end usage cycle of rains, storages, and flows. It is important to note that there are both natural and man-made water storages – reservoirs and canals, for instance – and both have an important role to play.

Water bodies in Tradition and History

In India, water is considered as one of the *"Panch Maha Boothas"* – air, water, land, wind and ether (atmosphere or sky). Ancients recognised the vital role of water in sustenance of human and other life. The respect for water bodies thus took various forms. Human settlements sprang up on river banks or near lakes, ponds and springs. Rivers were worshipped as gods and goddesses and invested with both divinity and human qualities. Hence, they are given feminine and masculine names. It is noteworthy that all names of big rivers like Ganga, Narmada, Krishna and Godavari are feminine or bisexual names while, Brahmaputra is the lone masculine name! In cases of storage sources like ponds, they were named after places where they were located or after deities. People go in large numbers even today on festival days to have a bath in the river and have food on river banks. Water in most rivers is considered holy. Water from the Ganga is used in purification

The Hussain Sagar lake, Hyderabad.

rituals or for cleaning oneself and the spirit. Science is now discovering, especially in the river Ganga, living organisms which do good to our health often offsetting the ill effects of bad bacteria and the like.

Many civilisations revered water. But some of them disappeared like Rome with the Tiber and Babylon with Tigris and Euphrates due to water being dealt with wrongly or with disdain. A whole sea in Central Asia disappeared to become the "Dead Sea". But the Arab world too protected its rivers and the oases of water as they were pools of the precious liquid, water, in an area where water was scarce, especially in the deserts. We notice a similar approach in India where many groves or clumps of trees were treated as "sacred" because they not only had water storage in various forms like springs, wells, waterfalls, streams or rivulets. Thus, even in mountainous regions, water was stored in oak tree clusters or in tracts like the shoal forests of Nilgiri Hills. The people, especially those living in and around arid areas, recognised the significance of the presence of water in these groves which could be drawn upon in times of distress caused by water crises. A study in Andhra Pradesh some years back of the "Sacred and Protected Groves" showed a considerable presence of such groves in the parched region of Rayalaseema. *Oraons* of

Rajasthan, *Lyngdohs* of Meghalaya and *Deverakadu* of Karnataka are other examples. In Kerala snakes are worshipped under trees like the papal (*ficus religiosa*) which exhale a great deal of oxygen and promote the evaporation cycle.

Benefits
Water bodies have various benefits. Flowing water in rivers brings silt and rich nutrients from the upper reaches to downstream regions, which become rich 'deltas' and valuable farmland. Farming, whether by flow, lift or baling depends on water bodies. Even in dry or upland areas not having man-made sources like reservoirs and canals, there are rainwater harvesting structures like below the ground aquifers, check dams on streams, wells and ponds, which supply water for both human needs and for valuable crops like cereals, pulses, and oil seeds. Water bodies inside forests sustain our wildlife – an invaluable pool of biodiversity aided by perennial pools of water. Water is important in industrial uses for cleaning equipment, cooling plants and for use as raw material in industries like leather tanning. In farms, water aids not only crop rearing but also fish culture in water filled fields. In most medicines, water is an important component both in manufacture and consumption. Hydel power, which is a valuable supplement to

Sukhna lake, Chandigarh

other forms of energy comes from water bodies whose flows drive the turbines. The water body in the sea nurtures marine life, plays a major role in the monsoon cycle and aids navigation through passenger and cargo ships and tankers. Inland navigation on rivers is another form of transport that is less costly and less polluting than other forms. Water bodies in the seas and lakes play a key role in keeping temperatures down and cooling winds, thus helping to moderate micro and global climate. Water bodies have a role in flood control as well. The flood plains and swamps act as sponges that absorb flood waters. Thus, while there are endless benefits, water bodies will continue to survive only when man gets his act together and stops polluting or harming them.

How water bodies are affected

If man continues to interfere, water bodies will have less water tomorrow, recharge less groundwater and will also affect the micro climate. Mostly, water bodies lose water when they are drained for land reclamation to convert buildings, parks, etc. Water bodies are also partially affected when they lose their foreshores or banks to similar developments. Foreshore will include loss of water absorbing trees like acacia *nilotica* (babul) or *barringtonia*. In water bodies which attract aquatic and avian (bird) life in themselves, such life is supported in different ways. Another ill effect on rivers is caused by excessive creation of storage capacity for hydel power generation or irrigation, thus diminishing the river water flow, which, if maintained at reasonable levels, helps in fertilizing deltas and supporting life, such as turtles, dolphins, otters and fish that move up and down a stream. If this freedom of movement is hampered, it affects the survival of such species. In Colorado river in USA, where such effects were observed, some dams were reported to have been dismantled to keep the river flowing. Such smooth flows in ocean going rivers help in discharging terrestrial nutrients into the sea, allowing marine life to flourish.

In many cases, the consequences of reclamation of beds of water bodies as in the Yamuna river bed can have other unforeseen consequences like flooding. A few years ago, reclamation of swamps and mangroves to create office complexes in the Bandra-Kurla area of Mumbai city caused overflow of water injuring lives and infrastructure. Overuse of water from water bodies can also have adverse consequences. An example is the cultivation of water intensive crops in the upper reaches of a canal, thus starving the tail end command (irrigable) area of water, creating imbalances in development and productivity and also resulting in water disputes. Over and above the optimal use of water even in the lower reaches can affect the river flows and deltas as in the Kaveri river in Tamilnadu. Equitable distribution of water from water bodies, especially in the villages, if neglected can create disaffection and distrust among beneficiaries. Excessive use of water leading to depleting water bodies can arise in other situations also. Flooding of farmlands beyond the optimum levels can affect crops and also diminish water sources.

Consuming water beyond real requirements or wasting it is rather more common in cities and towns. People in villages, deserts, and dry areas understand the value of water better than urban folk or industries, who merrily overuse or waste water. Such conspicuous consumption has severe consequences not only on water bodies but also on other users. If these demands on water escalate, tensions among people and even nations can erupt. Some forecasts of the next world war being a 'Water War' may look foolish or remote now, but it is something we have to bear in mind when using water or conserving water bodies. In the process, we can revert to developing human settlements near water bodies instead of transporting water over long distances using pipe lines that leak or water tankers that not only leak but also burn diesel just to transport water! The expansion of a city like Hyderabad is a case in point. The city is located in a water short area, which can no longer meet the requirements from proximate sources. Its three lakes do not supply enough water to meet the demands of the burgeoning population, with Hussain Sagar water no longer being potable. Now water is being pumped from the Krishna river, and the Godavari river is next in line to supply the city with water. If the city expands further and its water bodies, even in surrounding areas vanish at a rapid rate, there will be a problem that none of us will have a solution to. In about four decades, nearly 70 per cent of the

water bodies in the Hyderabad metropolitan area have been converted to other uses. Water bodies that existed earlier like the Masab tank and Gachi Bowli are now only names of places! Catchments capturing water for the lakes and the Musi river have been deforested or built upon and the top of the catchment in the KBR National Park is now threatened by recreational walking, creating roads and rills that take away water instead of recharging it. A well planned expansion of towns is simply not being considered.

Another big enemy of water bodies is the pollution caused by man-made factors. Discharge of urban or rural sewage directly into lakes or rivers is compounded by the problem of pouring of chemical wastes into water bodies, making them unfit for drinking, washing or recreation. Large-scale submergence of big idols using non-biodegradable material on festival days into water bodies aggravates the situation. Pollution often results in spreading diseases, especially among the poor who unwittingly use the water for domestic needs. Odour pollution can also affect the quality of life, recreation and tourism. Wrong use of water bodies or pollution even in villages is a matter of concern. Even vehicles are taken into the lake beds for washing and discharging oil wastes. This can seep into groundwater and village wells with major consequences on water needs of the villagers. Worse is the overuse of chemical fertilizers and pesticides in farm fields, the run-off from which enters water bodies. Where industries like leather are located in rural areas, their water effluent discharges deplete soil nutrition and crop production itself.

These problems that affect water bodies can no longer be ignored or dismissed as fanciful. Serious action has to be taken to ensure their integrity and availability of clean water.

Measures to save and conserve

While strict legislation to conserve our water bodies and prevent their misuse should be brought in, it is equally important to have an attitudinal change in our governments, civic bodies and local administration like municipal corporations and panchayats. Equally important is the approach to conservation by citizens and courts of law. Sometimes this is demonstrated by the people themselves as in Plachimada village of Kerala, where people stalled and stopped an industry from over exploitation of groundwater. Not everywhere is the public fully aware of the consequences of their water bodies being affected in any manner. Therefore, campaigns must be launched

by administrations, civil society organizations, experts, community leaders and citizens to conserve water bodies. Civic authorities should notify and enforce plans for development, earmarking and demarcating water bodies and refuse to allow diversions or deviations and not allow any occupation on them.

To tackle pollution, laws should be promulgated and enforced prohibiting discharge of industrial and domestic pollutants into water bodies. Inlets and outlets of water bodies should not be clogged by encroachments. Non-biodegradable matter including idols should not be allowed to be immersed in water bodies like seas, lakes and rivers. Panchayats should keep vigil against pollution of water bodies. Examples of optimum use of water as practised in deserts and arid areas and in countries like Israel should be set before the government, authorities and the people. It would be ideal to have a statutory authority in each state to enforce safe conservation of water bodies and order prompt action to quell encroachments and pollution.

Role of schools, academia, and teachers

As stressed above, creating awareness about the need to conserve water bodies and not waste water can be on the shoulders of our citizens, which should include our children, youth and teachers also. Children should set examples at home and in schools by using small quantities of water to wash, brush teeth, bathe, etc. Taps should be closed firmly after use. Walks should be organized on river banks and lake bunds not only to celebrate the conservation of water but to bring to notice of the authorities the encroachments or discharge of pollutants or throwing rubbish into water bodies. School managements and teachers should participate actively in this effort. The students can also take time off on holidays to remove wastes like plastic from water bodies, taking great care if they do not know swimming! Excursions to well conserved lakes and rivers would be an added attraction as well as a motivator to do something to conserve water bodies in their own localities.

The slogan should be "Save water bodies and Save Ourselves"!

The author retired as Secretary, Environment & Forests, Government of India and lives in Hyderabad.

Exploring waste management

R Rajamani

THE dictionary defines 'waste' as "waste material or food, useless remains or by-product, refuse, scraps, shreds." It is a well-understood term coming up daily in some form or the other. Food that is prepared but not consumed is waste. The paper and articles we throw away as useless is waste. Empty bottles and cans, used batteries and syringes and needles that are thrown into the waste paper basket or dustbin are all considered waste. In farms, the weeds, leaves that are not used, flowers that are worn and thrown away, fruit seeds are also waste. In factories and mines there are heaps of by-products not used, material coming out of machines as scrap, rejected mined material and so on. Many of the factories and laboratories generate material in semi-liquid form, which enters water courses as waste water or effluents or seeps into the ground – all considered waste. Offices throw away waste paper, pens, plastic chips, pins, bottles, old computers, printers, etc., which have been rejected after use. From the kitchens in households and hotels, a lot of vegetable skins and remains not cooked, meat morsels and bones not considered edible are all thrown out as waste. The list of such rejected material is almost endless as human beings eat more, produce more, buy and sell more, because of which more and more waste is generated.
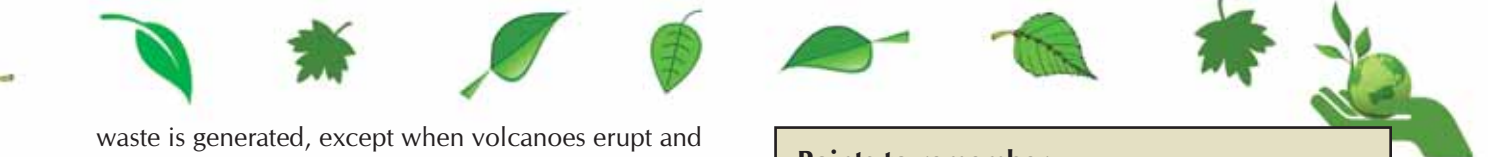
It must be noted that animals generate waste like dung and urine. Human beings also generate similar waste material in their toilets. Plastic bags, containers and other products are found as waste everywhere in gardens, parks, forests, farmlands, roadsides, marketplaces, factories, restaurants, hotels, etc. Municipalities try to collect the waste and sometimes their actions create mounds of waste, which breed mosquitoes, flies, etc., and lead to bad smells.

Organic and inorganic waste
Wastes are categorized as organic wastes like plant and tree material rejected in kitchens, farms and vegetable markets and inorganic waste generated in offices, factories and households. This distinction has to be kept in mind while discussing waste management. Waste can also be characterized as recyclable, bio-degradable, and toxic. In nature no

waste is generated, except when volcanoes erupt and all the matter goes back to Earth to be used again in some form or other. The saying is, there is nothing in nature which is not useful to plant and animal life and human beings. Leaves fall to form mulch, which helps in the growth of more plants, bushes and trees. Fruits are consumed by animals and birds and the rejected seeds fall on the ground to germinate again. Other plant material is converted by earthworms and similar insects into useful manure, which is again helpful for growth. This recycling process also involves biodegradability, i.e., waste which is converted into good material by biological means or nature. Where material cannot be so converted at all, it is considered non-recyclable or non-biodegradable. This distinction should also be kept in mind in waste management.

Why waste management?

If waste is not managed, it interferes with human life in many ways creating more problems. Waste enters our waters like rivers and groundwater and pollutes them threatening our drinking water sources. Wastes enter the land and render it infertile. Wastes are produced in such quantities by the transport and industrial sectors that they pollute the air, water and land to an extent where our health is affected by diseases like lung infections, fevers, eye diseases, gastro-intestinal disorders, etc. The accumulation of waste breeds insects such as mosquitoes and flies, which cause infectious and non- infectious diseases. Rats, pigs and stray dogs, which feed on waste also spread illnesses. The world is now facing a severe crisis called Global Climate Change caused by waste material escaping as air pollutants like oxides of carbon and nitrogen as well as methane from coal mines and similar sources. These also affect human health. Waste material like thrown away plastic enters all spheres of life and also affects our health. It also enters animals, which do not recognize it as non edible. Plastic also covers the Earth, preventing rain water going through the land to create groundwater sources for our benefit. Toxic wastes like gases and liquids, which have poisonous chemicals, are also bad for human beings, animals and even soil. Thus our survival itself is threatened by waste, and therefore its management with a view to eliminate or reduce it is crucial for our welfare.

How to manage waste

The primary approach to managing waste is to treat it as a resource or material that can be used or modified to suit our daily requirements and without generating more waste. Examples are waste paper, which can be converted into paper again, chemicals

Points to remember:

Recyclable items should be rinsed to remove food residues before putting them in the recycling bin.

For safety reasons, avoid crushing or piercing aerosol cans, and only recycle them once they are empty.

Oil should not be poured down the drain as it can cause blockages and pollute water.

Burning plastic is toxic and should be avoided.

used in producing goods, which can be recovered from waste and re-used for production. Pieces of wood when trees are cut or when furniture is made can be burnt as fuel, or better still help in producing toys, paper, etc. Fly ash waste from thermal power plants can be converted into briquettes. These are but a few examples of using waste as resource. In these matters, we can draw inspiration from nature, where everything produced or grown is reused. Carbon in carbon dioxide is absorbed by trees to help their growth and oxygen is produced by trees to provide clean air. Seeds fall down to produce more plants. Leaf litter becomes green fertilizers. Dead tree trunks are consumed by termites as food and in turn, termites become food for some animals. Snakes shed their skins and deer their antlers, which decompose on the forest floor to enrich nutrients in the soil.

But it is not always possible to use waste as a resource. Toxic wastes liker wastes from nuclear power plants are an example. It does not change character even after years, i.e., it does not degrade and cannot be reused. Poisonous chemicals and infected material like hospital wastes (needles etc.) are not always amenable to recycling as they may carry the risks of human health hazards in the new form also. In such cases, waste has to be minimized or eliminated by giving up the activity process or adopting incineration methods. It must be noted that incineration is not free from problems like escaping gases and residues. Producing substitutes, which cause less waste, is another option.

Techniques and options

The techniques and options may vary, depending on the type of waste generated, location of the wastes and the nature of available technologies of production and waste management itself. Some examples have been given earlier. However, it must be recognized

that there must be a change in approach and techniques for better waste management.

Producing biogas or using solar cookers are among substitutes that do not generate waste. Biogas produced from agricultural, animal, and human waste can be used for heating and lighting. The residue from biogas plants becomes good fertilizer. Having compost pits and introducing earthworms in them (vermiculture), which digest the waste and produce nutrients in the soil, is another biological option, which also saves the energy wasted in producing chemical fertilizers. Using animal and human energy for baling water or running oil making ghanies or transporting goods, etc., are examples by which animals also can be put to good use and their wastes recycled. In *goshalas*, the dung and other wastes can be vermicomposted and natural pesticides 'made like 'panchakavya'. Oils from sources like neem or neem cake can be used as pesticides or fertilizers, which do not create waste. Animal residue from carcasses like bones may be converted to bonemeal fertilizers. The residue of poultry farming can breed fish and the remainder can be used as fertilizer. Smokeless ovens can reduce air emissions while saving energy.
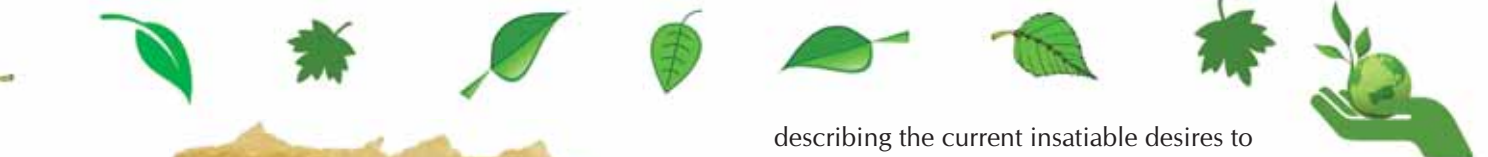
In the case of industrial manufacturing or even waste water treatment, the present methods of waste management are based on 'end of the pipe' solutions. Thus, after pollutants like chemicals and gaseous emissions come out through waste water pipes, chimney stacks or automobile exhaust pipes, efforts are made to clean by using techniques like chemical treatment, which again are energy intensive or waste water treatment using aeration ponds that take up valuable land or catalytic converters that do not eliminate waste altogether. Municipal wastes are dumped and then covered up to create landfills which pollute ground water.

The alternatives to 'end-of-the-pipe' solutions in waste management are the emerging 'cleaner' technologies, which do not create wastes at all by using them up in the process of manufacture and similar activities. Using waste heat by capturing it, direct reduction in iron and steel making, washing coal before burning it, re-using old batteries and cell phones by buying them back and re-processing, waste water treatment by using reeds which draw in the wastes or methods like upper anaerobic sludge using microbes and bacteria which can imbibe wastes are some examples. Some of these are being tried but not whole-heartedly on the ground of extra cost and labour, disregarding environmental consequences. Segregating wastes at household, office, and hospital and factory into biodegradable and non-biodegradable elements by using technologies to treat them differently by collecting them separately is an option being tried in several countries and to some extent in India. This leads to waste minimization, if not elimination. Thus, a change in outlook and techniques can help in waste management.

Limitations to waste management
In many of the above instances, techniques for treatment of toxic wastes have not been successful in many cases like hospital wastes, nuclear wastes

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Waste electrical and electronic equipment (WEEE) is marked with a crossed out wheelie bin symbol to show that it should be recycled. Some distributors will allow you to return old equipment free of charge when you buy a replacement product.

WEEE can be divided into the following categories:

- A – Large household appliances (cookers, washing machines, dryers)
- B – Cooling appliances (fridges/freezers)
- C – Display equipment containing cathode ray tubes (TVs, computer monitors)
- D – Gas discharge lamps (fluorescent tubes, low-energy light bulbs)
- E – All other WEEE (small mixed WEEE, wires)

It is particularly important to recycle categories B, C and D as they contain hazardous components. For example, category D contains mercury, which is extremely dangerous to water supplies and aquatic life.

What's not recyclable?
- Carbon paper
- Wax-coated papers
- Plastic-coated papers
- Tissue or paper towels
- Paper or containers contaminated by food or other organic waste
- Styrofoam

or hazardous wastes. The available methods to treat them also create problems like gaseous emissions or affect flowing or surface and groundwater.

Efforts to create 'zero emission' vehicles are not yet bearing fruit. A 'cradle to grave analysis' made of many practices, which look like sound waste management shows that somewhere in the chain of processes there is generation of waste where treatment is intractable as of now. Examples are cement industry where manufacturing techniques are improving air stock and dust emissions at factory site but mining of limestone and coal used in manufacturing cement and transporting them creates wastes. Use of electric vehicles or solar photovoltaic energy ensures less waste but the disposal of batteries used for them creates problems in waste management. Even bicycles, which are environment friendly, create waste through the materials manufactured for their assembly.

The limits and limitations to waste management have to be recognized and efforts made through better research and development.

Solutions at individual, community and school level
Individuals, communities and schools and even colleges can help in the effort of better waste management. Their efforts must be complemented by moving away from a 'throw-away' culture increasingly practised now with greater demand for more and more goods from a growing population and economy. Reducing wants by recognizing the distinction drawn by Mahatma Gandhi between 'greed' and 'need' is a must, even if it involves sacrifices and changes in attitudes. "How much is enough "asks an economist

describing the current insatiable desires to want more and get more. During World War II, the slogan popularized was, "Waste not, Want not." Individuals and communities should recognize the writing on the wall and try to lead a contented but socially and spiritually uplifting simple life. 'Simple living and high thinking sounds like Fool's Paradise now but not preaching them now will land us in Fool's Hell sooner or later.

Children and youngsters in schools and colleges and their teachers can help in this matter in several ways. They can absorb the lessons of the problems of waste management and spread awareness even among their parents of the consequences of neglecting better waste management. They can get into the spirit of wanting less and caring/sharing more. Food should not be wasted. Recyclable and biodegradable material should be used, thinking twice before using any item that is difficult to recycle. The most important contributions would come by thinking afresh on the whole subject, coming up with novel ideas, goading others to do better and thinking of the Earth and future generations which may inhabit it in a healthy and peaceful manner free of the severe problems of creation of waste and its poor management. The slogan should be Renew, Reuse, Recycle all materials and Reduce Pollution.

It is difficult, but can be done with a spirit of "We shall overcome!"

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The final R

Divya Choudary

The culture of disposal has caught on and we find ourselves burdened with more waste than any earlier generation. We all know of the three Rs (Reduce, Reuse, and Recycle) that are ranked in order of importance. While the first two Rs are about reducing the amount we consume and ensuring we consume well-designed products that can be reused, the third R is what this article is about.

Recycling can take many forms. Finding new uses for old stuff is considered recycling. On a larger scale, the process involves collecting used products and 'waste' and converting them into raw material for making new products for consumption. The quality of recycled products is rarely the same as that of the original. When a recycled product is of lower quality, the process is called downstream recycling. Eventually, all products, especially paper and plastic, move down to a stage where they cannot be recycled any further. There are instances of products being up-cycled, where they are more valuable than the original product.

It's important to know what can and can't be recycled. Broadly classified, the materials that can be recycled are organics, paper, glass, metal, plastics, wood, textiles, waste electrical and electronic equipment (WEEE), and packaging.

Photo: Udaan Fellows, Astitva, Dehradun
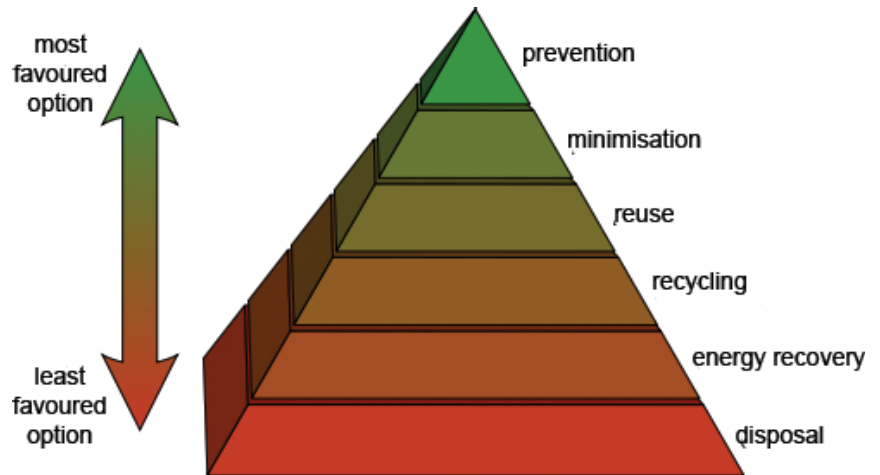
The easiest way to get the 'waste' started off on its journey towards recycling is by selling it to a 'raddi wallah'. They make the greatest contribution to the cycle of waste collection and recycling in the country and pay you for it! You could get Rs. 1 for every glass bottle, Rs. 5 per kg of newspaper and Rs. 6 for a kg of Iron. While you can get Rs. 2 per kg of old magazines and books, you would rather leave them at a book bazaar for someone else to read. Aluminium cans, office paper, and plastic containers are materials that are processed and recycled in large quantities.

Paper

Recycling paper would result in lesser trees being chopped down and lesser water and energy being used in production. Remove rubber bands and staple pins and keep the papers (newspapers/office paper) clean and dry before taking them to a raddi wallah.

Glass

Unlike paper, there is almost no downstream cycling when it comes to glass. Recycling glass (apart from that used in light bulbs and window panes) is much more efficient in terms of energy and cost than making virgin glass. Some companies collect and wash their bottles thoroughly before refilling them. Reusing glass jars and bottles is definitely preferable. For recycling,

glass is sorted by colour. Before sending glass containers for recycling ensure they are clean.

Plastics

Cheap to produce and non-biodegradable, plastic remains one of the most recycled products. Given its nature, plastic is usually converted into a new form but often ends up in a landfill.

Aluminium and steel cans

The quality of aluminium does not degrade on recycling. Steel and tin cans can be recycled as well and made into new cans or products like wires, cookware, etc.

Universal wastes are discarded products that contain significant amounts of mercury, lead, cadmium, copper, and other hazardous substances. Examples of these wastes are batteries, and electronic devices.

Electronics

Recycling electronics is a risky and labour intensive process with toxic materials such as lead and mercury being found in them. While finding someone to use the electronic product is preferable, there are companies specializing in recycling e-waste that can safely reuse and dispose the materials for a nominal fee.

Batteries

Batteries contain toxic material so put tape over the battery ends (the + and - terminals) to be safe and help prevent battery acid from leaking. Rechargeable batteries, used in cell phones, cameras and computers, reduce waste and energy needed for manufacture and transport. These types of batteries actually contain even more toxic materials and can be returned to the manufacturer for proper disposal. Car batteries and other automobile products like engine oil and tyres can be handed over to the auto shops.

Household toxics (paints, oils, solvents, pesticides, cleaners)

The best way to deal with these is to buy the correct amount, store it properly

▶ 315 kg: Amount of carbon dioxide not released into the atmosphere each time a metric ton of glass is used to create new glass products.

▶ 5 per cent: Fraction of the energy it takes to recycle aluminium versus mining and refining new aluminium.

▶ 20 million: Tons of electronic waste thrown away each year. One ton of scrap from discarded computers contains more gold than can be produced from 17 tons of gold ore.

▶ 9 cubic yards: Amount of landfill space saved by recycling one ton of cardboard.

and use or donate the leftovers. If you have to dispose them, contacting the company to find out their recommended method would be best. These products should not be emptied in the drain as it could cause blockages and contaminate the water. For paint cans, one method is to allow the little left over paint to dry before recycling the can.

The list is never ending and with the number of products we have today, knowing what to do with the used product can get confusing. While one way is to look online for a solution, another would be getting assistance directly from the company.

The danger with recycling is that it can provide us with a false sense of security. We have to keep in mind that although recycling is a step in the right direction, it can only help a little. The best and long-term solution would be to buy less stuff to stop the 'waste' stream at its source.

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Monocrop cotton field

Food, farming and hunger

Sagari R Ramdas

The author is co-director and a founder member of Anthra, a resource, training, research and policy advocacy collective in India, which works on livestock, people's livelihoods, environment and social justice concerns in the larger context of food sovereignty. A veterinary scientist by profession, she has been working in this field since the past two decades. She can be reached at <sagari.ramdas@gmail.com>.

The recent outrage against the estimated poverty level income of Rs 32 per day saw a re-examination of what it means to be poor, and what is needed to stave off hunger – that most insidious of killers. This article provides a background to the issue, allowing us to understand why hunger has become such a widespread problem in rural and urban India today.

DISPARITY between a tiny class of very wealthy Indians and a growing mass of human beings living in a permanent state of chronic hunger is deepening in India. In 2011, India has 55 dollar billionaires and about a 100,000 dollar millionaires according to Forbes' global list of billionaires[1]. India's near double digit GDP growth of the past decade along with a 300 million strong middle class marked as the new engine for global growth, stands in stark contrast to the uncontested fact that the number of Indians living in conditions of endemic hunger and malnutrition is growing[2].

Photos courtesy: Sagari R Ramdas

India has more hungry and undernourished people than any other country in the world, confirms the FAO Report on State of Food Insecurity in the World 2011. Nearly 224 million or 26.9% of the population was living in chronic hunger in 2006-2008[3]. With rising food prices and food inflation, this alarming figure is very likely to have increased substantially. In South Asia, India is ranked 67 of 122 countries in the Global Hunger Index 2011 below all the other major South Asian countries. The Global Hunger Index is an average of (i) the proportion of the population that is undernourished where India scores 21%, (ii) the prevalence of underweight children under five, which is 43.5% for India and (iiii) proportion of children dying before the age of five, which is 6.6% for India. According to the UNICEF, 2009, 1/3rd of Indian women are underweight, and over half the married women are anemic. Poverty is the principal cause of hunger, and consequently, food insecurity. According to World Bank poverty estimates[4], 75.6% of Indians earn less than $2 per day and 41.6% of the population lives below the international poverty line of USD 1.25 per day. All other international estimates, too indicate increasing and not decreasing poverty in India[5,6,7]. In the gender inequality index, India stands a miserable 122 among 138 countries, indicating persistent gender inequality[8]. The recent census 2011 points to a highly skewed sex ratio in the 0-6 yrs age group (914 girls for every 1,000 boys of the same age, or 75.8m girls and 82.9m boys) and reconfirms a growing bias against the girl child.

In 1979, a task force appointed by the Planning Commission of India defined the poverty line as a per-capita consumption expenditure level, which meets the average per-capita daily calories requirement of 2435 kcal in rural areas and 2095 kcal in urban areas. A key critique on the poverty measurement in India has been that current poverty lines do not correspond to these calorie consumption norms, resulting in a huge underestimation of the proportion of people living below the poverty line[9,10,11]. Thus, estimates of the number of people living below the poverty line in India ranges from the official figures of 37.2% in rural areas and 25.7% in urban areas, to 87% and 64.5 % in the former and the latter[12,13,14,15,16,17,18]. The poverty line is crucial as it determines who will be eligible and included in India's policy of targeted subsidized food for the "poor", and who will be excluded from the Public Distribution System (PDS), India's biggest food-based intervention that aims to provide access to cheap food to households throughout the country.

The tragedy is that half of those who suffer from hunger in India today, are ironically those who grow our food: the small and marginal farmers who are the mainstay of Indian agriculture, and the rest are landless agriculture labour and casual labour and their families. Seventy per cent of Indians (700 million people) depend on agriculture as their primary source of livelihood[19]. Sixty nine per cent of India's total area is described as dryland and 68% of agriculture is rainfed. Small farmers comprise 83.3% of the agriculturists, with

Farmer with diverse food crops.

an average land holding of less than 2 hectares, and own 41.14% of the total agriculture land. Sixty five per cent of the farmers in India, own only 20% of the total land, with an average holding size of 0.38 hectares. According to the 59th round of the National Sample Survey[20], 11% of the rural households in India are landless. Of the female workforce, 75.38% is located in this sector. Agriculture and livestock rearing are intrinsically dependent on one another and the landless, small and marginal farmers own 75% of India's livestock.

Deep food insecurity and hunger amongst those who grow our food is not because they don't produce enough, or that our farmers lack the knowledge, skill and ability to grow food, or because of "over-population", and the growing numbers to feed. The total food produced today is sufficient to provide every person on Earth with an adequate diet. Globally, available food per person increased almost 18.6% between the mid 1960s and 2007 to 2796 kcal[21] per day per person, which meets the need of an average adult male. However, between 2007-2009, the number of hungry people

grew globally by 150 million, an increase not linked to a decrease in food production but to steep increases in food prices that was triggered by increased oil prices, speculation and trading in food (as one would trade in stock and shares), and competition between food, fuel crops, and animal feed.

India was self-sufficient in food at the end of the 80s. There are clear political reasons for today's massive agrarian and hunger crises. India was forced (as were most developing countries around the world in the 80s and 90s) by the World Bank and the International Monetary Fund (IMF), and other wealthy countries of the world, to open up our hitherto closed agriculture markets, for import of highly subsidized food from the USA and EU, and in place of food, to bring in national policy changes, which would encourage farmers to produce cash crops such as coffee, tea, flowers, cotton, tobacco, for export. Known as Structural Adjustment Programs, (SAPs), they also required that governments cutback government spending in agriculture, ending price guarantees for farmers and consumers, modifying

and closing down public food distribution systems, withdrawing input subsidies to farmers and withdrawing support for extension services. Fiscal policy reforms were brought in to reduce government expenditure in all key public services, such as health care, veterinary health, energy, housing, sanitation, water, transportation, research, extension, and pave the way for privatization of these essential services. The failure of our democracy is that regardless of which political party is in power, our elected representatives, have blindly followed these international pressures and diktat, and have failed to craft a political and economic system to meet our needs, and which will address our concerns. A key part of this structural adjustment program in India is aimed at reducing the numbers of people dependent on agriculture as their key source of livelihood from 80% to 40% – and the reality is there for all to see...

Two decades of structural adjustments, economic reforms and globalization in India since the 1990s, have been characterized by the withdrawal of State support to agriculture and the liberalization of markets, unleashing massive agrarian distress[22]. It has sought to transform small-peasant controlled sustainable mixed crop-livestock food-farming systems, into a corporate controlled industrial system of agriculture production. The self-sufficient small farmer who produced a diversity of food crops and seeds, and reared different domestic animals, is being forced to become either a "crop commodity cultivator" or an "animal commodity producer", often in contract-farming "vertically integrated" tie-ups with agri-business corporations – typical of industrial agriculture modes of production. The change

is evident in villages with more farmers exclusively cultivating mono-cropped cotton, paddy, sugarcane, or maize and soya as animal feed for factory farmed animals. Tractors are used to plough the land, and mechanized harvesters to harvest the crop, replacing animals and humans (agriculture labour). Fertilizers are used in lieu of animal manure, and pesticides to control the explosion of pests that accompany such unsustainable farming practices. The government, in nexus with corporations, has projected biotechnology and the so-called "ever-green revolution", as the solution to the growing food crisis. Liberalizing land markets on the other end, has unleashed the explosion of the real estate markets, further squeezing out the farmers, who already in deep distress, are pushed to selling their lands. Acres upon acres of fenced agriculture fields witnessed along India's flashy new highways are testimony to this unfolding agrarian disaster. Meanwhile, whilst farmers struggle to graze

their animals on shrinking lands, we find a steady spurt of a new breed of landlords and "gentlemen livestock farmers" who have purchased massive quantities of land and are now investing in "goat/sheep/dairy/poultry farming", either individually or in partnership with corporations.

So, even the much maligned goat, which Gandhi referred to as the "poor man's cow", whose owners have historically been hounded by the forest department and conservationist alike for destroying forests, is now silently slipping away from the hands of the poor and becoming the rich man's asset.

According to the National Sample Survey (NSSO)[23] of 2005, 48% of farmers in India are indebted and 40% of farmers want to quit farming. Over a quarter of a million farmers' suicides occurred between 1995 and 2010.[24] The period 2003-2010, witnessed a greater number of suicides than the preceding eight years, which is alarming as the

total number of farmers declined significantly in the same period. Two-thirds of these suicides have occurred in five states: Maharashtra, Andhra Pradesh, Karnataka, Madhya Pradesh, and Chattisgarh.[25] Post neo-liberal reforms, farmers' income rose by 0.28%, whereas the incomes in other sectors, rose by 4%. With massive decline in real agriculture wages and rising unemployment, people are unable to purchase food, indicative of growing food insecurity in the country[26].

The average daily net per capita availability of foodgrain between 2005 and 2008 was a dismal 436 grams per Indian, less than 440 gms available in 1955-58. The consumption of pulses declined from 70 gms in 1955-58 to around 35 grams in 2005-08[27]. Rural households classified as "agricultural/other labour", who did not get food everyday during the year was relatively high compared to other households. In urban areas, houses that belonged

to the casual labour category had the highest percentage of not getting food everyday relative to other households[28]. In rural India, the agriculture labour category and in Urban India the casual labour category had lower levels of consumption of animal products (milk and milk products, eggs, meat and fish)[29]. In 1997, following the advice of the World Bank, the Government of India introduced the Targeted Public Distribution System (TPDS) in place of a universal PDS to curtail food subsidy. The income poverty line of the Planning Commission was used to demarcate 'poor' and 'non-poor' households and divide the entire population into below-poverty-line (BPL) and above-poverty-line (APL). The two groups are treated differently in terms of their eligibility for quantities of food and price of food. Several studies have pointed out how targeting has ended up excluding a whole lot of eligible citizens from accessing subsidized food, and ironically is also a major reason for the "overflowing" stockpiles of food in our public *godowns*[30]. In 2011, the Supreme Court of India, firmly reprimanded the Union Government that "in a country where admittedly people are starving, it is a crime to waste even a single grain," and suggested that the grain be released to those who deserve it.

Eradicating hunger begins with creating viable communities, where people have control over their lives and livelihoods. It is about producing enough food and the right kind of food and making it available and accessible to all. Industrial Corporate controlled food production worldwide, has demonstrated its utter inability to solve the related problems of hunger and safe and sustainable production of food.

Industrial agriculture is unviable and unsustainable for several reasons:
• There is exclusive focus on maximizing production and productivity of individual commodities and products.
• It is completely dependent on fossil-fuel inputs, which are globally projected to be exhausted in 60-80 years (fertilizers, machines, pesticides).
• It completely over-exploits scarce natural resources such as water.
• It is a huge threat to agro-diversity, peoples' livelihoods and knowledge (animal and plant genetics are controlled by companies. Farmers stop breeding their own breeds and saving their own seeds, they lose their knowledge once they stop applying their practices).
• It needs more and more land and natural resources to sustain production, and is a major reason behind massive global land-grabs underway.
• There is huge competition between land for food, feed, and fuels (e.g., maize).
• There are huge social and environmental costs which are externalized and not priced on the market.

- It is the reservoir of several new diseases (SARS, bird flu, swine flu) and the source of emergence of old diseases (e.g., Salmonella outbreak in USA).
- It is the source of environmental pollution and a key driver of climate change.
- It threatens smallholder livelihoods and pushes them out of production, thus enhancing hunger, as the farmers join the ranks of the "unemployed and under-employed".

There is growing movement led by small farmers, indigenous people (adivasis), pastoralists, fisherfolk, workers, and citizens in India and around the world who are resisting this corporate take over of lives and livelihoods, who are fighting to take back control and governance of and re-establish democratic food-farming systems. We are working towards rebuilding food sovereignty, which is beautifully captured in the words of *La Via Campesina (2007)*, the peasant's movement which first introduced the concept internationally in 1996.

"Food sovereignty is the right of peoples to healthy and culturally appropriate food produced through ecologically sound and sustainable methods, and their right to define their own food and agricultural systems. It puts those who produce, distribute and consume the food at the heart of food systems and policies rather than the demands of markets and corporations. It defends the interest and inclusion of the next generation. It offers a strategy to resist and dismantle the current corporate trade and food regime, and directions for food, farming, pastoral and fisheries systems determined by local producers. Food sovereignty priorities local and national economies and markets and empowers peasants and family farmer-driven agriculture, artisan fishing, pastoralist-led grazing and food production, distribution and consumption based on environmental, social and economic sustainability. Food sovereignty promotes transparent trade that guarantees just income to all people and the rights of consumers to control their food and nutrition. It ensures that the rights to use and manage our lands, territories, water, seeds, livestock and biodiversity are in the hands of those of us who produce food. Food sovereignty implies new social relations free of oppression and inequality between men and women, peoples, racial groups, social classes and generations."

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Grow a garden, nurture children, evolve a curriculum

The edible garden classroom

Sunita Rao

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IN early October this year, a group of children aged 8 to 14 years from Bangalore were poking around and pulling weeds in a garden. They had come all the way to the humid tropics of the Malnad region in Karnataka's Western Ghats on a three day "Learning for Life" camp. What seemed like a boring, sweaty task suddenly turned exciting as one of the children spotted a burrowing snake in one of the vegetable beds. The exclamations were tinged with excitement, wonder, and plain awe.

We gently pushed away the soil and peered at the disappearing end of what appeared to be a very pretty snake. It was a Shield Tail, but we could not identify which one, it was possibly a Madurai Shield Tail.

For a set of children largely unexposed to nature, it was heart warming that they did not once express a negative emotion. Nor did they question why a snake should be in a garden that grows food. They just unconditionally accepted that it could and should be there! I was delighted to say the least, that our session had been peppered with this unexpected interlude that would leave a lasting impression on the group.

A food garden, at whatever scale, is a whole universe unto itself. It offers not just an open classroom resource for young and old, but a way of learning and being that far surpasses many other teaching tools that we use. It is also something that one can do all one's life and continue to learn from. In today's context

A food garden offers a way of learning that surpasses other teaching tools.

Photos courtesy: Sunita Rao

with the food crisis, climate change, pollution, and loss of biodiversity looming large, a food garden is a wonderful way to feel you are helping address these issues in a simple, yet powerful way. For students, it can be especially empowering to learn of real issues, while engaging with some very simple, practical activities.

Vanastree is a small women farmers' seed collective committed to promoting food garden biodiversity and food security through the conservation of traditional seeds. It is based in the Malnad area of Karnataka's Western Ghats. Women here have been tending very diverse forest home gardens for aeons now as part of their culture and homesteading. Helping children and teachers see the joy and worth of having edible school gardens is one of our ways of making learning a meaningful experience.

We sat down once and attempted to list all that a forest food garden could provide, and we came up with a dozen very vital services. What followed was the joyous experience of creating a poster showing all of these. This really made us feel that a garden indeed could be a whole other realm, and a great resource for a growing classroom. So many different subjects, concepts and themes could be explored by attempting to begin a tiny food garden.

Growing and harvesting vegetables, fruits, flowers has also been proven to be very therapeutic. I recall a group of 16-18 year olds (a challenging age group to work with by any standards!) spending a morning heaving out huge specimens of the weed *Eupatorium*. Having used weeds effectively to teach a class before, I asked the group what they had learned from the activity. They had already been briefed about invasive plants and their negative impacts on the ecosystem earlier. The first response from one of them – this strapping, nearly 6 foot high young man – was that weeding was a good thing to do when you wanted to vent anger! We all laughed of course, but the discussion went on to talking about negative emotions, especially anger and how potent it can be if it is not addressed and released. That young man really taught me something that day about the value of having a garden and working in it. There are gardens on the outside, yet our mind also needs a lot of weeding, composting and recycling and can be thought of as an inner, private garden that needs nurturing too.

While the positive spin-offs are many, there are a lot of challenges to be reckoned with if you are starting a

food garden in school. How much effort it will require, whether your idea will be met with approval in a formal system where formal learning and growing food have no connection, managing the children through mud, water, slush, and other such considerations. Food gardens have been created very successfully in non-formal learning situations. Unfortunately, little is being done in regular formal schools and this is a very under utilized activity with so much learning potential.

In California, in the US, researchers have actually obtained data from public schools, that shows improved math and science grades of students who have participated in gardening programmes. In a country that is dealing with highly processed foods, and an all time obesity problem, costing the exchequer millions of dollars in terms of health, students growing, harvesting and eating the vegetables they grow provides untold benefits. With chances of better nutrition and opportunities to be in the outdoors, or even potter around with some

Simple (green) thumb rules

1. *Seeds* – get them from a good source locally, preferably organic open pollinated desi varieties.

2. *Pots* or containers or beds. Old tyres can be used to grow plants.

3. *Season of growing* – which is the best time for you to sow in your area.

4. *Keeping soils healthy* and handling pests in an organic way without pesticides.

5. *Age appropriate activities and skills*.

6. *Time available for gardening work* – whether it's a balcony or window sill or beds.

7. *Support from the school authorities* and how much independence you have.

8. *Building into the curriculum* and including art, science, cooking and other activities into a garden plan.

9. *Scale of growing* – even a few pots can bring a lot of joy and learning.

10. *Simple discussions* around food and garden and keeping a garden journal including some of the wildlife they may see coming in – even a butterfly or a bug can spark a lot of interest.

containers and play with earth and sow seeds, mental health improves and the levels of belligerence also come down.

Several successful attempts have been made in India to use food gardens as part of education in schools. The Development Research Communications and Services Centre (DRCSC) in Kolkata, West Bengal has done some good work in this area (www.drcsc.org). They have worked with a lot of rural schools, systematically set up gardens, got the students to work in it, record data, deal with pests, compost, save seeds and be part of the whole growing cycle.

The Centre for Learning (CFL), a Bangalore school based on the philosophy of J.Krishnamurthy, is building up a Land Based curriculum and seeing how best it can be translated from intent to action. This curriculum spans all age groups from six years to eighteen! It is a bold and challenging experiment, but the school is small and progressive enough to want to persist with this approach. A vegetable garden is an intrinsic part of this initiative.

Children tending to a food garden.

What a sight! Freshly grown cucumbers.

The Isha Home School and Samskriti School at the Isha Foundation near Coimbatore have also invested time and energy in developing a well thought out food garden programme for their students. They have successfully merged the local festivals pertaining to food and growing with the activities. At a time, when there is an increase in the industrialization of food production, this is a wonderful way to create a connect in young minds with the *culture* of agriculture.

Kusuma, a young woman with Vanastree, recalls her school days in a modest village government school. With their teachers, they created a vegetable garden every monsoon and tended the garden. When the harvest was ready, the students were made to float mock tenders for the sale of the vegetables, arranged for purchase and thence cooking of the produce. The learning was tremendous and they had a lot of fun doing this. A self-possessed woman with a lot of poise, Kusuma attributes a lot of her personality to the garden she worked in. She says it did not cost anything, and wonders why all schools can't have this

simple yet powerful activity going. She hopes to teach her own 3 year old daughter all that she knows.

How do you start if the above examples sound like too much trouble? Even a few pots on the window sill with some beans, radish and methi sown will yield results that will make any student excited. A bit of observation, maybe some drawings of what they see each week, and then the joy of harvesting and eating what they have grown in a small food session in the class. Visitors to these pots can be talked about. Did a butterfly descend on one of the flowers to pollinate? Any bugs chewing up the leaves? How about earthworms? Discussions can follow about what the students' favourite foods are, and from how far away each ingredient of the foods listed comes, thus introducing the concept of Food miles.

Even with a few pots, you can go many places. Perhaps talk about how much the students eat outside, what their favourite places are, why eateries like KFC, Macs, etc., are so popular and why traditional foods may be going out of fashion. Genetically Modified (GM) foods are now in the news and form a rather controversial subject. This could be a topic for students in high school to discuss. Apart from all these seemingly complicated issues, just pure simple joy can be got from tending to a few plants.

Listed here are some basic considerations that teachers or garden facilitators will have to take into account. Key resources are also listed, although the best resource is yourself and your class. You can just dig in and get started. Do not be afraid of getting your hands muddy! The rewards are untold and immeasurable.

What is biodiversity?

Geetha Iyer

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Photos courtesy: Geetha Iyer

Egret in a village pond

THE term biodiversity has its origins in the term 'natural diversity'. It is so broad in its scope that it has been interpreted in several different ways in literature and in speech. It is taught in schools generally with reference to the diversity of different living species. Biodiversity is a broad term encompassing several diversities associated with life on earth. Many in the scientific world believe that it is nothing but an alternative term to ecology.

Historically, the term, 'biological diversity' was introduced in 1968 by the wild life scientist, Raymond F Dasmann, in a book that highlighted the need for conservation. The scientific community chose to replace the commonly prevalent term, natural diversity with biological diversity only in the 1980s after leading American conservationists started advocating its use and began using it in their talks and books. This term was further shortened to biodiversity by W G Rosen in 1985, and the famous myrmecologist, E O Wilson chose it as a title for the first publication of National Forum on Biological Diversity in 1989. It is now the accepted term when referring to issues related to conservation. In the scientific world, there is still no accepted agreement as to what this term stands for. The Convention on Biological Diversity (CBD) is an internationally binding treaty set forth by United Nations. It defines biological diversity as, "The variability among living organisms from all sources, including, 'inter alia', terrestrial, marine, and other aquatic ecosystems, and the ecological complexes of which they are part: this includes diversity within species, between species and of ecosystems."

Biodiversity by this definition is a sum of parts; is a whole of four levels of diversity: ecosystem, species, genetic, and molecular diversity. This unified representation initially did not have molecular diversity. With increasing work done at the molecular level to identify species – DNA barcoding for example – this was added as one more representative component in 2003. Why so much talk about biodiversity when there is a fully established scientific discipline called ecology to study all the four levels mentioned? What

difference does this term bring to us? This is a difficult question to answer. But, if I were to hazard a guess then it would be that this term is easily understood. Although the understanding and usage is often superficial relating to just one level namely to species of living organisms, if it can serve the purpose of awakening people's conscience to the need for conservation, then any or all new terms may be welcomed.

Human species are part of nature's intricate web. Despite their consumeristic habits that lead to habitat loss, the inherent longing for nature is not lost. So humans seek to visit nature preserves, keep animals as pets and many still maintain age-old traditions of providing food to animals before taking it themselves. E O Wilson called this *Biophilia*, meaning 'an attraction for living beings'.

How many species are to be found in our planet? It is a difficult task to put a number to the life forms on this earth, as many are yet to be discovered! Experts claim that we should have anywhere between 5-30 million species (May et al. 1995) on this Earth. A modest estimate is 6 million. Practically speaking, between 1.5- 1.8 million (Source: IUCN) species have been identified, which include plants, animals, and micro-organisms. Taxonomy is the science of classification; with the advent of and increasing popularity for biotechnology, taxonomists themselves are a declining group among biologists. But what is the current scenario about biological diversity? Here is a sample of species that are not always talked about as enthusiastically like a tiger, bird, or an elephant:

We have, worldwide, 1,00,000 types of fungi, 80,000 types of slugs and snails, and 5000 types

Nephila (Wood spider spinning)

of frogs. About 40% of all living species are beetles. It is believed that a gram of fertile agricultural soil may contain 2.5 billion bacteria, 400 000 fungi, 50 000 algae, and 30 000 protozoa.

There are several ecosystems that have been poorly explored and some difficult to explore. Modern technology has come to the assistance of taxonomists who are now attempting to study ecosystems such as tree canopies, ocean depths, and soils of tropical rainforests. The ocean's belly is revealing its secrets only now and some of the organisms met within its depth defy our understanding of the concept of life. Soil loss is such a great concern that scientists believe several of these organisms may be lost forever before they can be identified.

The distribution of living beings or the existence of ecosystems across the Earth is not uniform. Diversification of living organisms is dependent on favourable conditions such as precipitation, temperature, food availability and other geographical factors. The tropical regions support maximum diversity while the cold regions of the poles have minimum. Geographical areas supporting diversity are referred to as 'biodiversity hotspots'. The Western Ghats and Himalays are examples of hotspots in India.

Penninsular rock agama,
Psammophilus dorsalis

At a very basic level, biological diversity helps to meet the needs of food, shelter, and clothing for human beings. In the language of economics, these are described as ecosystem services provided. Biodiversity is the foundation for human health. Indian medicine system of *Siddha* and *Ayurveda* are linked to species diversity. Local varieties of cereals have widespread use in India. These are yet to be completely documented. With rapid destruction of habitat, and mindless promotion of hybrids, many indigenous varieties of rice are already lost for cultivation.

Studies of physiology and biochemistry of wildlife have the potential of leading to important discoveries in medicine. Several researchers are already studying bears to learn more about osteoporosis, sharks to know more on immunity and osmoregulation; analyzing the chemical in the stinging cells of jellyfishes for developing painkillers; studying cetaceans to understand how they deal with the pressure in the deep seas.

Biodiversity has recreational, cultural, spiritual, and aesthetic values. The Millenium Ecosystem Assessment reports have highlighted how sustainable ecosystems are essential for human health.
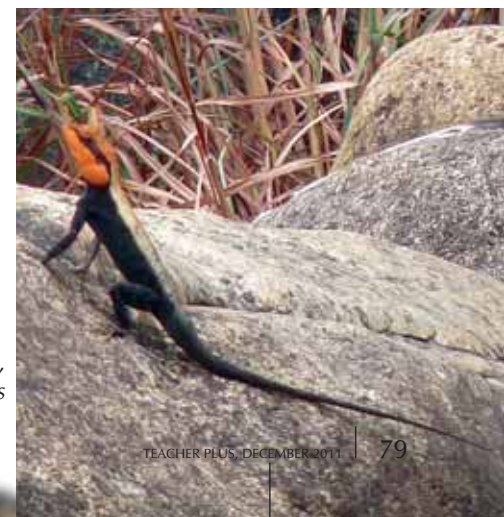
Topics for biodiversity projects

Grey Wagtail

The entire biology curriculum in schools and the topics on agriculture learnt in geography classes are nothing but studying biodiversity. Environmentalists have popularised this term in a bid to be heard on the crucial issue of conservation of habitat and species. All plant and animal studies are nothing but studies of biodiversity. Therefore trying to see how biodiversity can be specially introduced is a futile attempt. Biodiversity studies lend itself well to an integrated curriculum and as topics for projects.

Only at the High school level does it make any sense to examine biodiversity.

Here are a few examples:

✦ At the primary level studying plants in one's garden is the first introduction to biodiversity.

✦ Analysing school lunch is an introduction to diversity of agricultural produces.

✦ We rarely remember that the ingredients in our kitchen is an index of biodiversity. Food in different cultures; food festivals and their significance; food suited for climatic conditions and hence agriculture at different places in India and its effect on food are some of the topics that can be dealt with in middle school while teaching plant diversity. (suitable for all levels)

✦ A study of cereals found in India would be an excellent explorative lesson that can be used to highlight diversity

at the genetic level. Historical, geographical and cultural significance, along with songs and practices is an integrated approach to studying biological diversity (High school).

✦ Taxonomy is an integrated part of middle and high school programmes. Field studies of different ecosystems and species found in such systems would not only cover principles of ecology but also taxonomy.

✦ Mapping skills can make use of data from biodiversity-for eg: data of population of species such as tigers, elephants or leopards; of wildlife sanctuaries to show the distribution of geographical features coupled with distribution of species.

✦ Study of sea shores to understand the biodiversity of oceans.

✦ Ecological principles at high school levels.

✦ Genetics of the sweet pea, fruit flies etc to not only understand concepts in genetics but also to become aware of the pros and cons of genetic engineering.

✦ Perhaps the most important study that can be undertaken is to examine this question: is it morally, and ethically correct to alter the genetic sequence of living organisms? Is it right to want to create life in a test tube? What are the repercussions of artificially created life or creating life artificially?

✦ What are genes? What makes a set of molecules become alive to don the mantle of biodiversity?

Termite gecko

It is imperative therefore that we understand the significance of preserving this diversity. It is also equally important that disciplines such as taxonomy and ecology receive greater attention and funding in India. That there is no scientist who studies millipedes in India is an example of the woeful lack of documentation of biodiversity of this country. Many taxonomists seek information from Natural History museums of UK and USA to identify species found

in India. Dr.Madhav Gadgil one of our well-known ecologists has often remarked that the Kew laboratories have more of our wild plants in their collection than we do. This is indicative of the lack of importance to and the attitude towards studying biological diversity.

D Ehrenfeld, put it aptly in 'Conserving Life on Earth 1972'- "The non-humanistic value of communities and species is the simplest of all to state: they should be conserved because they exist and because this existence is itself but the present expression of a continuing historical process of immense antiquity and majesty.

Long standing existence in nature is deemed to carry with it the unimpeachable right to continued existence."

We do not have any right to 'grant' other species the right to existence. This is obvious if we do realise the diversity and beauty of what exists and what has already been lost forever.

Polypedates maculatus
(Common tree frog)

There is still hope!

— Alankrita

The calendar of nature

Suhel Quader

The author is an ecologist at the National Centre for Biological Sciences in Bangalore. He has a particular interest in participatory science; that is, in working with volunteers from all walks of life to contribute to a better understanding of the natural world. He runs two such Citizen Science efforts, MigrantWatch (www.migrantwatch.in) and SeasonWatch (www.seasonwatch.in), the latter in collaboration with Wipro Applying Thought in Schools. He has an M.Sc in Wildlife Science from the Wildlife Institute of India followed by a PhD from the University of Florida and post-doctoral research at the University of Cambridge. He can be reached at <suhelq@ncbs.res.in>.

THE natural world is changing so rapidly that entire landscapes are being unrecognisably altered within a few decades. These changes are driven by humans in one way or another. We affect these changes directly, in removing habitats for mining, dams and houses, and in continuing to hunt the land and the sea. But human activities also have indirect effects, for example, in spreading invasive species, and in nudging the Earth's climate further and further from what wild species are used to.

The need has never been greater for individual and collective action to stem this tide of change and loss, and for the social and political will to temper our desire for more and more. Only then will future generations be able to wonder at the beauty of a coral reef, the grandeur of a rain forest, or the hypnotic stare of a wild tiger. What is required for this action to occur? Simply put, we need an emotional and intellectual engagement with nature. We need to have an emotional connection, through which we value nature for its own sake – otherwise we are not

motivated to do anything. And we need to use our intellect to understand the problems facing the natural world, and to devise solutions.

The question I would like to pose here is this: can we engage both the hearts and minds of children in nature through a constructive school-based activity? I think the answer is yes, and below I describe one such activity.

Climate change and phenology
One of the dramatic effects of climate warming, an effect that cannot be explained away by skeptics of climate science, is on phenology – the timing of seasonal events in the natural world. Seasonal cycles in temperature and rainfall influence bird migration, the flowering and fruiting of trees, and the reproduction and growth of virtually every living organism. The change in climate from decade to decade changes these seasonal cycles and, in consequence, seasonal patterns in nature. The change in phenology in response to changing climate has been well documented in North America and Europe. Summing over various phenological measures, including migration time and the emergence of leaves and flowers, Spring is calculated to be arriving 3 days earlier every decade in these regions.

In the tropics and the developing world in general, and in India in particular, little is known about decade-to-decade changes in phenology in response to changing temperature and rainfall. There are anecdotes about shifts in flowering, for example of the Amaltas (Cassia fistula) in Kerala, but we simply don't know how widespread such patterns are.

SeasonWatch
To document these possible changes we have a started a project called SeasonWatch (see Box). In SeasonWatch, we invite members of the public to contribute systematic observations on the timing of fruiting, flowering and leafing of trees. The basic activity consists of choosing a tree to monitor, visiting that tree once a week, and noting down simple details of its leaves, flowers and fruits. The tree can be anywhere – in your garden, along your street, at your office, or in your school premises. A year's observation allows you to draw up a calendar for your tree; which can then be compared with other trees of the same kind, with other parts of the country, and with other years. Here is an example of a year-by-year comparison, taken from phenological observations of trees at Rishi Valley school.

Patterns of emergence of fresh leaves in two species of trees, Neem (*Azadirachta indica*) and Pala Indigo (*Wrightia tinctoria*) at Rishi Valley. Forty individuals of each species have been monitored fortnightly since end 2007. Each dot represents a tree with fresh leaves. Clusters of dots mean that many trees had fresh leaves. You can see that the emergence of fresh leaves begins a little later for *Wrightia* than it does for Neem each year. For both species fresh leaves emerged over a longer period in 2008 than in 2010. *Wrightia* shows a particularly shortened period with fresh leaves in 2010. The difference between the years might be because of differences in rainfall in the previous years: total rainfall was around 900 mm in 2007, but only 600 mm in 2009. The reduced rainfall in 2009 may have led to lowered food production and storage by these trees, and therefore a delayed and shortened leafing period in the following year. (*See figure on next page*).

What can these observations tell us? At their most basic, they build up a documentation of seasonality. But they also allow us to compare yearly changes in phenology with year-to-year changes in climate, and to warn us about potential disruptions in ecological networks. The possible disruptions arise from the fact that plants are the backbone of any ecosystem. They produce food out of carbon dioxide, water, sunlight, and little else. Everything else depends directly (herbivores) or indirectly (carnivores, decomposers) on the food that plants produce. Since much of this food is produced seasonally (as leaves, flowers and fruits), any change in plant seasonality can profoundly affect the animals that depend on plants. There are already a couple of examples from temperate regions where a mismatched change in phenology might be leading to population decline in some species.

So SeasonWatch helps document potential changes in phenology and to provide a warning if things are not going so well. But how can it contribute to an emotional connection with nature? The idea here is that, by noting down what a tree is doing, week after week, a person develops a bond with that tree. I have been monitoring two trees on my walk to my office for almost two years now – and I have begun to think of them as *my* trees, not so much with a sense of ownership, but rather with a sense of responsibility. As I begin to understand the various interconnections affecting my trees – the rain that stimulates fresh leaf growth, the soil that provides nutrients, the birds and butterflies that visit it, and the constant threat of the road-widener's axe – my sense of responsibility broadens out from the individual tree to the larger world around. Whether, in fact, such an emotional connection develops in those who participate in SeasonWatch remains to be seen. This may not happen spontaneously, and so we must develop additional tools and activities that encourage it.

Having already gone through a long period of educational and social programming, adults may be less susceptible to developing these emotional connections. But children have perhaps not yet been fully co-opted into the modern world's disdain for nature. For this reason, SeasonWatch has a strong emphasis on drawing in school teachers and children to the project.

SeasonWatch in schools

In our schools programme, children monitor trees, and teachers coordinate the activity. The activity can be class-based, or it can be carried out as part of a school nature club, as in many of the schools we work with in Kerala. The basic activity is standard: a child chooses or is assigned a tree, and then spends five minutes at the tree every week, noting simple information about its leaves, flowers and fruits. Now, doing this week after week can get very dull, so we are working on a weekly activity book that will make participation both more interesting and educational. Some activities can be more creative, like sketching a leaf or the entire tree; others encourage cross-disciplinary application, such as estimating the height of the tree using trigonometry or simple ratios (the ratio of the height of a tree to the length of its shadow is the same as that for a student, or a pole of known height). Students can discuss their favourite nature-themed poems and what imagery best evokes the rustling of leaves in the wind; and they can document the variety of creatures, from ants to bats, that inhabit

their tree. They can explore the texture of its bark and fruit; and examine the bumps and spines of its pollen under a microscope.

In this way, SeasonWatch can be expanded or compressed according to the needs and flexibility of the school and children. At its most basic, participating in SeasonWatch requires just 5 minutes per week, noting the state of leaves, flowers and fruits. At the next level, children could work on

SeasonWatch is still in its fledgling stage, and apart from the protocols of monitoring phenology, all other project-related activities are still being thought through and developed. If you have an idea for how to make the project more effective, intellectually and emotionally, or would like to help test out the effectiveness of some of the activities we will soon start to implement, or would like to take part in monitoring the phenology of trees, please do get in touch.
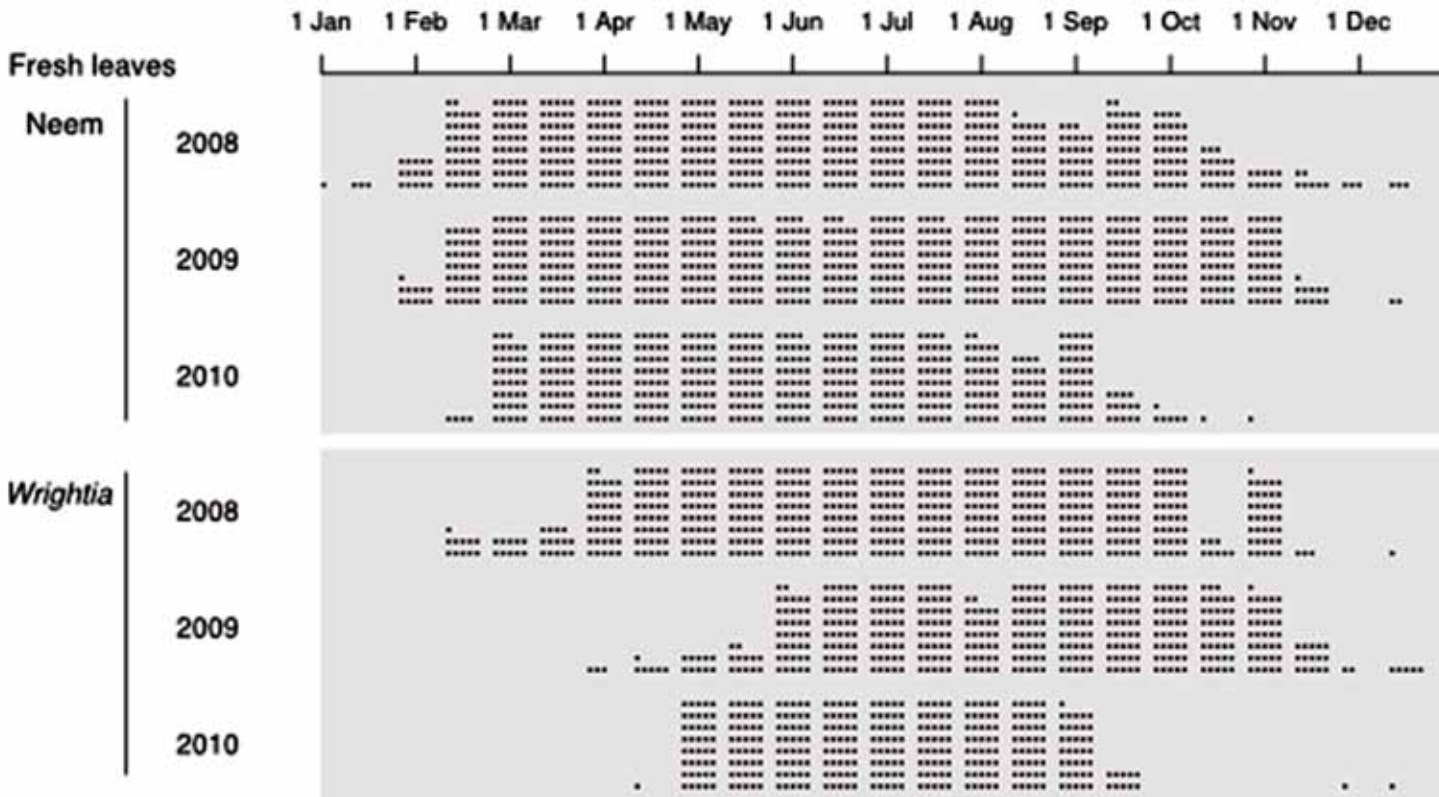
the pre-designed activities described above. But if tree-based exploration is embraced whole-heartedly into the school system, the possibilities are limited only by the creativity of teachers and the children themselves. For example, for language class, children could write a poem about their tree. For maths, they can use the tree to explore counting, fractions, trigonometry, and fractals, depending on their age. For physics, they can address questions of stress, strain, structure, stability, and elasticity. For biology, they might investigate carbon storage, pollination, dispersal, and biodiversity. Through all this, we might perhaps emphasize that the tree is not just an object that provides us something that we want (shade, fruit, wood, oxygen), but a living, breathing, growing entity with a history and a future – and it is one of billions of such organisms that share the world with us.

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Other Citizen Science projects designed for school children

Project BudBurst: plant phenology project (USA).
http://www.neoninc.org/budburst/

Nature's Calendar: plant and animal phenology (UK).
www.naturescalendar.org.uk

School of Ants: documenting ant diversity (USA).
www.schoolofants.org

World Water Monitoring Day (USA).
http://www.worldwatermonitoringday.org/

Rejuvenating child-nature link in the Himalayas

Back to Nature

Dr. Pranav Trivedi

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EVERY child of the present age is prone to take the Earth for granted. With humanity living in a myth of 'control over nature' through advances in science and technology, this is not an unusual outcome! A child imbibes values and attitudes from the society/culture in which it is born and tends to reflect the general trend of negative attitude towards nature/wildlife. The child is unaware of the impact on the Earth of the materials it uses; endangering the survival of a number of plant and animal species and ecosystems in the process. This lack of understanding about our actions and responsibility towards maintaining life supporting processes on Earth, a highly reduced/diluted direct experience/appreciation of nature combined with the breakdown of the socio-cultural institutional mechanisms for the transfer of local knowledge/perspectives about our links with our bio-physical world, has severely influenced the awareness of nature among today's children.

The world of a 12-year old child residing in a remote village in the Spiti and Ladakh regions of the Indian Trans-Himalaya is no different. From a generation of children who enjoyed a semi-wild existence among the lofty mountains, following the herds of yak, goats and sheep; attuned to the change of seasons, watching wildlife each day and knowing a vast range of local flora and fauna; the present day child spends six to seven hours in the classroom of a local school and almost the whole day in some kind of constructed space if attending a residential one. She studies about the world while mostly alienated from her local environment. To her parents, the knowledge of local plants and their uses just came naturally – through direct contact and passed on by the earlier generations, or from more knowledgeable friends with whom they grazed livestock or went collecting dung and useful plants. But, for this child there's no meaningful way to connect with her surrounding landscape or the wild flora and fauna. The space and wildlife are still there, just a few yards away from either school or home, yet she does not have any link with these elements of her environment. This is the situation that most rural children face today. In a sense, it is worse than urban children whose parents or schools expose them to some form of 'nature' in the way of visits to protected areas, zoos and nature
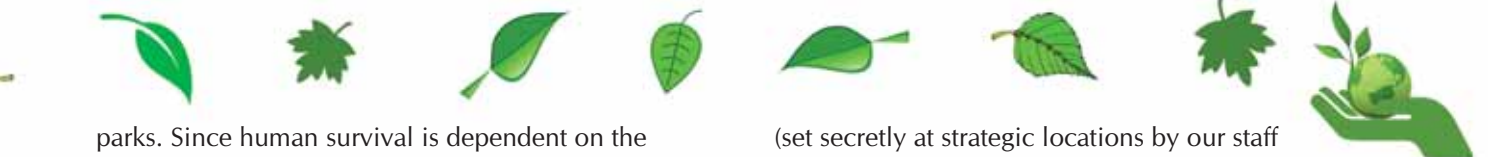

In solitude
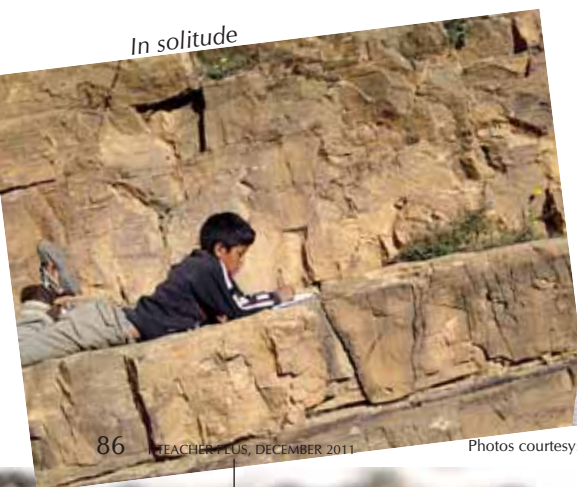
A lens in my hand makes me observe more

Contemplation

Photos courtesy: Pranav Trivedi

parks. Since human survival is dependent on the health of the rest of life on Earth and their interactions with the physical environment, this 'disconnect' could prove perilous for our species.

If children are provided with opportunities to be out-of-doors and interact with nature using all their senses, this missing link can be re-established. Bridging this disrupted link, which is so crucial not just for nature conservation but also for healthy development of the child and expression of her creativity is the focus of this article. Now regarded as a psychological discipline called eco-psychology and considered a key part of the pedagogy for education in general, this avenue has not been explored adequately in the Indian context. For the past five years (2007-11), we have engaged with children to figure out how they view their natural environment and wildlife and whether we can help bring a change in their perspective.

Here, I share the experiences and learning of an attempt to reconnect children with nature through direct exposure to the natural world. It is about the nature education camps that we have been conducting for school children of the Spiti Valley and Ladakh region. These are conducted at two pastures located at about 4,500 metres! Each of these camps is a three-day springboard experience for children of classes V to IX. Children arrive in the morning on day one and leave after lunch on day three. With a mix of excitement, adventure, activities, solitude/reflection and time to just be with themselves, the focus is on experiencing nature, tooth-and-claw.

At present, we have two storyline-based modules catering to children aged 10 to 14 years. In both modules, a challenge is set for the children, which motivates and pulls them. In meeting that challenge, which involves looking for hidden messages/clues

(set secretly at strategic locations by our staff and volunteers), they explore and discover the beauty and wonders of natural pastures and a new meaning of nature. Each message that they find is a matter of joy and excitement and leads to an activity. There are about 10 to 12 activities that involve exploration, the use of senses, knowledge generation through direct contact/experience and reflection. These are followed by documenting/expressing the learning by children in their own words (verbal/written). Most activities are team and pair-based. The day typically begins with some light exercises, silent sitting (meditation) and sharing a good thought. After breakfast children are drawn to the challenge of finding the hidden messages and the process continues for the day with lunch, afternoon lemon juice and dinner providing the energy and time breaks.

The activities include exploration of the environment using all senses, learning about plants and animals of the high altitude pasture, expanding and filtering their view to notice the whole as well as parts of the landscape using binoculars and magnifying lens respectively. In between and at the end of each day, there are sessions to facilitate the processing of learning that takes place. These include value clarification activities such as role play, skits on local environmental issues and writing the experiences/learning. One of the most interesting aspects of these camps is the time we provide for reflection, as each child is an active learner and we recognize her ability to go back to analyze what she's learnt and how it's useful for her. This is generally done through an activity called the "magic spot" or "silent spot", where children just sit and relax or even lie down and ponder. They can choose their sitting places and these often tend to be rocks overlooking a pond. They can do anything here except talk and walk! This solitude gives them the time and space to be themselves and

Immersed in the natural world
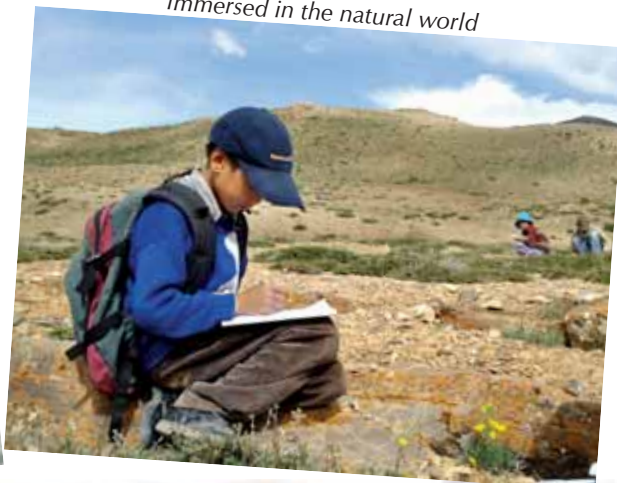
Never thought plants can be so interesting

Displaying their creations

reflect on the whole day. We encourage them to use this time to be creative or descriptive and write. Much of what they think or jot down over here, they share during the campfire each night. We encourage and support them irrespective of *how much* they share. By day three, each child develops the courage to speak in front of all. This activity, thus, facilitates the drawing out of a key feature of healthy development of the child – the capacity to express one's feelings, observations and points of view.

The activities have different goals with respect to the kind of learning that is brought about. A majority of the activities revolve around the theme of developing positive values and feelings about wildlife and the landscape. These include love and respect for all forms of life (inherent value of life), appreciation of patterns of beauty and harmony in nature, joy of being in touch with nature and valuing the natural ecosystems and landscape for their inherent worth as

well as for their 'free' services. Some activities create knowledge and understanding of the local flora and fauna, however, this is done without emphasizing names. Instead, children are encouraged to create names for these species based on what they observe. We do give names but only after being sufficiently sure that they have observed the creatures long enough to create an identity in their mental folders or when we need to caution them or when they already know the creature but not the correct name for it.

A natural question to ask will be "how effective is the programme?" So far, we have had over 800 children and 60 teachers from 23 schools participating in 28 nature education camps (25 in Spiti and 3 in Ladakh). This number in an area with human densities of less than one person/sq km is a strong indicator of the response received for the programme. Analysis of the written feedback (descriptive and pre-post) of children and verbal sharing during the programme indicates

increased awareness among the majority. From creating knowledge based on direct observations to developing positive values and emotions, the camps are indicating positive gains on these fronts. To assess the learning and change in their values, emotions, knowledge and attitudes, we used a pre-post feedback consisting of 15 statements, for which the children are requested to respond in either 'agree' or 'disagree'. From the analysis of the feedback of about 450 children who attended the nature education camps at least once, we found that out of the 15 statements listed, nearly three-fourth showed movement towards desirable responses and these were statistically significant. The statements, which showed no such change included their attitudes towards predators, which kill their livestock and the sharing of pastures with wild creatures. These, as we understand are more rigid and reinforced attitudes emanating from the communities that bear the brunt of economic loss and hardly get compensated. These may require more time/effort; or a different approach for change. What is relevant and important to point out though is these results emerge from a 3-day outdoor exposure. Here, I've listed some of the feedback that we received from children and teachers in the descriptive mode –

• "I learnt that nature is full of surprises and peaceful...we are so lucky to be born in the Himalaya...I'll remember for my whole life that we went for summer camp." – LobzangTandup

• "This 3-day nature camp has been a great educational experience for both students and teachers...the positive effects could last for many years to come, even a lifetime..." – GriffenSchutt (Teacher – Highlander school, Shego)

Found the hidden message!

• "I learnt how to make out which creatures are found in a pasture based on droppings, footprints & feathers." – TanzinDolkar

Through these changes brought about by camps in values, emotions, knowledge and often in attitudes of children, we see a ray of hope as these are all precursors to action. And we don't wish to end with a single outdoor experience. So, we emphasize repeated and sequential exposure, i.e., taking these children outdoors as often as possible (with a maximum of three exposures) and build on the previous experiences/learning to make up for the 362 days that children spend without consciously getting connected to nature! This long-term contact is more likely to lead to behavioural change. We have been doing other awareness activities twice a year by going to all the 30 schools in Spiti and Ladakh, where we have set up Himalayan Nature Clubs (HNCs). Besides, the teachers who coordinate the HNCs also conduct one/two activities on their own. These help strengthen the message that we wish to communicate. Though children seem to play little direct and significant role in influencing decisions and charting the path that a society takes, they are the seeds with the potential to affect change as they move into adulthood. Besides, through a strong influence on their parents, they hold an important niche in the community to bring about change. The higher a society invests in education (not necessarily schooling), the better are its prospects for future.

Finally, I share here an example of real change observed in a group of 12/13 year olds at Kibber village. This group of about 10 children, motivated by their camp outing spent almost the entire winter looking for, following and understanding wildlife in the village pastures. They did this on their own and also sought help from our local staff. An MSc student carrying out research on blue sheep was flummoxed when these children started rattling out names and numbers of various species present in and around the pastures when he met them! The nature education camps have thus provided us with a window to peep into the child-nature link. Strengthening this initiative has the potential of creating a generation of adults who are more likely to be responsible and sensitive.... we eagerly await to watch them blossom!
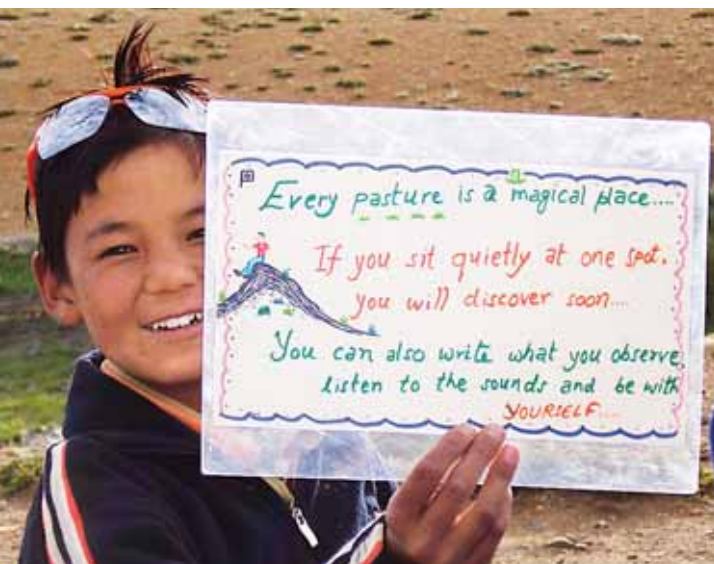
Envisioning the future of the city

Sujata Patel

GROWING up as a teenager in a middle class locality in Bombay (Mumbai), I thought the city represented a life of freedom, allowed ways to create new worlds of work and leisure and were intrinsically emancipatory. It was a site for the growth, development and spread of all new ideas, ideologies and social imaginaries. It allowed us to dream and create new utopias thus encouraging us to recreate lives in myriad of ways. And I thought cosmopolitan narratives – stories of intercultural mingling and coexistence – thrived in cities.

Over the years I have realized that this was merely one fragment of the many utopias and now dystopias circulating about the city. Cities are more complex than the social worlds we imagined we can create. And that is because like other systems of social organization it caters to individuals and groups in distinct, different and uneven ways. If some find confidence to dream, others recognize it as a site of extreme violence and exclusions. If it allows and creates space for new forms of autonomy and independence to be organized for many, it is also a site for institutionalizing constraints and systemic cultural control together with decreasing purchasing power and increasing poverty.

Today in spite of the recognition of these negativities, the numbers flooding cities is increasing, particularly in the countries of the South. And it has become difficult to sustain urban populations not only in terms of work but also in terms of food and water, and energy systems. The future of cities depends on how we can rethink the problem of sustainability of our world in terms of three themes: work, housing and sustainability for all, tolerances to differences between and within caste, ethnic, and/or religious groups and a life of dignity for all individuals irrespective of gender and age.

A large part of the world's population live and work within the informal sector and stay in informal housing settlements, called slums and/or squatter settlements. Often times the place of their work is the same as their home where they reproduce their family and labouring lives through the use of meager capital and low cost appropriate technology. Generally economists and political commentators have deplored this form of labouring because it is not sleek, savvy and big. And yet it has sustained and continues to sustain the lives of huge populations. It is energy saving and allows integration of family life with work life and allows for neighbourhood work-based communities to flourish.

Thinking green

The growth of cities and the constraints this places on resources can be explored by children in a variety of ways:

- ▶ Interviews with migrant labour
- ▶ Conversations with people who used to have property in villages but have sold it to move completely into the city
- ▶ Field trips to the outskirts of a city where small villages have become part of the urban sprawl
- ▶ Issues of water, transportation and housing in cities
- ▶ Mapping areas of conflict and crime in a city and discussing reasons for this

These are only some of the pathways. You and your students could probably think of many more!

Of cities and megacities

It is official. According to the United Nations the world's urban population now exceeds its rural population. This is a milestone in demographic history when one considers the fact that in the 19th century only 3% of the world's population lived in cities. By the end of the 20th century that figure rose up to 47% and if this growth rate continues the UN forecasts that by 2030 three out of every five people will be living in cities causing the rural population to decline and cease to grow altogether.

With more people migrating to the cities in the hope of better standards of living, our cities are growing into megacities – 'the urban phenomenon' of the 21st century. The UN has defined a megacity as a 'high density metropolis' with a population of more than 10 million. The official figure for megacities stands at 21 today with Tokyo being the world's largest megacity with a population of 34,300,000 million. Lagos in Nigeria is the fastest growing megacity in the world growing at the rate of 5% every year with Delhi close behind growing at 4.60%. By 2020, UN predicts that Asia will be home to 12 megacities of the world. Even today the top 5 megacities belong to this region.

Rank	Megacity	Country	Continent	Population	Annual Growth
1	Tokyo	Japan	Asia	34,300,000	0.60%
2	Guangzhou	China	Asia	25,200,000	4.00%
3	Seoul	South Korea	Asia	25,100,000	1.40%
4	Shanghai	China	Asia	24,800,000	2.20%
5	Delhi	India	Asia	23,300,000	4.60%

(Source: Wikipedia)

I think our first challenge is how to rethink development and sustainability to ensure that this kind of economic organization, based on low energy costs and appropriate technology systems become a model for reframing the global economy?

Second, cities have become sites for violent conflicts between caste, ethnic and religious groups. Sometimes these intolerances are translated into xenophobia and target the poor who flood the cities. How can we reframe our lives to build inclusive cosmopolitan social imaginaries in which all find place to dream and create new worlds based on varying identities?

Lastly, individuals are key nodal points in this reframing of cities and ensuring the blossoming and the maintenance of difference and the reframing of collective, inclusive imaginaries. Today they find little recognition (except as celebrities) and often times their sexual, age, ideological and imaginative orientations are controlled and policed through technologies of power and knowledge.

Can we rethink through these three principles of sustainability? Can we recreate cities in their original image of being truly cosmopolitan, emancipatory spaces?

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The transport tangle

Sujit Patwardhan

The author is a Graphic Designer and Printer by Profession. He is also founder member and Trustee of Parisar, an NGO working for environmental awareness, education and action. During the last fifteen years Parisar has increasingly been focusing on Sustainable Urban Transportation as the conventional Traffic and Transport Policy has been damaging the urban environment in most of our cities. He can be reached at <patwardhan.sujit@gmail.com>.

DEVELOPMENTS in transportation are among the most impressive achievements of mankind. Man who couldn't move much faster than about 4 km/hr (kilometers per Hour) on foot was able to increase this on a bicycle and the horse cart (to about 20 to 30 km/hour). The invention and availability of the automobile made it possible for humans to cover anything between 60 to 100 km/hr and well over that on motorways. If you take a train, this speed can rise to 80 to 100 km/hr. For the purpose of this article, we will ignore air travel.

Since post -World War II, man has pursued faster modes of travel through machine-driven vehicles. However, these vehicles are also creating many problems for the world. As one can see, the growing number of auto vehicles has pushed our cities to build more roads, widen the older ones, and to build flyovers. But even

after this, vehicle congestion (what we call traffic jams) continues to get worse year after year.

Most of us can remember the days when traffic was not so bad. One could travel from one end of the city to the other in reasonable time and for shorter distances one could even walk or cycle quite safely. But during the past few decades our cities
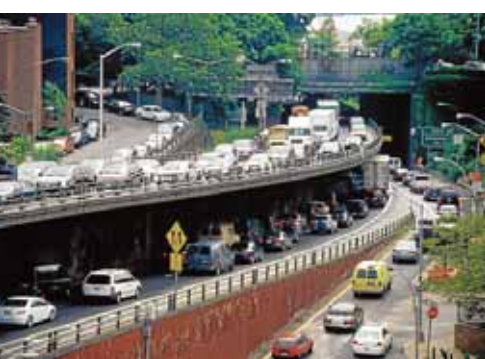
Photos courtesy: Parisar
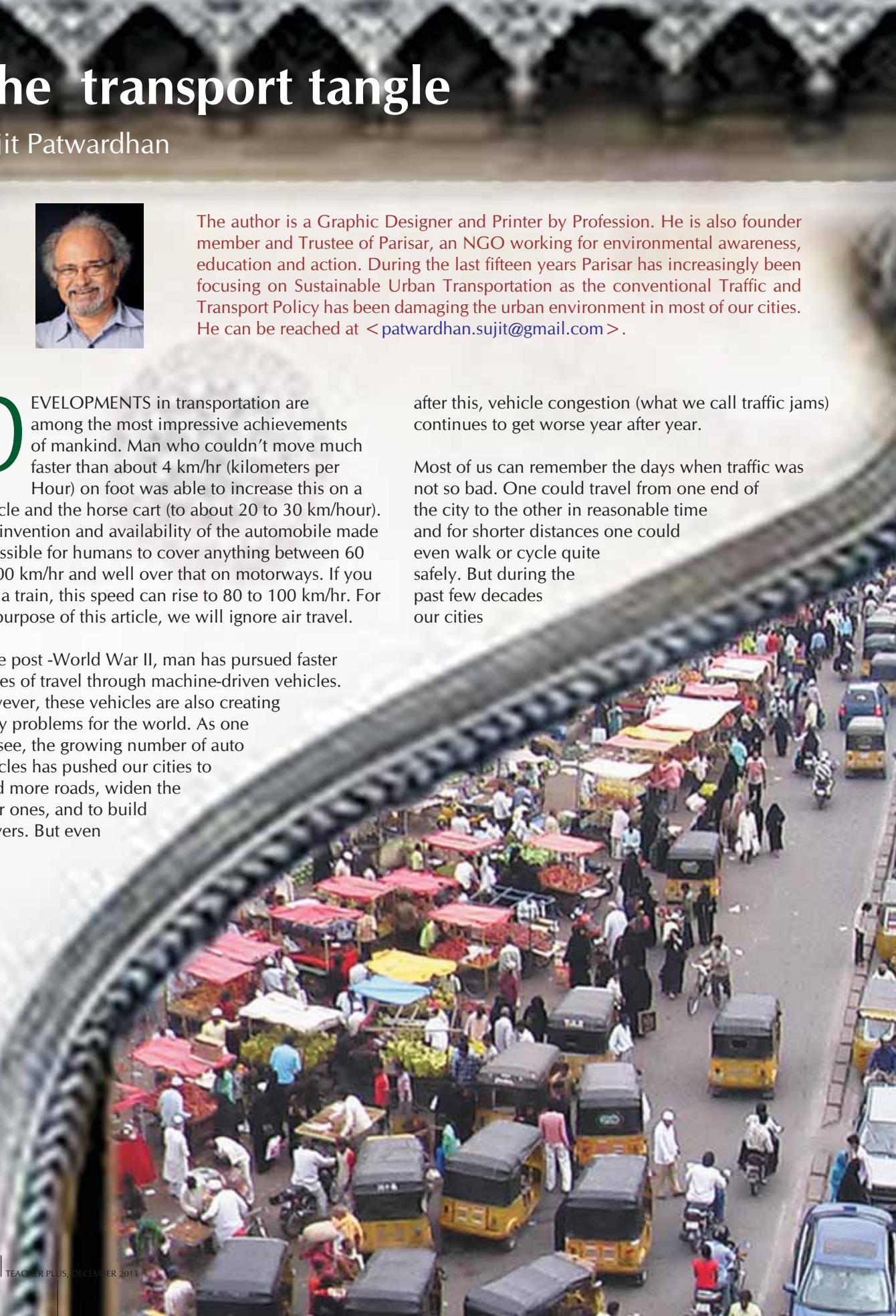
have been taken over by automobiles. There are so many fast moving vehicles occupying every inch of the road that for pedestrians even just crossing a road is an ordeal.

Conventional thinking suggests that a solution to congestion is to widen roads, build more roads and even build flyovers (road over road) to meet the growing number of cars, scooters, and motorbikes. Most of our cities have followed this path with gusto, with the result that road making and road repairs now account for a major portion of the municipal corporation's budget. In Pune, the amount budgeted on transport (road making and road repairs) exceeds the amount for health, sanitation and slum redevelopment put together. Despite such heavy expenditure, traffic problems haven't reduced. In fact,

they have worsened. The situation is not much different in other cities, including the ones touted as Silicon Valleys of India (Bangalore, Hyderabad, Pune etc).

So while cities grow and prosper and peoples' incomes rise, there are noticeable improvements in housing, education, entertainment, shopping, leisure activities, the clothes people wear, the food they eat, etc., in one area despite its growing wealth, the city seems to go from bad to worse; and that is the traffic situation. Today our cities face more vehicle congestion, health threatening pollution, parking problems and road accidents – many of them fatal. In addition to these visible assaults, the old and outdated approach to traffic also starts posing a threat to our natural and built heritage. Traffic vision, riding on the assumption of more and more roads, inevitably comes in conflict with heritage conservation. Cultural, architectural and historical landmarks are bulldozed for road-widening as "solving road congestion at any cost" assumes priority. Similarly, natural assets of a city, like trees, rivers, lakes, water bodies, hills, urban forests and open spaces serving traditional community functions are often sacrificed when it comes to choosing between these and the "needs of traffic". What's worse, anyone questioning this approach (of

more and more roads being the ultimate solution to the traffic problem) is quickly branded as anti-development.

Let's look at this a little closely. Does building more roads solve the city's traffic problems? There is now near unanimity in city planners and traffic experts that just making more and more roads does not solve the traffic problem. Studies show that "every 1% increase in lane miles induces a 0.9% increase in vehicular travel

within 3 to 5 years – almost wiping out all the expected benefits*." That's why newly built roads, widened roads or newly built flyovers don't seem to make much impact on congestion and if anything encourage even more auto vehicles to travel on the roads adding not only to the congestion but also to the pollution. The poster from the Municipal Office in the city of Muenster, Germany (see below), should be an eye opener for those who haven't considered options other than road widening for reducing traffic problems.

If everyone used his car, the street will look overcrowded (Pic 1). If the same number of persons use the same road for travelling by bus (Pic 2) or by bicycles (Pic 3) the road suddenly appears to be free of congestion.

Although this poster starkly displays the connection between our choice of vehicle and road congestion, we have always known that personal vehicles like the motor car and even motorized two wheelers are low capacity

vehicles while public transport are high capacity vehicles. In other words, to carry 3,000 persons from point A to point B we will need about 2,000 cars or 2,400 motorised two-wheelers, but only about 45 buses. (average capacity per vehicle from studies of peak time traffic: Car: 1.5 persons, Scooters/Motocycles: 1.25 and Bus: 70 persons). If more people choose to use public transport for their daily commute, our roads will not overflow with vehicles as they do today.

However, for the last two or three decades, our policy makers have been following the outdated



① **Car**	② **Bus**	③ **Bicycle**

vision of traffic planning that tries to build its way out of traffic congestion. But in the process our cities have got into a vicious cycle that is highlighted in the diagram.

This shows that the mode of travel, not just the width of the road is an equally important factor contributing to traffic congestion. But before we explore how the desirable modes of travel can be promoted and prioritized, let us look at the existing situation in our cities.

How do people go to work? How many commute by personal vehicles? How many by public transport? How many cycle to work and how many persons just walk? The modal share for daily commute in Pune (population 32 lakhs) on the basis of traffic surveys shows that over 75% of trips to work comprise of NMT (non-motorized transport) and public transport. See the chart below:

- ■ Walk
- ■ Bus
- ■ Cycle
- ■ 2 Wheelers
- ■ 3 Wheelers
- ■ Cars
- ■ Rail
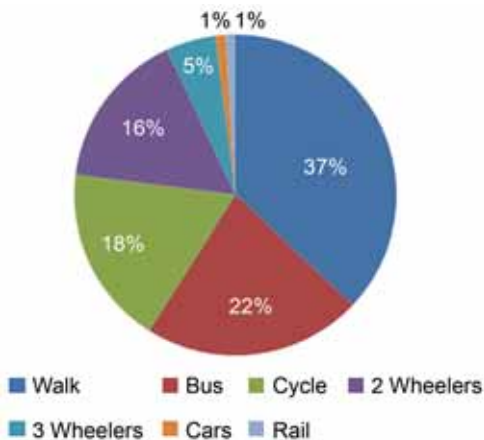
In Mumbai with a population of 1.2 crore, the walk trips are over 40%. In other Indian cities also, the number of persons who walk to work is quite high.

Although this often comes as a surprise to many, the high percentage of citizens who use NMT and public transport is quite logical for the following reason. Young people do not qualify for a driving licence till the age of 16/18. Senior citizens find it increasingly difficult to continue driving and at some stage stop driving all together. Many women particularly from the lower middle class don't drive, and a large percentage of our population belonging to the low income groups cannot afford to own personal auto vehicles.

So, in order to address these problems we need to rethink our assumptions and priorities. The visible problem is the growing mismatch between the number of personal auto vehicles on the roads and the space available for them to function efficiently. The old way to do this was to simply go on building more and more roads and parking lots to accommodate the growing number of auto vehicles in the city. We have seen what this leads to – road congestion, pollution, accidents, damage and destruction to the city's environment and massive sprawl that ends up making commuters totally auto dependant. Prime examples of this are the car-dominated cities in many parts of the US. In terms of global environmental sustainability, this will count as the worst practice scenario for urban transport, and one that is costing the country billions of dollars to correct/ repair.

The other way is to ask why so many vehicles need to be on the roads in the first place. People need access. Access to workplace, access to schools and colleges, access to shops, theatres, recreational places, etc. Mobility is only a means to reach these places, and this can be achieved through deploying various modes – for example, Walking: for short trips of up to one km, Cycling: for trips between 2 to 7 kms, public transport bus: for the longer trips.

But this is not the way we look at our travel options. If we happen to own a two-wheeler or a car, we just take out this personal vehicle for any/every trip. Although excessive personal auto vehicle use during peak travel time is at the heart of the urban traffic

problem, we rarely think about the options that have little or no impact on traffic – such as walking or cycling (no burning of fuel, no pollution, no road congestion, no noise, little chance of accidents and so on. We also don't think too much about public transport buses, though the poster from Muenster shows how large capacity vehicles cause minimum road congestion. They also (per passenger) need far less fuel, cause far less pollution and are overall far safer than personal autos. If we have adequate, reliable, clean and comfortable buses many of us will opt to keep our personal vehicles home for most of our work trips. Of course, cars and two-wheelers will still be an option but they will share a greater portion of the cost they impose on the city and with the result they will become more costly to use.

But this is not happening and the reason is obvious. Our cities are still dominated by the automobile-centric vision. There is a hue and cry when potholes appear on our roads, when a road acquires a reputation for repeatedly getting jammed with traffic, when we feel it is difficult to find convenient parking space when we go out

shopping. Authorities swing into action and try to ease the congestion that "we" cause by insisting on taking our personal vehicles for every journey we make.

If this is to change, the city needs to pay at least some attention to facilities for convenient and safe pedestrian and cycle journeys (good quality and wide footpaths, cycle lanes on big roads, and safe cycle paths with speed limits for auto vehicles on smaller roads, auto vehicle free zones (open only to pedestrians and cyclists) in congested areas of the city; and all these initiatives combined with a strong Transport Demand Policy (TDM), which in other words means disincentives for the use of personal auto vehicles. There are many forms of TDM, from the congestion charging as in London, vehicle restriction based on number plates as in Bogota, Colombia, etc., permits for purchasing cars and electronic area licencing schemes that levy heavy charges for entering the congested parts of the city in cars as in Singapore, progressively higher parking charges for cars coming to centre of the town (usually congested) as in many cities in Europe and

building cycle friendly cities as in Copenhagen, Amsterdam, Paris, etc., where citywide bicycle hire scheme is put in place to encourage people to use cycles hired out at very low charge.

When this happens, the city will begin to reap many other benefits, such as – cleaner air, less noise, less problems for parking, less stress, healthier citizens, better public spaces, parks instead of parking, better heritage conservation, more tourists and overall a far more pleasant city to live in or to do business in.

Indian cities have still not sold their soul to the automobile-dominated vision (though we are certainly moving in this direction). We don't have to make the same mistakes that US and European cities made post World War II and are now spending millions to undo. We can leapfrog and do things right the first time. Whether we succeed or fail in this will be a good indicator of whether we as a nation are going to live up to the promise of flowering into one of the great countries in the coming century or going to continue mindlessly aping the west.

Notes and references:

* Hansen, Mark. 1995. Do New Highways Generate Tarffic? Access 7:16-22

NUTP (National Urban Transport Policy, Govt of India 2006)

Traffic congestion in Indian cities: Challenges of a rising power, Azeem Uddin

Removing Freeways – Restoring Cities
http://www.preservenet.com/freeways/FreewaysWestSide.html

In the classroom

Teachers and students can together explore some of these issues and collect data for their own city. In the process they can test the hypothesis put forward in this article.

1) Have new roads (and flyovers) built in the last five to ten years led to a reduction in the vehicle congestion on the city's roads?

2) How many auto vehicles are there in your city? Can you collect yearly data from the year 2000 to 2010 for number of two-wheelers and four-wheelers added for each of these ten years? You can also work out the percentage rate of growth of auto vehicles (separate for two-wheelers and four -wheelers).

3) Is parking of vehicles a problem? What do you think is the solution?

4) What are the parking charges for personal auto vehicles (please mention separately for two-wheelers and four-wheelers). Is it the city's responsibility to provide free parking spaces for personal vehicles on public roads?

5) Will traffic problems reduce or increase if parking is provided free throughout the city? What if the parking charges are substantially increased?

6) What is the city's annual budget? What percentage of the budget is spent on traffic and transport related projects annually?

7) Are there walkable pavements on all roads in the city? If not, what percentage of roads have walkable pedestrian pavements?

8) What is the norm for width of pavements/footpath?

9) Are city's roads easy to cross? If not, what are the main impediments? These questions should be answered by people who walk at least one kilometer every day on city's roads.

10) Are there at grade (at the road level) pedestrian crossings in the city? If not are there foot over bridges or subways? Do pedestrians use them? If not why?

11) What percentage of commuters walk to work, cycle to work, use personal two-wheel auto vehicles, use cars and what percentage use public transport (buses and local trains)?

12) Are there any cycle tracks built by the Municipal Corporation for safety of cyclists? Are any planned?

13) What is the quality of public transport in the city? Excellent? Satisfactory? Unsatisfactory?

14) What is the amount invested in public transport buses and infrastructure for these buses (such as depots, parking areas etc) each year for the last five years?

15) How many buses does the public transport system own? How many of these are older than 10 years? Older than 15 years?

16) How many new buses were purchased/acquired by/ for the public transport bus undertaking each year for the last five years?

17) How many roads accidents take place in your city annually (figures for the last five years). How many of these were fatal?

18) Do citizens feel there are adequate public spaces in the city – such as public gardens, public playgrounds, urban forests open to public?

19) Is the air quality monitored on a daily basis and are these figures readily available to the public?

20) If so is the air pollution below "safe" level? If not how much above safe level? 25%? 50% More?

21) Does the city prepare an Environmental Status Report each year?

22) Are the pollution related ailments on the rise in the city? Major hospitals may have details of ailments such are respiratory diseases, hypertension, heart ailments, lung cancer, stress related ailments, etc.

23) If you were asked how to solve/reduce the traffic problem in your city what are the three or four things that need to be done (in what order of priority)?

24) Does this match the perception of local media (newspapers, TV channels) as judged from the articles that appear and features that are aired on TV?

If you ask your local corporator (elected representative) what is needed to reduce traffic problems in the city, are their answers in line with yours?

Driving the craft movement

Pushpa Chari

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IN "India's Crafts: Crisis and Opportunities", economist and crafts activist Ashoke Chatterjee asks, "What Indian industry offers employment to millions ...is primarily based in rural locations, has immense export potential...and a low carbon footprint, contributes competitive skills to a large number of key industries and offers a huge social and political safety net?" The obvious answer is the country's huge traditional art and crafts industry, comprising a workforce of some 40 million artisans (some estimates put the number at 100 million) "who are talented, skilful, inventive, and often entrepreneuria, and who represent a culture that is natural, not self conscious" – and who live largely off the land.

Economy drivers

India's traditional art and craft industry is the biggest employer in the unorganized sector, after agriculture. It is linked, as it has been through the centuries and millennia, with our civilizational expressions, be it dress, lifestyle products both decorative and utilitarian, and with our ritual and religion. India's textile jewellery and gems traversed ancient trade routes from pre-history to Greek and Roman times, from the Silk Route's historic pathways to the medieval pre-colonial and Colonial eras. Foreign travellers from Megasthenes (Circa 5th BCE) to Chinese Buddhist traveller Huen Tsang (Circa 6th AD) to Ibn Batuta in the 12th century and Bernier and Tavernier in the 18th century have written about the superb textiles , jewellery, and hand crafts of the country and the brisk trading in them which went on in the streets and bazaars of the cities. It would seem that then, as now, handicrafts played a pivotal role as economy drivers. Today, handicrafts form the biggest single export earner at Rs.7,000 crores. According to Liebel and Roy, authors of "Handmade in India" (2010), the early post liberalization period saw the greatest spurt in the export of handmade textile and products.

The seeds of this growth can logically be traced to the proactive post-Independence government policy, which not only saw the setting up of a nodal Handloom and Handicrafts Ministry that oversaw the growth of handicrafts and handlooms, but also led to the setting up of state handicraft emporia, the Central Cottage Industries Emporium, an actively pursued export trade and the holding of marketing events such as craft fairs, melas, haats, etc., sponsored by the government. The various Festivals of India in the 80s and 90s created awareness of our craft internationally, while the various State and National Awards, the Shilp Guru Award, etc., gave a further fillip to the status of artisans. The setting up of self help artisanal

Photos courtesy: Pushpa Chari

groups, design, and development training programmes and wide spread work by NGOs are other landmarks in the growth of the crafts sector. However, ultimately the growth has been driven by the skills of the Indian artisan with his inherent strength to create, innovate, evolve, and endure.

In a state of crisis

To sustain is to endure, which is what India's crafts have done through 5000 years. So does traditional Indian art and craft need external inputs to help it sustain, endure and survive? The answer is yes. India's crafts are facing a crisis today. Many craftsmen are leaving their hereditary vocations faced by diminishing markets or the lure of jobs in urban centres. The spread of education among the younger generation is another factor that fuels this phenomenon. Many crafts have begun to languish or have totally disappeared due to changing lifestyles. The consumer culture plays a role in the disconnect of the artisan with his trade as is his perceived lack of status in society. The very perception of craft itself is often seen as purely a part of market economy, based on its marketability, profits and financial survival. However, another view held by many sociologists, anthropologists, and economists veers towards seeing hand work as part of cultural economics, and intrinsic part of the fabric of the

community, which goes beyond monetary value. The UN Report of the World Commission on Culture and Development has called culture along with its products the "soul of development". And according to Richard Sennet, working with one's hands builds moral character, a learning of social skills and problem solving techniques. Needless to say, both the 'monetary' and the 'cultural' values are intrinsic to defining handicrafts.

Craft education in schools

Perhaps ensuring sustainability of hand crafts could start with education. The introduction of craft education in schools will not only teach children invaluable hand skills, but build character and expose them to an understanding of its green processes. The introduction of craft education in the syllabus of classes 11 and 12 by the NCERT is a significant step in sensitizing children to handwork and creativity. Scholarships and incentives for children of traditional artisans is another avenue that is being increasingly explored. One could also tap into the deep-rooted knowledge and skills of the artisanal community as teachers at premier institutions like NIFT, IRMA, etc. They could also work with industry clusters in

research and development. In fact, Tanishq and Titan represent one such success story, in which master artisan skills have been at the heart of the design and manufacture of precious jewellery and watches.

In another success story, ISRO has utilized the skills of Kerala's bell metal artisans in the area of nanotech solutions, where science and technology had failed to provide answers. Design teaching by artisans at NID (National Institute of Design) has resulted in a large range of product development. All these case studies should be studied academically and taught in IIMs and MBA courses. Innovation, trust, and information sharing is the key to ensuring sustainable craft growth. Over a period of time, technology and design inputs have sustained a large number of crafts. However, intervention has to be done with sensitivity, taking the artisans' viewpoints and empowering them by making them partners in the decision-making process be it in the area of design, product development, or marketing. The artisan is a natural innovator and has to be taken alongside the designer in any journey of transition. Equally important is information sharing with the primary producers, the

Learning from the artisan

Craft is perhaps the most natural subject to teach children since every child reacts with happiness to colour and texture, flowers, birds butterflies and trees, the shape of the clouds and the stars in the sky.............. Who hasn't experienced a child's pure joy in making mud pies and sand sculpture, dolls out of poppy flower and boats and kites out of paper? From nature study walks at age 6 to environmental science at 12, 13 and 14 is a process of transition and assimilation by the child. It is also perhaps the right time to expose the child to fashioning shapes, dolls, objects and movement out of nature's bounty and every day organic materials such as paper, mud, wood, stone etc, . For the older child, the thrill of creativity can be combined with lessons on the preservation of the environment and the eco-friendly and organic nature of crafts. Craft should be taught as a holistic discipline in history, culture, the environment and design.

A child of 12-14 is definitely ready to create in the serious sense of the word. The World Crafts Council, an international NGO working for the cause of craftspersons worldwide has already launched a programme of teaching traditional crafts to children from ages 12-16 in Chennai. The craft lessons are hands on classes where master craftspersons teach the children from primary source to the end product. According to Ms. Usha Krishna, President WCC, "Our aim is to sensitise children to our traditional arts and crafts so that they appreciate not just the craft and its processes but the artisans who create them. They learn from the artisan, apart from craft, stories about their lives and environment and the deep relevance of handicrafts which are at once about history, geography, culture creativity, environmental preservation and economics".

Teachers could prepare short interlinked lessons on the cultural, historical eco-friendly, organic and creative aspects of particular crafts. Field trips could be organized to the source of raw materials. Lessons in vegetable dyes could include the actual making of the dyes by the artisan and the student. Modern science and technology, interiors architecture and town planning could be linked in the lessons to the relevance of handcraft bringing it into the ambit of contemporary life. The inclusion of crafts in the NCERT syllabus of classes 11 and 12 is a wonderful step in making crafts part of the education of our children.

artisans. Government attention is export centric and focussed on increasing trade opportunities. Yet, the artisan remains largely uninformed about the demand of his goods and has no control over marketing information. There is, to quote a leading economist, "vastly asymmetric information as well as asymmetric capabilities between the artisan and market operations." Both government and NGOs should set this asymmetry right by spreading information from cluster to cluster.

Educating the customer on the deep relevance of hand crafts, its eco-friendly processes, its heritage and humane value is yet another important area which government NGOs and the media should work on. With ecology and environmental awareness fast gaining ground, the green factor inherent in crafts should be emphasized. If every 'tea kadai' and 'dhaba' across the country carries relevant posters, hand crafts could get a tremendous boost.

A synergy between government policy, NGO involvement, and individual entrepreneurship is what is driving the craft movement forward today. Plus, the passion and commitment of the artisan whose skills will take hand crafts into the streets of the future. We should all walk alongside him for the survival of craft and a value-based life.

# UNESCO and sustainability in classrooms

Sridivya Mukpalkar

WE ushered in the seventh billion baby not so long ago, and with these happy tidings, we are reminded of the fact that we, and our children, need to re-look at our lifestyle choices and ensure that the future is as good or better than today. Teaching children sustainability approaches can be exciting and inclusive, as I'm sure this issue of *Teacher Plus* will compel you to believe. UNESCO has a dedicated website on sustainability education for teachers that extends some of the issues we discuss here, and help us enliven classroom discussions on these vital issues.

Teaching and Learning for a Sustainable Future (TLSF) http://www.unesco.org/education/tlsf is part of UNESCO's program on sustainability. TLSF aims to create a curriculum that instills in students, teachers, trainers, policy makers and educators the responsibility to contribute to a sustainable future. The site answers diverse questions such as why should teachers learn about sustainability, how can they teach about sustainability and vitally, the website elucidates teachers' role for a sustainable future.

The program is divided into four themes: Curriculum Rationale, Sustainable Development across the Curriculum, Contemporary Issues and Teaching & Learning Strategies; all in multimedia format. The website hosts 27 modules and the duration of the entire program is about 100 hours. Each module explores different aspects of sustainability and through activities, lesson plans and plenty of examples, reinforces the concepts introduced in the module. Various resources including articles, activities, lesson plans, presentations and games are easy to download

and print for classroom use (though printing may not be a great idea, ahem).

The site employs a simple layout and language, while the examples and activities are generic and easy to adapt to a teacher's setting.
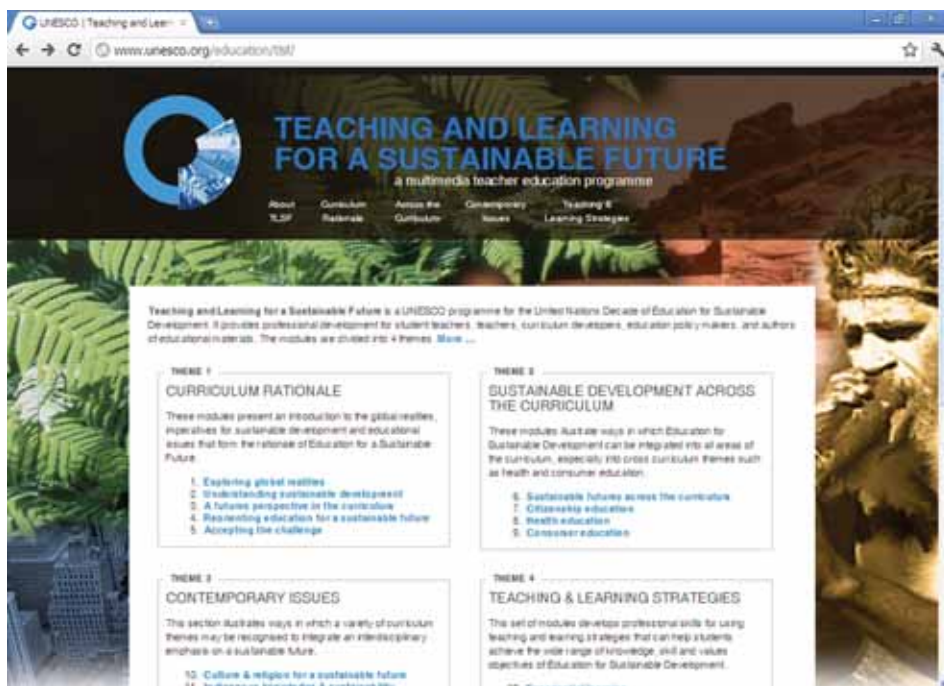
The Dissemination & Training Toolbox is another big element of TLSF. The Toolbox provides different ways to train teachers and implement TLSF into a curriculum. There are many resources in the form of presentations, text and other media. The Toolbox also has workshops plans and sample workshops that can be used for trainings.

UNESCO's TLSF is part of its big plan for a sustainable future, i.e., 'UN Decade of Education for Sustainable Development', which began in 2005 and will go on till 2014. Teachers are not just a part of this grand plan but key influencers and change makers. The website, I hope, will be a continuation to your discussions and plans fostered by this issue. Happy surfing!

# My upcycled life

Nina Subramani

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TODAY it is almost mandatory for the words 'development', 'lifestyle' and even 'technology' to be prefixed with the word 'sustainable'. When we read that something was built keeping sustainability in mind, we feel more comfortable about that product. We may build sustainable homes (often confused with exposed brick facades of buildings) and join the rest of the planet in turning off our lights for an hour in the evening once a year – but really, how sustainable are our lives – and is it possible to live an entirely sustainable lifestyle?

I may choose to ride a cycle to work – thus saving on fuel, which is precious. Once I reach my workplace, I may munch on an apple or pear, and drink some juice that I've carried in my backpack – but what if those fruits and juice are imported products – that have reached my Bangalore supermarket all the way from the USA or New Zealand – how much fuel have I really saved? Leading a sustainable life, therefore, in my opinion, is a snowballing effect, or as they say in the Lays Chips ad, you can't stop with just one (way of being sustainable!).

Some of my friends have inspired me to change my lifestyle. One of them is a CEO of a company – he either cycles or takes the bus to work – about 8 kilometers one-way. No chemical cleaning ingredients can be found in his home. Indeed his home, which was built recently, is a lesson in sustainability. The roof is made of bamboo. There are no tiles on the floor or in the washrooms. The glass for his windows is all sheets from demolished buildings. The wood for the staircase, window frames and cupboards is all wood recycled from packing crates. His kitchen and washroom sinks, taps and even the WC are second hand – from demolished buildings. The water from his washing machine and kitchen sinks 'grey water' leads into the garden. His large screen television, state of the art refrigerator and a few other appliances are second hand too. He says there is no need to keep buying new things and junking perfectly good products that may be a little out of style.
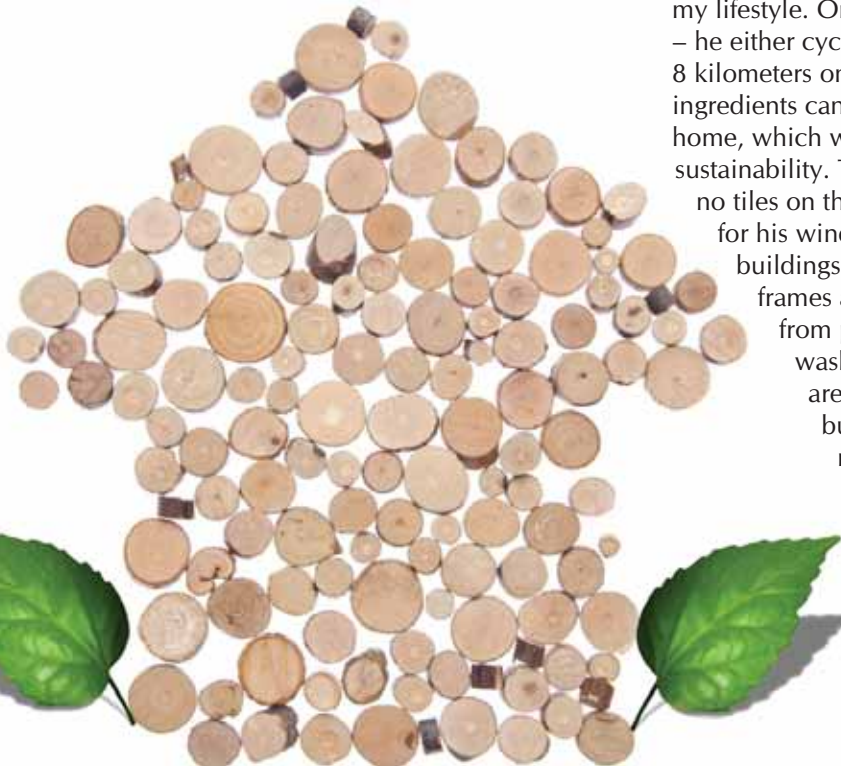
Needless to say his home is beautiful. He has also saved up to 40% of his building costs on plaster, cement and interior products.

Nothing looks second hand. Why am I saying this? In our society, there is a stigma against second hand products, against 'saving' money if you can afford not to. Plus if you're the CEO of a 'BIG' company, it is almost mandatory to have all the fittings of a 'hi-carbon' lifestyle as opposed to a sustainable one. In fact, I sometimes think the biggest hurdle to living sustainably is the inherent snob factor.

Another friend lives almost 35 kilometers from her work place. She started a car pool – the rule was simple. If there weren't at least 4 people in the car, the car would not be used. Along with her colleagues, a schedule of timings and leave days was made and adhered to. The movement within her office grew and soon car poolers got preferred parking. When she built her home, she invested in solar energy. The result, between 6 pm and 9 am her home is run solely on solar power. She started segregating waste and composting at home. This naturally led to gardening, which soon spun into her farming an empty plot adjacent to her house – growing corn, tomatoes, spinach, and other vegetables. All without chemical pesticides. This wasn't enough for her - when she realized her 'grey water' had detergents and chemicals from shampoos and clothes whiteners, etc., she started using soap nuts even in her washing machine. She even learnt to drink tender coconut straight from the coconut rather than use the plastic straw.

So how did these two people and countless others that I read about inspire me? Of course like many people, my first step towards sustainable living was using a cloth bag rather than plastic. I then started segregating my garbage. Now all the vegetable and kitchen waste, biodegradable, go straight into my compost bin and then later to my plants. The milk packets, plastic containers, glass bottles all get recycled. My aim is a no garbage home – one that I haven't achieved yet.

I stopped buying drinking water – if I forget to carry a water bottle I stay thirsty. I stopped using auto rickshaws for my errands – I either walk or use my bicycle. I hardly ever use my printer. I don't buy any imported food. I make it a point to look for local foods, I even learnt to make my own ricotta and mascarpone cheese – now I don't have to buy the one
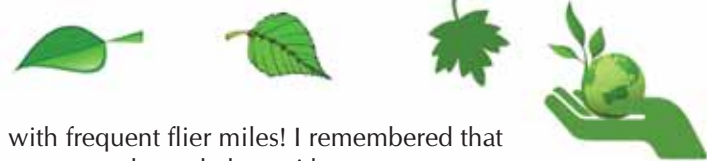
with frequent flier miles! I remembered that my mom cleaned glass with a wet newspaper and I stopped buying the fancy chemical filled glass cleaner.

In fact, when I really stop to think about it, I grew up in a very sustainable home – of course we didn't know it then. My brothers and I used the same school and lunch bags for years on end, we cycled to school, we removed the unused sheets of paper from our notebooks and had new ones bound at the end of every school year. Textbooks were passed on from seniors to juniors. Between cousins and friends, clothes and shoes were handed down – it was never a matter of affordability – everyone did it and there was never any shame in it.

I try to do the same thing with my daughter now – with my other 'mom' friends, we have a chain of supply of clothes, toys and books that go all the way from Delhi to Coimbatore. Nothing gets thrown away and we reuse till it can't be used any longer. She sometimes brings me a box, or a carton and says 'what can we do with this now?' Of course the flip side of all this recycling is that now you get really beautiful products that have been recycled or 'upcycled' and in the guise of being 'eco friendly' you'll end up buying all sorts of things that you don't need and then you'll need to throw it all away a few years later when you're 'clearing up'.

The fun part about living this way is if you really stop to think about all your actions, you can find ways to make everything sustainable. I work from home – so if I bathe in the afternoon – I don't need to switch on my geyser. The water is heated up in the tank anyway and I get piping hot water. Free of electricity! Yeah and that's another victory for the planet and me!

Think about it – and let me know what else I can do.

Those that did not make it

Zeba Raziunnisa

THE word 'Sustainability' is often associated with environment. But as an idea it is much more. Often explained as the capacity to endure, it can be applied to education, relationships, businesses, health, tourism and art as well as to dimensions like energy, development, and architecture. For a process to be sustainable it would have to be interest driven, innovative and efficient, ensuring that the quality does not degrade. This issue of *Teacher Plus* examines sustainability within the realm of environment. While we have tried to include articles on several issues that need to be addressed, there are still many more that could not find a place due to space constraints. We present a few of them here.

Consumption

Population control and meaningful consumption are two important aspects of environmental sustainability. Environmental campaigners stress that the world has a seriously lopsided consumption pattern, where a huge majority of humans use very little of the Earth's resources, while a small minority use the vast majority of natural wealth. The World Bank estimates that the richest fifth of the world has more than three-quarters of the income; while the poorest fifth has just 1.5 per cent.

Problems of overconsumption, exploitation, uneven distribution of resources, pollution and reckless use of raw materials hold great consequence for each one of us. Recent consumption trends have sparked overwhelming levels of environmental deterioration. If allowed to continue unchecked, the dismantling of the natural world can have catastrophic effects. Small steps like careful and wise use of resources, minimization of waste and pollution and use of renewable resources are easy achievable goals. Lifestyle changes and meaningful consumption are key to environmental sustainability.

Eco-tourism

Eco-tourism is responsible travel to natural areas that conserve the environment and improve the well-being of the local people. A tourist destination to a far away land cannot be called eco-tourism unless it benefits and helps conserve and improve that environment and raise awareness and funds to help protect it. Eco-tourism is an innovative approach to maximize the economic, environmental and social benefits of tourism.

Ecotourism is geared towards uniting conservation, communities and sustainable travel, building environmental and cultural awareness and respect, providing positive experiences for both visitors and hosts, providing financial benefits for conservation and for the empowerment of the local people. Eco-tourism aims at preserving and sustaining the diversity of the world's natural and cultural environments. Its approach to tourism is minimally intrusive or destructive to the environment and sustains and supports the native cultures in the locations it is operating in.

Population

The world population reached 7 billion on October 31, 2011. With an average of 4.17 births per second the United Nations has projected the world population to touch 9.3 billion by 2050, and India is expected to overtake China to be the world's most populous country by 2025.

The rising numbers would not be a growing concern if there were enough resources to go around. However, population has to be balanced against depleting resources, safeguarding the environment and protecting against climate change.

Population sustainability is an important part of sustainable development, the logic being – as the pie cannot be enlarged, reduce the number of hands competing for a share. World Population Day observed on July 11 every year is an annual event established to raise awareness of global population issues.

Birds as environmental indicators

Environmental indicators are a subset of sustainable development indicators. Environmental indicators help trace and understand changes taking place in the ecosystem.

One of the most effective and significant indicators of environmental health are birds, as they score highly on many of the criteria defined for selecting environmental indicators. Researchers study birds to compare their diets from different locations to see how the local environments affect nutritional intake and the overall health of bird populations. Even a feather from each bird, can help explain the environments in which they live and, likewise, the overall health of the environments in which we all live.

Changes in bird populations tend to integrate a set of ecological factors and can provide a useful indication of environmental change. Migratory birds are valuable and key indicators of environmental health. A shift in migratory patterns reflects a serious environmental change. If the birds have trouble migrating and surviving, it is a sign that the environment is also in trouble.

Green Architecture

An interesting and sensible way to be a part of the green movement is to adopt Green Architecture. Green architecture refers to the creation or restructuring of buildings that is environmentally responsible and resource-efficient, right from the building's design and construction to its long-term operation and maintenance.

Green architecture is designed to reduce the overall impact of a structure through an efficient use of energy, water and other resources, improving indoor environment quality, protecting occupant health, and reducing building operating cost and waste through use of eco-friendly building materials and construction practices.

A basic green design would include the strategic placement of windows to decrease the demand for artificial light during the daytime, ventilation systems for efficient heating and cooling, collection vats to harvest rainwater, using organic building material wherever possible, taking advantage of renewable resources like solar energy and wind energy, use of recycled architectural salvage and an efficient use of space to effect a minimal loss to the natural habitat.

Ecological Footprint

Ecological Footprint is an effective resource accounting tool that measures humanity's demand on nature. It measures how much land and water area a human population requires to produce the resource it consumes and to absorb and mitigate associated waste.

Conceived in 1990 by Mathis Wackernagel and William Rees at the University of British Columbia, Ecological Footprint accounts provide a robust estimate of human demand on the biosphere as compared to the biosphere's productive capacity. Ecological Footprint records have shown that since the 1970s, humanity has been in an ecological overshoot with the annual demand on resources exceeding what the Earth can regenerate each year. Such an overshoot is ecologically unsustainable and highlights the reality of ecological scarcity.

Ecological Footprint of a population can assess our pressure on the planet, which helps us manage our ecological assets more wisely and take personal and collective action in support of a world where humanity lives within the Earth's bounds.

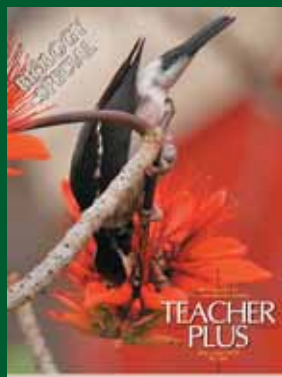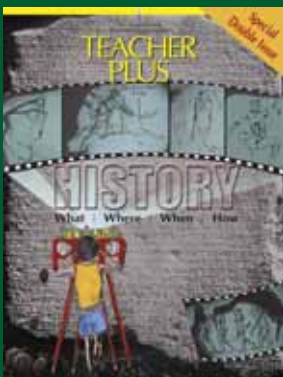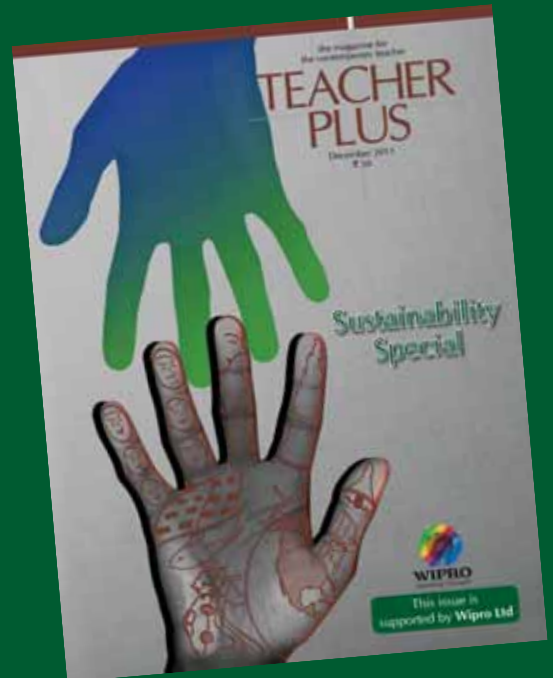The author is a freelancer based in Hyderabad. She can be reached at <zeba_117@yahoo.co.in>.

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