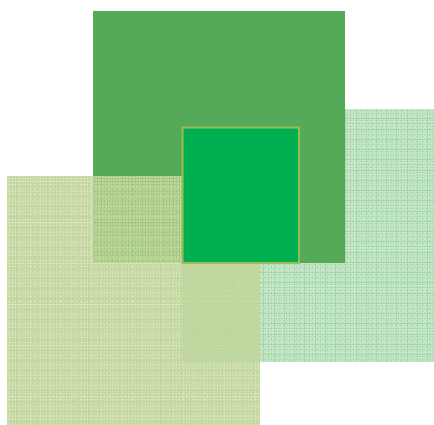




International
Labour
Office
Geneva



Skills for green jobs in India

Unedited background country study

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National Institute of Science, Technology and Development Studies

ILO Skills and
Employability
Department

2010

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Foreword

The world finds itself in a slow recovery after the deepest recession since the Great Depression. The world is also coping with a host of environmental problems and the urgent need to reduce carbon emissions. A greener future also promises an enormous potential in a much needed employment growth. However, without suitable skills, this potential cannot be realized. Today, skills gaps are already recognized as a major bottleneck in a number of sectors, such as renewable energy, energy and resource efficiency, green building and retrofitting, environmental services, and green manufacturing. Training response measures are successful where they are coherent across policy domains, systemic and systematic, and targeted at disadvantaged groups. These training measures can only be effective if based on timely identification of skills needs. Effectiveness of training measures is decisive not only for the economic recovery but also for a longer-term sustainability agenda.

This report was produced in the framework of the project, ‘Skills for green jobs’. The project was implemented in cooperation between the International Labour Organization (ILO) and the European Centre for the Development of Vocational Training (Cedefop). The project identifies skills needed for greener economies with respect to structural shifts, and new, emerging and changing occupational profiles. The ‘Skills for green jobs’ study is embedded in the Green Jobs Initiative, a joint initiative of the United Nations Environment Programme (UNEP), the ILO, the International Employers Organization (IOE) and the International Trade Union Confederation (ITUC), to assess, analyze and promote the creation of decent jobs as a consequence of the needed environmental policies. The global study was jointly funded by the Skills and Employability Department of the ILO and the Green Jobs Initiative.

The following countries have been included in the study: the ILO covered Australia, Bangladesh, Brazil, China, Costa Rica, Egypt, India, Indonesia, the Republic of Korea, Mali, the Philippines, South Africa, Thailand, Uganda and the United States. In addition, Cedefop covered six European Union (EU) member States: Denmark, Estonia, France, Germany, Spain and the United Kingdom. The ILO global synthesis report,¹ which analyzes the situation in all 21 countries involved in the study, and the European synthesis report,² which covers the six EU countries, as well as all individual country reports, are available at: http://www.ilo.org/skills/what/projects/lang--en/WCMS_115959/index.htm (the ILO website) and <http://www.cedefop.europa.eu> (Cedefop website; look under *Skills Needs* theme). The unedited background country studies have been published in the electronic form in order to make them available quickly. The summaries are published as part of the synthesis reports.

The global project in the ILO was coordinated by the Skills and Employability Department and, in particular, benefited from comments and technical guidance by the team under the leadership of Olga Strietska-Ilina, Christine Hofmann, Mercedes Duran and Shinyoung Jeon. The ILO coordinating team would like to express great thanks to the authors of the report, Vipan Kumar, Kasturi Mandal, Naresh Kumar, and Taposik Banerjee of the National Institute of Science, Technology and Development Studies, for their background country research which contributed to the global study. Special thanks also go to the ILO regional and country field offices for the project support and the ILO colleagues who assisted research at national level.

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Director
Skills and Employability Department, ILO

¹ Strietska-Ilina, O.; Hofmann, C.; Duran Haro, M.; Jeon, S. (forthcoming 2010). *Skills for green jobs: A global view. Synthesis report based on 21 countries* (Geneva, ILO Skills and Employability Department).

² Cedefop. (forthcoming 2010). *Skills for green jobs: European synthesis report* (Luxembourg, Publications Office of the European Union).

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Abstract

The project was initiated at NISTADS under the sponsorship of the International Labour Organization (ILO) to identify major challenges and priorities related to climate change and environmental degradation and the subsequent greening policies and strategies to generate a green jobs environment in India. The study is a part of the major programme on “green jobs” by ILO under which about 21 countries are participating. NISTADS undertook this short study through: (i) meeting with several stakeholders which included Ministries, trade unions, academia, Industry and non-governmental organizations (NGOs); (ii) Conference on Green Economy; and (iii) Case Studies; to come up with this report.

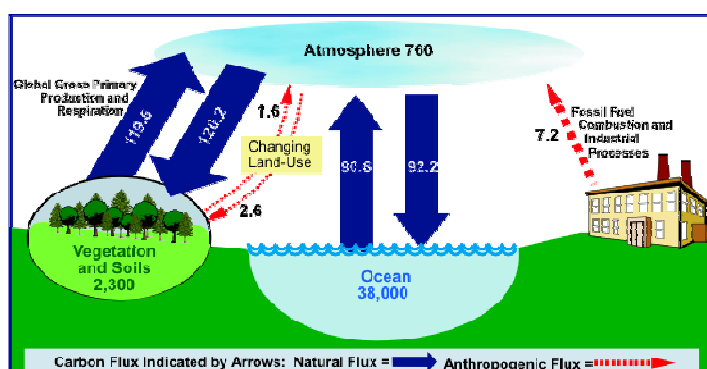
In the report, an attempt was made to provide an insight of major sectors with a green job potential in the country, with special emphasis on traditional sectors; and analyze whether and how skills response strategies are incorporated into larger ‘greening’ policies and programmes. The report has further presented a brief skills needs for new occupations, new skills for greening existing occupations and retraining needs in sectors undergoing structural changes as a result of policy implementation, and introduction of greening technologies and practices. The report also provided conclusions and policy recommendations for skills development and strategies, skills provision at national, sectoral, local or enterprise level in the green jobs area.

Executive summary

Definitions

The “green jobs or occupation” existed from the time-immemorial in India, however, the phenomenon has attracted attention of academia and policy makers after the recent initiatives of United Nations Environment Programme (UNEP) and International Labour Organization (ILO) for the publication of the report on “Green jobs: Towards decent work in a sustainable, low-carbon world”. The green jobs help to protect ecosystems by reducing energy, materials, and water consumption through high efficiency strategies. It also helps de-carbonize the economy and minimize all forms of waste and pollution for sustainable development. It is an energy auditor mechanism helping creation of energy efficient buildings, or a rural person practicing sustainable farming, or a plumber installing water-recycling systems, they are all part of change required for greening economy. The Intergovernmental Panel on Climate Change (IPCC) suggests that the Earth’s climate has warmed between 0.6 and 0.9 degrees Celsius over the past century through human activities (jobs) which are important driving factors affecting the atmosphere. Figure 1 gives a schematic of the natural carbon cycle as provided by the vegetation/Soil and the ocean and the anthropogenic (manmade) flux. It can be observed that “Anthropogenic; i.e. fossil fuel consumption and the industrial process” has a net negative effect on the atmosphere.

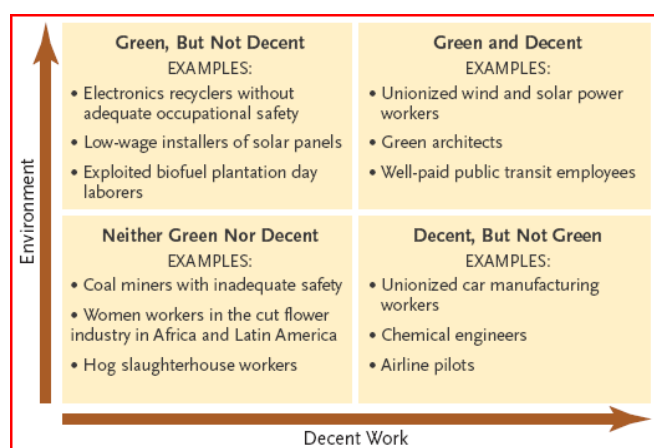
Figure 1. A schematic of the Global Carbon Cycle³



A green job is one that helps bring about and maintain a transition to environmentally sustainable forms of production and consumption. Figure 2, which is the schematic of “green/decent jobs” in four quadrants matrix illustrates linkages between green and decent jobs i.e. (i) green and decent, (ii) green but not decent, (iii) decent but not green and (iv) neither green nor decent. A country can adopt the model on the green economy for development if entire jobs domain converges to “green and decent”.

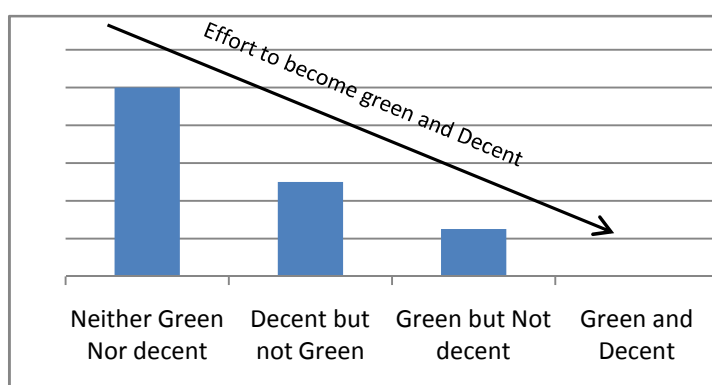
³ Reproduced from Climate Change 2007: *The Physical Science Basis*

Figure 2. Definition of green jobs⁴



The schematic diagramme shown below depicts the effort required to go “green and decent”. The jobs which are presently neither green nor decent, i.e. low wage workers of coal mines, low wage workers in forging/foundry etc; may require maximum effort to go be green. Similarly the jobs which are decent but not green, i.e. workers in petroleum industry, Unionized car manufacturing workers, may require less amount of effort to go “green and decent”; and so on. The word “effort” may have both tangible and intangible components.

Figure 3. Effort required by any job to become “green and decent”



Present study

The study was undertaken on behalf of ILO which looked at creation of green jobs at a global level. The present study is a part of the “Global study” on green job initiatives by 21 countries. It is a short-term study with basic objectives of bringing together the stakeholders initiative in Indian context. The study was a short term for three months; the following efforts have been made during the study period:

- (i) A workshop/brainstorming seminar on “Green economy” was organized by National Institute of Science Technology and Development Studies (NISTADS), 14-15 Dec. 2009. The objective was to bring together policy makers and stakeholders (from

⁴ Michael Renner, Sean Sweeney and Jill Kubit (2008), *Green jobs : Working for people and environment*, World Watch Report 177

Academia, Corporate, NGOs, trade-unions and various ministries) at one platform to know the current status and potential of green jobs in India.

- (ii) Eleven case studies have been undertaken involving professionals from different organizations, i.e. Price Water House Coopers (Kolkata), Development Alternatives (New Delhi) and Jawaharlal Nehru University, New Delhi, working on sustainable development/green economy areas. The two case studies, jute and Paper/Pulp was dropped due to lack of inputs. Finally seven out of nine case studies were carried out by the NISTADS team with the inputs from the experts.
- (iii) Field visits to actual sites for case studies
- (iv) Interviews with stakeholders like trade-union/ ministries etc.
- (v) Feedback from the consultants, like PriceWaterhouseCoopers; Development Alternatives and MSME Foundation, etc.
- (vi) Attending meetings and discussion related to “green jobs” in different organizations such as Minister of Labour, Centre of Indian Trade Unions (CITU), etc.
- (vii) Literature survey.

Outcomes/deliverables

Workshop on green economy

As a part of a project on “Prospects of green occupations in India with special emphasis on skilled professions” NISTADS organized a two-day workshop on “Green economy: Challenges and responses to changing conditions” on 14-15 Dec. 2009 at India International Centre, New Delhi. The workshop aimed to focus on economic sectors with greening potential, such as water, energy etc and the skills response strategies towards current and future labour market demand for green collar workers at different levels, i.e. national, sectoral, regional, company and training provider. A discussion on the priorities of the country for mitigating and adapting to climate change in response to environmental degradation among researchers, academicians, bureaucrats and stakeholders was a part of the workshop. Following is the broad outcomes of the conference:

- The role of environmental auditor was elucidated with special emphasis on the environmental auditors in the grassroots level. It was also emphasized that the environmental auditors must also be employed by the local governing bodies apart from the industry. Environmental auditors even have a bigger role in informal sector as opposed to the formal systems. The small and medium enterprises in informal sector are now also getting into the awareness about the environmental pollution.
- About the skill gaps in informal sector it was observed that the training of the workers in this sector was continuous and could not be placed into broad bands. This makes the measurement of skills a difficult task and the consequent understanding of an appropriate wage-skill equation.
- Many talks revolved around the topic of energy efficiency in the spectrum of energy intensive industries/units. All the instruments/appliances must carry the label for the energy efficiency. New technologies should be adopted/created for the same. The employment in the energy/environment/green sector is fast emerging. These new green jobs are labour intensive and thus expected to rise. However a correct estimate of this rise is difficult as huge data gaps exist. Also, India is a net importer of green technologies; there were fewer jobs in the manufacturing but more jobs existed in the maintenance and service area. Also, the physician function of energy auditors would create jobs.
- National Water Policy and the National Water Mission as one of the missions under climate change deal with water issues. Much needs to be done as far as research information is concerned regarding water flows, river basins. In case of ground water, recharge

methodology can be as high tech as being used by ISRO and as close to the ground as using village wisdom. Consequently, a different skill set is required, so that social equity, economic efficiency and environmental sustainability can be promoted. There is a need for a trans-disciplinary knowledge base for managing water and an understanding of policy issues. Water governance is legal centric with users having use right but not ownership right. Adequate access of safe water must be considered as a human right. Technical scarcity in terms of quantity of water vs. relative assessment of quantity, distribution and institutional aspects merits attention. Public system efficiency needs to be improved and it is possible. Water crisis exists not because of water scarcity but poor water management. It is caused due to rapid urban growth, waste or loss and pollution of water bodies. Several participants have argued that water needs to be treated as an economic commodity.

- Value chain development has a vast potential in MSME sector as they are often polluting, hazardous and exploitative. Green enterprises should come up to deliver goods and services for sustainable livelihoods so that billions of people can work their way out of poverty and contribute to a greener planet. A case study on dairy sector in Jabalpur with emphasis on the basis of the CO₂ and methane emission, energy efficiency level and the health and safety of the workers and the potential for job creation and growth was discussed. The whole value chain was structured such that each and every stakeholder was involved in the seamless flow of the knowledge from one level to other. The whole concept was based on the participatory approach of the stakeholders inclusive of SME, large enterprises, lead firms, foreign buyers, industrial bodies, supply industries, BDS providers, government departments, academia, NGO, accreditation agencies, banks and veterinary doctors.
- It was observed that as a response to financial crisis resources were primarily invested towards promoting growth rather than towards green technologies. One reason for this could be that green projects incur large fixed costs in which case such projects could be implemented during normal periods. Providing incentive through appropriate pricing strategy could be a way for the market to respond in favour of a green economy.

Case Studies

Green structural change and (re)training needs

Sectoral Case Studies

1. Barefoot Solar College of Tilonia
2. Energy Sector: A Case Study of conversion from conventional to “green” power plants
3. Water and sanitation in West Bengal

Occupation-Based Case Studies

Case studies on new green collar occupations

1. Green buildings’ Architects
2. Standardization: Case study of CNG in Delhi

Case studies on greening existing occupations

1. Tanners of West Bengal
2. Green farmers of Meghalaya (this case study fits more into “Further improving green occupations”)
3. Foundry workers of Samalakhia

4. Vertical Shaft Brick Kiln (VSBK): The fireman's occupation

Box 1. Some quotes from the Conference

Dr. Parthasarathi Banerjee, Director, NISTADS

He said that the organized sector had their trade unions but the unorganized sector did not. Further, he added, MSMEs in unorganized sector were left behind along with the villages and the peri-urban areas. Another lacuna was the language of discourse as a villager could not come and express his challenges or needs in an atmosphere like India International Centre where the intelligentsia met. Green jobs are leading to a de/re-industrialization phenomenon and it can be observed at multiple levels- between countries, within the country, across governance levels and the effects need to be observed and assessed.

Dr. Paritosh Tyagi, ex-chair, Central Pollution Control Board (CPCB)

He argued the relevance of environmental audit, its objectives and the driving forces behind it. He elucidated the role of an environmental auditor, the components of the audit and the methodology involved. Phases of the audit and its benefits were explained as well.

Dr. Vinish Kumar Kathuria, IIT Mumbai

He advocated for a "Need for an integrated approach" to curb vehicular traffic which is a major contributor to pollution. Furthermore, behavioural changes on the consumer end are required as well. Various instruments have been used in countries like Norway, Singapore, USA etc that mandate electronic road pricing, landing zones etc. The selection of the instruments to be used is crucial and can be arrived at keeping private and social costs into consideration.

Prof. Reddy, The Indira Gandhi Institute of Development Research (IGIDR), Mumbai

He highlighted historical perspective of the previous energy crises. He suggested enforcing efficiency standards and labelling of appliances and encouraging the industry to manufacture energy-efficient technologies.

Dr. Nityanand, Tata Energy Research Institute, New Delhi

According to him there is a shift towards energy efficiency and the use of renewable sources of energy to reduce the impact of global warming on Global Climate changes.

Abbreviations and acronyms

ASI	Annual Survey of Industries
ASSOMAC	Association of Italian Manufacturers of Footwear, Leather Goods and Tanning Machinery
AVTS	Advanced Vocational Training Scheme
BEE	Bureau of Energy Efficiency
BPL	Below Poverty Line
BTK	Bull's Trench Kiln
CD	Community Development
CDM	Clean Development Mechanism
CEA	Central Electricity Authority
CETP	Effluent Treatment Plant
CITU	Centre of Indian Trade Unions
CLC	Calcutta Leather Complex
CLCTA	CLC Tanneries Association
CLRI	Central Leather Research Institute
CNG	Compressed Natural Gas
CoEs	Centres of Excellence
CPCB	Central Pollution Control Board
CRSP	Central Rural Sanitation Programme
CSR	Corporate Social Responsibility
CTS	Craftsmen Training Scheme
DDSS	Demand Driven Sanitation Strategy
DGE&T	Directorate General of Employment and Training
DGCI&S	Directorate General of Commercial Intelligence and Statistics
DOE	Department of Energy
DRDA	District Rural Development Agency
DTC	Delhi Transport Corporation
ECBC	Energy Conservation Building Code
EHS	Environment, Health and Safety
EPI	Environmental Performance Index
GHG	greenhouse gas
GT	Greening Technologies
GWP	Global Warming Potential
ICT	Information and Communication Technologies

IEC	Information, Education and Communication
IGBC	Indian Green Building Council
IIMs	Indian Institutes of Management
IISC	Indian Institute of Science
IITs	Indian Institutes of Information Technology
ILO	International Labour Organization
IPCC	Intergovernmental Panel on Climate Change
IPM	Integrated Pest Management
IT	Information technology
ITES	Information Technology Enabled Services
ITIs	Industrial Training Institutes
JNNURM	Jawahar Lal Nehru National Urban Renewal Mission
KVA	Kilo Volt-Ampere
LEED	Leadership in Energy and Environmental Design
MES	Modular employable skills
MNRE	Ministry of New and Renewable Energy
MoU	Memorandum of Understanding
MSME	Micro Small and Medium Enterprise
MW	Megawatt
NAAQMP	National Ambient Air Quality Monitoring Programme
NABARD	National Bank for Agriculture and Rural Development
NATCOM	National Communication
NCEUS	National Commission for Enterprises in the Unorganized Sector
NCR	National Capital Region of Delhi
NEERI	National Environmental Engineering Research Institute
NGO	Non-governmental organization
NISTADS	National Institute of Science Technology and Development Studies
NIT	National Institutes of Technology
NREGA	National Rural Employment Guarantee Agency – also the Act
NREGS	National Rural Employment Guarantee Scheme
NSDM	National Skill Development Mission
O&M	Operation & Maintenance
PCB	Pollution Control Board
PESTLE	Political, Economic, Social, and Technological Analysis
PIL	Public Interest Litigation
PRI	Panchayati Raj Institutions
R&D	Research and Development

RCC	Related to Climate Change
REW	Rural electronic workshop
RKMLP	Ramakrishna Mission Loksiksha Parishad
RVPNL	State Electricity Utility
S&T	Science and Technology
SAARC	South Asian Association for Regional Co-operation
SC	Supreme Court
SDC	Swiss Agency for Development and Cooperation
SHG	Self Help Groups
SIDBI	Small Industries Development Bank of India
SIPRD	State Institute for Panchayat and Rural Development
SME	Small and Medium Enterprises
SPA	Schools of Planning and Architecture
TARA	Technological Assistance to Rural Artisans
TERI	The Energy and Resources Institute
TIDE	Technology Informatics Design Endeavour
TSC	Total Sanitation Campaign
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCC	United Nations Framework Convention on Climate Change
UNICEF	United Nations Children's Fund
VET	Vocational Education and Training
VSBK	Vertical Shaft Brick Kiln
WBSEs	Women Barefoot Solar Engineers
WEG	Wind energy generators
WHO	World Health Organization
WP	Waste and Pollution

1. Introduction

Sustainable development is a need of the hour as natural resources are increasingly vanishing. The sustainable development may be achieved through ‘green economy’ which is a niche area for growing new economic development model. This model is dissimilar to the existing model of development that is based on fossil fuels, such as coal, petroleum, and natural gas. The green economy aims at interdependence of human economy and natural ecosystem by addressing the issues of global warming and environmental degradation. Since the green economy is a new concept which requires enormous resources and human capital by creating green jobs, ensuring real, sustainable economic growth, and preventing environmental pollution, global warming, resource depletion, and environmental degradation. Green jobs help to protect ecosystems and biodiversity; reduce energy, materials, and water consumption through high-efficiency strategies; de-carbonize the economy; and minimize or altogether avoid generation of all forms of waste and pollution (WP). Some developed economies have taken leading steps towards green jobs and technology and developing country such as India and China are making efforts to go for green economy. Green jobs include opportunities for managers, scientists and technicians particularly in informal sectors where most: youth, women, farmers, rural populations and slum dwellers may be a major player. India has large potential of human capital so there is a big scope of green jobs. However, some green jobs are also dangerous such as recycling and waste management, biomass energy and construction. Recent developments in technology and the process of globalization along with climate change issues have shifted the priority of global labour markets. In developed economies the measures in this direction has been initiated but developing nations have not yet taken the leap. The phenomenal growth rates achieved by some of the developing countries like India and China has changed the carbon footprint of the world. In this context keeping in mind the importance of sustainable development, these countries will require a radical shift in developing new skills and qualifications which will offer great potential for the creation of green jobs.

India has a large share of traditionally trained manpower (i.e. potters, rural artisans etc) which is already in-line with the green skill domain; the remaining contemporary technical manpower has to be transformed both at the level of skill as well as in the thought process. This will aid towards building a greener economy.

2. Policy context

2.1 Key challenges and priorities for the green economy

India is at a crucial cusp of breaking into the path to the ‘being a developed’ country. The journey to this path is not going to be smooth as the rapid growth brings in its own set of challenges. One of the biggest challenges is to maintain the environment according to international commitments, bringing down the fossil fuel based consumption and substantially increasing the non-conventional (green) energy consumption. Though India is a signatory to the United Nations Framework Convention on Climate Change (UNFCCC), she is not required to contain its GHG (greenhouse gas) emissions. India’s policies for sustainable development, by way of promotion of energy efficiency, renewable energy, changing the fuel mix to cleaner sources, energy pricing, pollution abatement, a forestation, mass transport, besides differentially higher growth rates of less energy intensive services sectors as compared to manufacturing, results in a relatively GHG benign growth path. This would mean creation of millions of “green jobs” in the coming 10 to 15 years. Presently expenditure in India on adaptation to climate hovers around 2.6 per cent of the GDP,⁵ with water, agriculture, health and sanitation, coastal

⁵ *Climate Change : Perspective from India*, UNDP Report (2009), p. 23, Expenditure

development and forests being the areas of concern. India's obligations to UNFCCC includes the periodical information on India's contribution to GHG being provided by National Communication (NATCOM); which also assesses the impact and vulnerability and makes appropriate recommendations regarding social, economic and technological measures. The first NATCOM was presented in 2004 and the next will be presented to UNFCCC in 2011. Preparation of NATCOM II is an exercise based on an extensive network of research and scientific institutions in India and draws upon expertise and excellence from different institutions.⁶

Technology forms a critical component of actions aimed at responding to climate change. Availability and/or dissemination of existing climate-friendly technologies and goods to developing countries as public goods and at affordable costs is essential to enhance the actions of developing countries to pursue sustainable development policies. The collaborative R&D (research and development) effort has to be promoted, with multilateral financial support under the UNFCCC in order to facilitate rapid and widespread dissemination, absorption and application of climate-friendly technologies. A Copenhagen package incorporating this component, with an accompanying multilateral financing package, would be an outcome necessary to address climate change in a manner consistent with goals of sustainable development⁷.

Agriculture

About 60 per cent of the working population in India are engaged in agriculture and thereby makes it the most employment generating sector. Crop production in India is critically dependant on the summer monsoon. A rise in global temperature due to climate change may have an adverse effect on Indian agriculture by changing the monsoon precipitation dynamics.

Water resource management

India is bestowed with a river system comprising more than 20 major rivers with several tributaries. Apart from these rivers, groundwater provides another important source of water. However, there is a major problem with the serious degradation of water resources in the country, caused by excessive water withdrawal for various reasons such as irrigation, industry and domestic consumption. Moreover, the catchment areas for the water resources are now seriously degraded which limits the extent to which groundwater can recharge. The natural drainage and water flow of many important rivers has been altered due to the withdrawal of water and the construction of large dams. Therefore, there is an urgent and growing need to address the issue of water resource management in a sustainable manner.

Technological up-gradation for green economy

To keep up with the development path, developing countries have to increase their per capita energy consumption. This does not necessarily mean that it would also correspond to the increased GHG levels. It is possible to maintain cleaner environment with use of appropriate fuels and innovative technology. Therefore future technological advancements will ensure that the developing world will shift from fossil fuels based energy to clean renewable energy solutions. This colossal shift would require a drastic change in the future research and development in the area of energy research. The scientometric analysis (scientific publication and patent analyses) in the key energy areas show that developing countries like China are keeping

⁶ National Communication (NATCOM), Ministry of Environment and Forests, Government of India

⁷ National Action Plan on Climate Change (NAPCC), Prime Minister's Council on Climate Change, Government of India

pace with the latest development in the energy research. The other developing countries like India and Brazil have to really work hard to create a technological capability⁸.

Tradeoffs between development and environment

The issues of economic development and environmental protection have always been a matter of contention between developed and developing countries. Most of the developed countries like the USA, Germany and UK have depended upon polluting industries for their wealth. Now they fear that uncontrolled economic development in the Third World will lead to environmental disaster. They argued that enormous clearing of tropical rainforest for farming threatens biodiversity and may affect the global climate by adding more pollution to the environment. Though developed nations demand more energy and produced from burning fossil fuels such as coal. However, India argues that it must make industrialization and economic development a priority because they have to support their growing populations and yet it is producing carbon dioxide below the world average. According to a report by ASSOCHAM and Ernst & Young on Climate Change (<http://www.assocham.org>) reveals that India's emission levels are 70 per cent below world average and 93 per cent beneath those in United States. This is despite India being the 4th largest economy (Based on purchase power parity) and fifth largest greenhouse gas emitter, accounting for 5 per cent of global emissions. So, India was always a victim of climate change and is unfair to blame developing countries for environment as rich countries are accountable for current environmental damage. Further, India's per capita emissions are almost twenty times less than of those of the United States. India's per capita carbon dioxide emission is about 0.933 per 1,000 people as compared to USA (19.48 per 1,000 people) and China (2.66 per 1,000 people).

India is considering environmental reforms as one of the most significant agendas for legislation. Ministry of Environment and Forests have recently given a 20 point agenda (Table 1) for the issues of climate change, which is in line with the general guidelines of UNFCCC. Growing Indian economy is taking a toll on the natural resources. Many sectors directly linked with economic growth are also natural resource intensive, and therefore balancing economic growth and environmental impact will remain a major challenge for the country.

Air pollution and depleting water resources are few of the other environmental issues which is concerning us. Most of our metropolitan cities fall in the category of the "Polluted Cities" according to the standards set by the World Health Organization (WHO).⁹ The tradeoffs between development and the environment will be crucial going forward.

Poor performance on environmental indicators

One of the most comprehensive measures of a country's environmental performance is the Environmental Performance Index (EPI) which is the initiative of *Yale Center for Environmental Law & Policy, Yale University* and *Center for International Earth Science Information Network (CIESIN), Columbia University*. It ranks 149 countries on 25 indicators tracked across six established policy categories: Environmental Health, Air Pollution, Water Resources, Biodiversity and Habitat, Productive Natural Resources, and Climate Change. The EPI identifies broadly-accepted targets for environmental performance and measures how close each country comes to these goals. As a quantitative gauge of pollution control and natural resource management results, the Index provides a powerful tool for improving policymaking and shifting environmental decision-making onto firmer analytic foundations. Although India appears to have

⁸ Kumar Vipin (2009), *Energy imperative for developing world: Case study Brazil, China and India*, Working Paper, German Development Institute, Germany and South Centre, Geneva.

⁹ WHO Air quality guidelines for particulate matter, ozone, nitrogen dioxide and sulfur dioxide, *Global Update* 2005.

a considerably better EPI score than China or Pakistan; it has a lower EPI score compared with South Asian Association for Regional Co-operation (SAARC) countries like Bhutan, Sri Lanka and Nepal and a few other large South Asian countries.¹⁰¹¹

2.2 The response strategy

2.2.1 General environmental strategy

The Government of India is supporting and facilitating major research programmes to assess various aspects related to climate change. India has a comprehensive scientific climate change programme (along with the national level employment guarantee scheme and programmes to development of skills at various levels of employment) in place that involved over 120 research institutions and over 220 of the best scientists in the country. It has also released the results of a range of rigorous studies that estimate the GHG emissions profile of India for the next two decades, which show that India's total and per capita emissions over the next two decades will remain modest. For example, it finds that India's per capita emissions in 2030, will remain below 4 tonnes of CO₂, well below those of the developed countries, even if they were to take ambitious emission reduction targets (25-40 per cent) as recommended by the IPCC for the mid-term¹². India is also on the path to launching its own satellite to monitor greenhouse gases in the atmosphere, which will put it in an exclusive club of three countries. The vulnerability assessment and adaptation studies of climate change have been made in various areas such as water resources, agriculture, forests, natural eco-systems, coastal zones, health energy and infrastructure. This has been carried out as a part of the Initial National Communication of India to the United Nations Framework Convention on Climate Change (UNFCCC); Further, the Expert Committee on Impact of Climate Change set up by the Ministry of Environment and Forests in June 2007 assessed the impact of climate change on six areas, namely water resources, agriculture, Natural Eco-system, Health, Coastal Zone Management and Climate modelling.

National Action Plan on Climate Change (NAPCC)¹³

India released the NAPCC on 30 June 2008 to outline its strategy to meet the challenge of Climate Change. It outlines a national strategy that aims to enable the country adapt to climate change and enhances the ecological sustainability of India's development path. It stresses that maintaining a high growth rate is essential for increasing living standards of the vast majority of people of India and reducing their vulnerability of the impacts of climate change. The National Action Plan advocates a strategy that promotes, firstly, the adaptation to climate change and secondly, further enhancement of the ecological sustainability of India's development path. The Action Plan identifies measures that promote the objectives of sustainable development of India while also yielding co-benefits for addressing climate change.

Eight National Missions form the core of the National Action Plan, representing multi-pronged, long term and integrate strategies for achieving key goals in the context of climate change. These Missions are:

¹⁰ *Pilot 2006 Environmental Performance Index (EPI)*. (2008), Yale Center for Environmental Law and Policy, Yale University and Center for International Earth Science Information Network (CIESIN), Columbia University, Joint Report

¹¹ *Country Analysis Report – India: In-depth PESTLE Insights*, Datamonitor.

¹² NAAQMP, Ministry of Environment and Forests, Government of India

¹³ NAPCC, Prime Minister's Council on Climate Change, Government of India

Box 2. National Missions and their goals

National Missions

- National Solar Mission
- National Mission on Enhanced Energy Efficiency
- National Mission on Sustainable Habitat
- National Water Mission
- National Mission for Sustaining the Himalayan Eco-system
- National Mission for a Green India
- National Mission for Sustainable Agriculture and
- National Mission on Strategic Knowledge for Climate Change.

Goals under NAPCC

- ensuring energy conservation and improved energy efficiency in various sectors as well as setting up of Bureau of Energy Efficiency (BEE)
- promoting use of renewable energy
- power sector reforms and active renewable energy programme
- use of cleaner and lesser carbon intensive fuel for transport
- fuel switching to cleaner energy
- afforestation and conservation of forests
- promotion of clean coal technologies
- reduction of gas flaring
- encouraging Mass Rapid Transport systems
- environmental quality management for all sectors

While India finalizes the details of the Missions under its NAPCC, there are several other initiatives being undertaken and facilitated by the Government of India to address the issue of climate change.

India is also promoting afforestation on an unprecedented scale. India, which has a fifth of its area under forests, is one of the few developing countries in the world where the forest cover is increasing, by 0.8 million hectares a year, despite the pressures of population growth and rapid economic development. This is neutralizing 11 per cent of India's annual GHG emissions. India has more than doubled its budget for forestry this year to Rs 8,300 crores (USD 1.85 Bn) and this increase is going to be sustained every year. New programmes to increase the capacity of frontline forestry personnel, improve forestry infrastructure and control forest fires are also being implemented. India is also taking leadership in facilitating international dialogue and discussion on climate change issues. Table 1 summarizes the 20 recent initiatives taken by the Indian Government.¹⁴

¹⁴ *India: Taking on Climate Change, Twenty recent initiatives related to climate change*, Ministry of Environment and Forests, Government of India.

Box 3. Forestry

Dr Kirti Joshi, Fellow Scientist, NISTADS

Capacity building in Forestry

The essence of greening resides in the context of environment. Forests, being a valuable ecosystem of a country play an important role in the chain of carbon management. The plausible fact that they act as massive carbon sequestering sinks, converting the burgeoning amount of carbon dioxide to more useful form makes them indispensable in carbon chain. Infact India's forest cover is on the rise as observed from the latest forest survey reports. This partly can be attributed to the institutional mechanism as well as the organizational structure of the country which is continuously striving to achieve the magic figure of 25 per cent of national land area under forest cover.

Accomplishing this Herculean task needs the support of the masses who are aware and concerned of the consequences of denudation of mother earth. Generating this pool of environment conscious people in India is managed through top to bottom approach.

Forest Management

In India, Ministry of Environment and Forests is the nodal agency looking after the national forests. Under its aegis are the State Forest Departments responsible for administration and management of forests in the state and enforcement of National Forest Policy and Central and State Legislations in forests, wildlife and environmental matters. Each state has its own chain of command as depicted in the box.

Hierarchy in the Department

Range – A Range is the basic unit of functioning in the Forest Department and the Forest Range Officer in charge of the Range executes various forestry works and performs such other duties as may be assigned. For administrative convenience, a range is divided into Beats looked after by Forest Beat Officer.

Division – Few Ranges constitute a division which is headed by a Divisional Forest Officer. The Divisional Forest Officer can be from State Forest Service (SFS) or from Indian Forest Service (IFS).

Directorate/Head of Department - All the Forest Circles are under the control of Principal Chief Conservator of Forests who is Head of the Department.

From <http://www.forest.mizoram.gov.in/>

The Forest Range officer/ forest guard is at the grassroot level of the system having direct interface with Panchayati Raj Institutions (PRI). PRIs are the local governing body of the village system representing the forest/tribal community.

The training of these frontline forest personnel thus has its own significance. The knowledge infused through these capacity building programmes permeates to the local people when they mingle and interact with them. In fact, this social dialogue between the PRI's and forestry officials creates environmentally conscious people. Being the custodian of the protected ecological niches, these forest dwelling communities then assist in conserving and managing the forests through

sustainable and judicious measures. Hence it can be said that through this knowledge transfer chain, skilled government officials spread the sense of greening as well as of environment protection to the whole community!

The themes for training workshops under the capacity building programmes include knowledge management in forestry sector, role of forests in water supply and conservation, watershed management, climate change, training curricula and effectiveness review, bio-prospecting, interventions required for scientific management of NTFPs and livelihood concerns of local communities, changing needs of forestry administration and management etc.

Apart from these trained forest officials, India has the regular mill of forestry colleges and research institutes under the ambit of Indian Council of Forestry Research and Education (ICFRE). These impart post graduate and diploma courses on forestry, natural resource management, environment management, non wood forest products, paper and pulp technology and wood science and technology.

Inclusion of forestry within NREGA

National Rural Employment Guarantee Agency (NREGA) is India's flagship employment guarantee scheme. The beneficiaries are the rural BPL (below poverty line) masses. Recently in 2008 forestry related activities were also included under the scheme. It includes plantation activities like weeding, pitting, plantation, bund construction, trenching and gully plugging or fire line tracing, construction of roads/ trek paths etc. Most of these activities do not require skilled persons. For this reason perhaps most of the BPL persons become eligible for availing the benefit. This in turn accrues labor involved in greening activities.

Table 1. Twenty recent initiatives by India related to greening economy

Area	Initiative / Event	Contribution
A. Forestry	1. Launch of CAMPA	Rs 11,700crore (USD2.5Bn) Programme for conservation, regeneration and management of existing forests and wildlife habitats
	2. Capacity Building in Forestry Scheme	Rs 369 crore (USD 80Mn) approved by Cabinet for a comprehensive human resource development programme for forest personnel, with special focus on training frontline staff
	3. Intensification of Forest Management Scheme	Rs 600 crore (USD 125Mn) approved by Cabinet for a scheme to improve management of forest areas, strengthen infrastructure, control forest fires, etc.
	4. Accelerated Programme for Restoration & Regeneration of Forest Cover	Rs 500 crore (USD 100Mn) Scheme announced in this year's budget; Guidelines being finalized
	5. Inclusion of Forestry within NREGA	Forestry related activities included as part of India's flagship employment guarantee scheme; Convergence guidelines ready; Pilots being implemented
B. Energy & CDM	6. Energy Efficiency Standards for Appliances	Energy efficiency ratings made mandatory for 4 key appliances — refrigerators, air conditioners, tubelights and transformers from 7 Jan. 2010; more to follow through 2010
	7. Energy Conservation Building Code (ECBC)	Introduced by Delhi government for all new government buildings; Other States initiating similar measures
	8. Fuel Efficiency Norms	Plan for fuel economy norms for vehicles announced; to be fully operational in two years
	9. CDM Program	India assessed as Best CDM Country by independent study; Second largest number of registrations in the world; equivalent to 10 per cent of India's emissions by 2012
C. Research agenda	10. Impact Assessment of Climate Change	Scientific study to assess impact of climate change on various sectors of economy
	11. Himalayan Glaciers Monitoring Programme	Comprehensive scientific programme to monitor the trend and causes of the retreat of the Himalayan glaciers – Phase I complete; Phase II launched
	12. Pathways of India's Carbon Emissions	Modelling of India's Carbon Emission Pathways until 2030 under different assumptions; to be released 2 Sep. 2009
	13. India's Forest and Tree Cover as a Carbon Sink	Scientific Paper estimating the carbon stored in India's forests and the emissions it neutralizes; released on 10 Aug. 2010 in Dehradun
	14. Launch of Indian Satellite to Monitor greenhouse gases	Specific Proposal ready in collaboration with ISRO and Planning Commission
D. Outreach	15. Public and Media Campaign	Regular Discussion Forum with Editors Guild, CEOs, National and International Media; More interactions with various stakeholders being undertaken through the year
	16. Release of India's Submissions to UNFCCC	Report documenting India's 12 proactive submissions to UNFCCC made public; released and put on website
E. Key events	17. SAARC CDM Conclave	1 Sep. 2009: Workshop for CDM capacity building of experts from SAARC nations
	18. India Carbon Markets Conclave	2-3 Sep. 2009: Forum for knowledge sharing and emerging scenarios in the global and Indian carbon markets
	19. SAARC Environment Ministers Conference	19-20 Oct. 2009: Conference to identify areas for mutual cooperation and joint action on environment and climate change

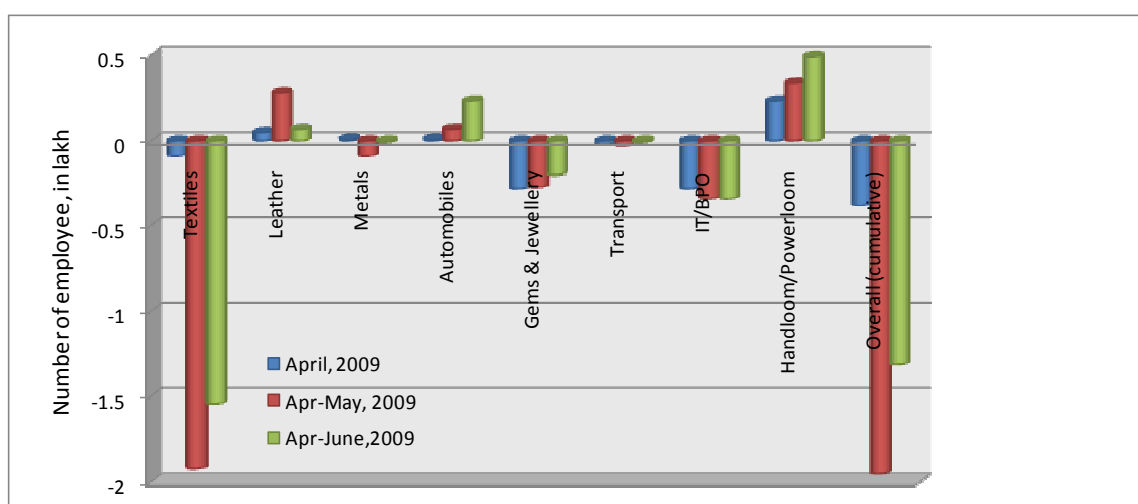
Area	Initiative / Event	Contribution
	20. Conference on "Climate Change: Technology Development and Transfer"	22-23 Oct. 2009: Global Conference to define the roadmap for enabling technology development and transfer to developing countries. Key contribution to UNFCCC process

Source : Ministry of Environment and Forests, Government of India

2.2.2 Green response to the current economic crisis

The subject of "green jobs" and "green economy" is at a very nascent stage. To exactly get the information of the green response to the financial crises is therefore very difficult to access. However in the present study a report which came up in this period by Ministry of Labour was consulted. The report talks of the change in the employment during the financial crisis. Figure 4 shows the different sectors employment during the peak three months of financial crisis. It is understandable that there cannot be any direct correlation between the financial crises and jobs in the "green sectors", the crisis has adversely affected the jobs in almost all the sectors.¹⁵

Figure 4. Change of employment due to current economic crisis



Source: Effect of economic slowdown on Employment in India, Ministry of Labour and Employment, Government of India

¹⁵ *Effect of economic slowdown on employment in India*, Ministry of Labour and Employment, Government of India

Box 4. Conference on green economy

Karan Singh, Consultant, ICRIER

"To bail out of the recession, how much investment of the economic stimulus plans went for the greening jobs? It is understandable that during recession, not a single penny was devoted to green jobs in India. For example take up the case of energy usage in the times of recession. It was observed that during the study period India's net import values of crude oil and petroleum products shot up depicting an increase in usage of carbon emitting fuels. This should not have been the case if investments were diverted to green renewable fuels. The consumption pattern of renewables (solar, biomass, biofuels, hydro etc) was meager. During the crisis, more resources went for growth than for green jobs. If this is because green projects are incurring large fixed costs then why they are not implemented during normal periods. This is possible only when the market to respond by changing the incentives for the green economy (by pricing externalities)"

Excerpts from the Proceedings of the conference on "Green Economy: challenges and responses to changing condition", 14-15 December 2009, NISTADS, New Delhi

Box 5. Effect of economic slowdown on employment in India

According to the report on "Effect of economic slowdown on employment in India," which is based on a sample survey of 2,581 units conducted by the Labour Bureau, Ministry of Labour and Employment, during Oct.-Dec. 2008, there was decrease in employment of about half a million workers during the period. The most affected sectors were gems and jewellery, transport and automobiles where employment has declined by 8.58 per cent, 4.03 per cent and 2.42 per cent respectively during the period. In textile sector, 0.91 per cent of workers have lost their jobs. Another thin sample survey conducted to assess the employment situation in January 2009 over December 2008 indicated a loss of about 1 lakh jobs in the month of Jan. 2009. However, it may be possible that the unemployment indicated is seasonal in nature since the employment estimated in the reference period of the study is not in comparison with the same period in previous year and the employment in period Oct. to Dec. 2008 is compared to that in Sep. 2008 and later Jan. 2009 against Dec. 2008. The survey conducted by the Labour Bureau for the period Jan. to Mar. 2009 covering 3,192 units in 21 centres, however, indicated improvement in the selected sectors with employment rising by a quarter million. Sectors registering increased employment were gems and jewellery (3.08 per cent), textiles (0.96 per cent), IT-BPO (0.82 per cent), handloom-powerloom (0.56 per cent) and automobile (0.10 per cent).

A sample survey conducted by the Department of Commerce for 402 exporting units revealed job loss (direct and indirect) to the tune of 1,090,513 persons during Aug. 2008 to mid-Jan. 2009. Another sample study conducted earlier (for the period Aug.-Oct. 2008) by the Department of Commerce for 121 export-related companies belonging to several sectors, primarily employment-oriented sectors like textiles including garments, leather, engineering, gems and jewellery, handicrafts, food and food processing, minerals, marine products has revealed loss in export orders to the tune of Rs. 1,792 crore and loss of jobs of around 65,507. Two other surveys for the period Aug. 2008 to 9 Feb. 2009, and Aug. 2008 to 9 Feb. 2009 revealed job losses (direct and indirect) of 1,170,602 and 1,190,159 persons respectively.

Source: Economic Survey of India 2008-09

2.3 The skills development strategy in response to greening

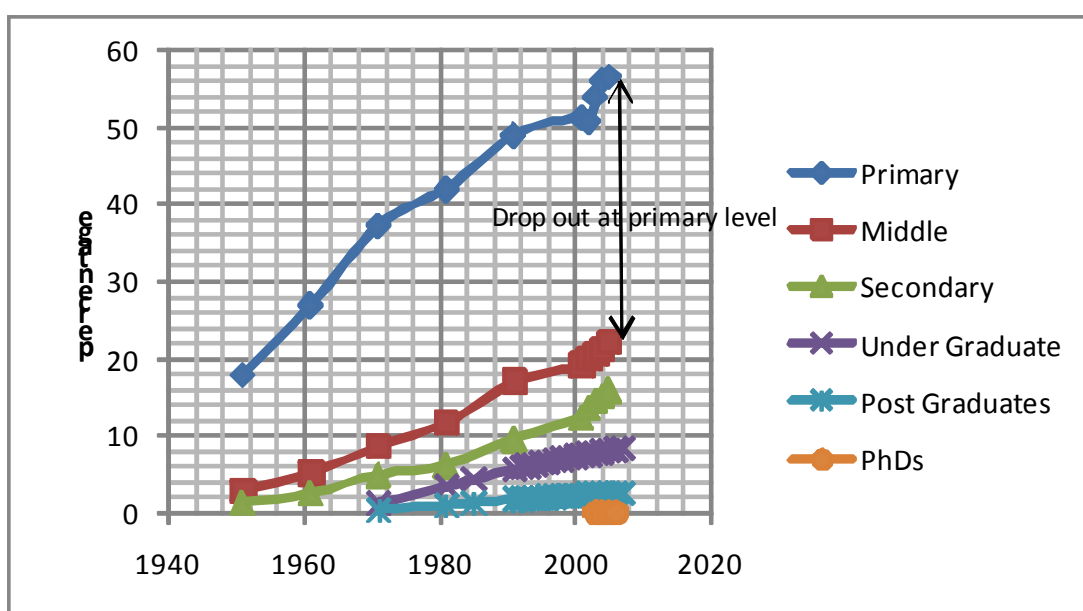
Indian being the second most populous country in the world is bestowed with the large working population (estimated median age of 25.3 in year 2009). This large young population gives it an access to huge active workforce; thereby giving an edge over most of the other developing or developed countries (median age population is better than China and most of the developed countries). One of the biggest hurdles remains with the shortage of skills which prevents this large segment of the Indian population out of the development story. According to a recently concluded study by NISTADS¹⁶; more than 44 per cent of the India's schools going population drop out at primary education level (Figure 5, year 2006). Nearly 84 per cent of this 'could be school going' population drops out at secondary level. The skill set of large volume of population is almost measured from the science graduates, post graduates and PhD's. The report

¹⁶ Kumar, Vipin; Kumar, Naresh; Kumar, Neelam (2009), "Pattern of enrolment at different educational levels", in the chapter "S&T Human Resource" of *India Science & Technology 2008*, published by NISTADS, May 2009, pp. 3-7.

says that 85 per cent of Indian science graduates fail to enter the PG levels, and only 5 per cent of the total entrants at graduate level enroll for PhD (Figure 6). This compares unfavourably with, for example, China, where access to secondary education is almost universal and enrolment in higher education exceeds 20 per cent. Moreover, the quality of most Indian graduates is poor and employers offer very little skills upgrading (16 per cent of Indian manufacturers offer in-service training to their employees, compared to over 90 per cent of Chinese firms). The informal sector employs over 90 per cent of the workforce, but there is very little investment or opportunity for formal 'skilling' for informal workers and enterprises.¹⁷

Although the Indian economy has experienced rapid growth over the recent period, the low levels of education and formal training of the workforce are a matter of concern. Workers without education and skills are stuck at the bottom of the labour market with low productivity and earnings. From the point of view of the economy, the lack of skills, the inability of the workers to adapt to changing technological and market conditions, and the existence of low productivity sectors cannot but constrain the growth of the economy and lead to a lop sided growth structure in which the majority of workers are not able to participate effectively in the development process. The estimates of total employment and employment of informal sector workers as per 61st Round Survey during 2004-05 were 457.5 million and 394.9 million respectively. Which means 86 per cent of the total workforce belongs to unorganized sector.

Figure 5. Enrolment at various levels of education, in percentage of school going population i.e. 5-14 year age group¹⁸



¹⁷ World Bank Report, *Country strategy for the Republic of India for the period FY 2009-2012*

¹⁸ Computed from the Ministry of Human Resource (MHRD) data and Census data

Figure 6. Declining science education, some trends
The highest scale (100 per cent) shows BSc level, taking it as base level¹⁹

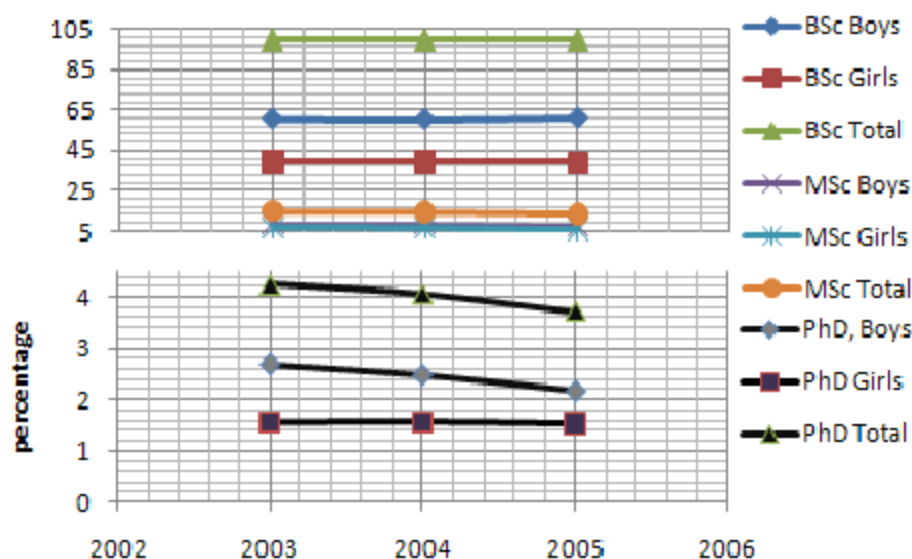
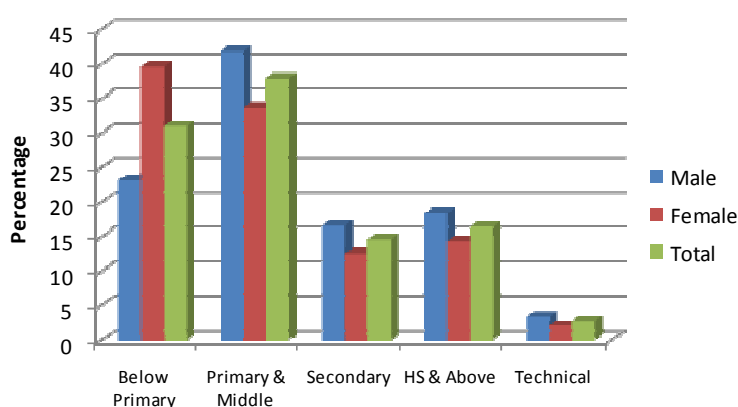


Figure 7 shows the skill set of the workers in unorganized sector. More than 23 per cent of the male and 40 per cent of female population in this sector is below primary level. The combined figure for below secondary is still more alarming as more than 83.5 per cent of the workers fall in this category. This situation is extremely disturbing as the vocational skill development programmes start after secondary level.²⁰

Figure 7. Skill of workers in unorganized sector



Source: Annual Survey of Industries (ASI), 2006, Government of India

¹⁹ Computed from MHRD, Indiastat Database, University Grants Commission data

²⁰ Annual Survey of Industries (ASI), 2006, Government of India

“In order to meet the new challenges related to climate change, human resources would require to be enhanced through changes in curricula at the school and college levels, introduction of new programmes at the university level, and training of professionals and executives in relevant fields. An overall assessment of additional skills required will have to be carried out at the national, state and local levels, so that necessary measures can be undertaken for enhancing the quality and quantum of human resource required in the coming years and decades. The latter would have to be viewed also in the context of the current difficulties faced in attracting young people to careers in science in general, to overcome which steps are being taken during the 11th Plan”²¹ (Plan period is 2007-2012).

In a recent report by Department of Science and Technology, “National Mission on Strategic Knowledge for Climate Change”, the following focus areas are suggested:

- Mapping of knowledge and data resources pertaining to climate change and creating a knowledge network among various actors
- Identification of knowledge gaps and formation of global technology watch groups
- Capacity building with of five dedicated centres having 50 Chair professorships and about 200 trained professionals (mostly PhDs) on climate change.
- Promotion of R&D and Innovation on climate science, technologies.
- Building international co-operation
- Formation of policies for a sustained developmental agenda

A Thirteen Point Action Plan is suggested by the National Commission for Enterprises in the Unorganized Sector (NCEUS) under the Ministry of Micro Small and Medium Enterprise (MSME) for Employment in the Unorganized Sector^{22,23} (see Table 2).

Box 6. Conference on green economy

Prof. Rahul Varman and Dr. Manali Chakraborty, IIT Kanpur

As opposed to the formal systems, the training of the workers in the informal systems was continuous and could not be placed into broad bands. This made the measurement of skills a difficult task and the consequent understanding of an appropriate wage-skill equation.

Excerpts from the Proceedings of the Conference on “Green economy: Challenges and responses to changing condition”, 14-15 Dec. 2009, NISTADS, New Delhi

²¹ National Action Plan on Climate Change, Prime Minister’s Council on Climate Change

²² *A Report on Technology Upgradation for Enterprises in the Unorganised Sector*, National Commission for Enterprises in the Unorganized Sector (NCEUS), Government of India

²³ *11th Plan Document*, Planning Commission, Government of India

Table 2. Thirteen Point Action Plan for employment in unorganized sector

A. Protective measures for workers

1. Ensuring minimum conditions of work in the non-agricultural and agricultural sectors:

Two bills, for agricultural workers and non-agricultural workers, that specify the minimum conditions of work, including a statutory national minimum wage for all workers

2. Minimum level of social security:

A universal national minimum social security scheme, as part of a comprehensive legislation covering life, health and disability, maternity and old age pension to protect the workers in the unorganized sectors.

B. Package of measures for the marginal and small farmers

3. Special programme for marginal and small farmer:

Revival of the targeted programme focusing on small and minor farmers, with an initial thrust in the areas wherein the existing yield gap is also considered high. A special agency or a coordinating mechanism should be set up if required.

4. Emphasis on accelerated land and water management:

Immediate priority to, and significant up-scaling of, programmes for land and water management.

Revision of the priority sector landing policy to provide a quota for micro and small enterprises.

5. Credit for marginal/small farmers:

RBI to monitor, separately, credit to this segment, expansion in the outreach of credit institutions in rural areas and a credit guarantee fund to obviate the need for collateral by the marginal/small farmers in accessing the institutional credits. A 10% share for small and marginal farmers in the priority sector credit

6. Farmers' Debt Relief Commission:

The Central government to lay guidelines and provide 75:25 assistance for setting up State-level Farmers' Debt Relief Commissions, in the States experiencing agrarian distress — natural or market related.

C. Measures to improve growth of the non-agricultural sector

7. Improve credit flow to the non-agricultural sector:

Per cent sector and sub-sector/purpose

10 per cent for small and marginal farmers; 8 per cent for other farmers, 10 4 per cent for micro enterprises with capital investment (other than land and building) up to Rs 0.5 million and 6 per cent for other micro and small enterprises. 12 per cent on loans up to Rs 0.5 million to the socio-economically weaker sections for housing, education, professions, and so on.

8. Encouraging SHGs (Self Help Groups) and MFIs for livelihood promotion:

Measures to encourage growth of micro finance and SHGs in poor States and in the backward areas

9. Creation of a National Fund (NAFUS):

Rs 5000 crore initial corpus for an exclusive statutory agency to take care of requirements of micro and small enterprises in agriculture and non-agriculture sectors that are presently not reached by SIDBI (Small Industries Development Bank of India) and NABARD (National Bank for Agriculture and Rural Development).

10. Up-scaling cluster development through growth poles:

Twenty-five growth poles in the traditional industries clusters with incentives at par with SEZs

D. Measures to expand employment and improve employability

11. Expand employment through strengthening self-employment programmes:

Rationalization and strengthening of the four major self-employment generation programmes with 5 million annual employment generation target.

12. Universalize and strengthen National Rural Employment Guarantee Act (NREGA):

Extension of NREGA Programmes to all districts.

13. Increase employability through skill development:

On-job-training cum employment-assurance programme to provide incentive of Rs 5000 per person to any employer willing to provide one-year training on job skill enhancement.

Source: 11th Plan Document, Planning Commission

3. Anticipation and provision of skills

3.1 Green structural change and (re)training needs

3.1.1 Green restructuring and its impact on the labour market

India has faced the challenge of balance between the rapid economic growth and the environment. To go away from the development model of fossil fuel based economy to so-called “green economy” the entire economic model has to be turned around. The structural change, be it economic, technological or social for a country is a massive effort to start with. India has already plunged into this “changeover” with NAPCC which have a set of eight missions to develop this “green restructuring” of the nation. Out of eight missions (discussed in the previous chapter), (i) Jawaharlal Nehru National Solar Mission and (ii) National Water Mission will be on utmost priority for the green economic development.²⁴

Jawaharlal Nehru National Solar Mission:²⁵ The Union Cabinet has approved the Jawaharlal Nehru National Solar Mission that aims to add 20,000 megawatts (MW) of power in India by 2022. The Cabinet has initially approved Rs 4337 crores for the startup. If the target is achieved, 10 per cent of the estimated power to be generated by then will be from solar sources at a cost of Rs.90,000 crore. It will mean electricity for three cities of the size of Delhi. It is the first of the eight missions — originally suggested by the Council in 2008 — to get approval before the Copenhagen Climate Change Summit. Various fiscal incentives have been proposed under the mission document to the manufacturers, as well end-consumers to propagate solar plants and technology, for instance to displace diesel generators, UPS and inverter system with solar-based systems. Another aspect of the Solar Mission would be to launch a major R&D programme, which could draw upon international cooperation as well, to enable the creation of more affordable, more convenient solar power systems, and to promote innovations that enable the storage of solar power for sustained, long-term use. The massive diffusion of Solar Energy will require a several fold increase in technically qualified manpower of international standard. It has been estimated that Solar Industry will employ at least **100,000 (One lakh) specially-trained personnel across the skill spectrum**; which will include management, Engineering and R&D personnel.

National Water Mission:²⁶ A National Water Mission will be mounted to ensure integrated water resource management helping to conserve water, minimize wastage and ensure more

²⁴ These two Missions are taken as the first (Solar) Mission is already launched by the government and second (Water) Mission is of utmost priority and will be launched soon. The case studies are also from these two Missions in this chapter. Taking all the eight Missions in this chapter is beyond the scope of this study.

²⁵ Jawaharlal Nehru National Solar Mission, Mission Document, Ministry of New and Renewable Energy, Government of India, <http://mnes.nic.in/pdf/mission-document-JNNSM.pdf>

²⁶ Mission Document, Ministry of Water Resources and National Action Plan on Climate Change, Prime Minister’s Council on Climate Change, eight Missions.

equitable distribution both across and within states. The Mission will take into account the provisions of the National Water Policy and develop a framework to optimize water use by increasing water use efficiency by 20 per cent through regulatory mechanisms with differential entitlements and pricing. It will seek to ensure that a considerable share of the water needs of urban areas are met through recycling of waste water, and ensuring that the water requirements of coastal cities with inadequate alternative sources of water are met through adoption of new and appropriate technologies such as low temperature desalination technologies that allow for the use of ocean water.

The National Water Policy would be revisited in consultation with states to ensure basin level management strategies to deal with variability in rainfall and river flows due to climate change. This will include enhanced storage both above and below ground, rainwater harvesting, coupled with equitable and efficient management structures.

The Mission will seek to develop new regulatory structures, combined with appropriate entitlements and pricing. It will seek to optimize the efficiency of existing irrigation systems, including rehabilitation of systems that have been run down and also expand irrigation, where feasible, with a special effort to increase storage capacity. Incentive structures will be designed to promote water-neutral or water-positive technologies, recharging of underground water sources and adoption of large scale irrigation programmes which rely on sprinklers, drip irrigation and ridge and furrow irrigation.

3.1.2 Identification of (re)training needs

India is an emerging economy and has undergone major transformation over the last few years. The process of economic reforms resulted shift in the employment opportunities. For example the entire ITES (Information Technology Enabled Services) industry has emerged because of these economic reforms. India is the largest stock in terms of human capital which constitutes a major share of semi-skilled manpower. Moreover, huge drop-out rates, large unorganized sector, exploitation and under-employment of labour, a large pool of semi-skilled/unskilled labour, and no direct linkage with the Industry requirements are some issues which make Skills Development a necessary action. Therefore, to help this human resource requires sustainable employment options and avenues. Accordingly, government of India is taking corrective measure to come out this problem as reflected in the policy statement:

*“The vast majority of our youth seek skilled employment after schooling. Last year I spoke the need for a Vocational Education Mission. Such a Mission is ready to be launched. We will soon launch a Mission through which we will open 1600 new industrial training institutes (ITIs) and polytechnics, 10,000 new vocational schools and 50,000 new Skill Development Centres. We will ensure that annually, over 100 lakh students get vocational training- which is a four-fold increase from today’s level. We will seek the active help of the private sector in this initiative so that they not only assist in the training but also lend a hand in providing employment opportunities”.*²⁷

It is more important because for the next 20 years the biggest resource available would be human resource as India leads the youngest population in the world (median age 24 years). India needs a large infrastructure to accommodate the existing human capital which could generate enough jobs particularly ‘green jobs’.

²⁷ Excerpts from Prime Minister Dr. Manmohan Singh's message to the Nation, 15 Aug. 2007.

Box 7. Conference on green economy

Dr. Nityanand, TERI

“The emerging employment sector in the Energy Sector”

In view of the Global Climate changes, there is a shift towards energy efficiency and the use of renewable sources of energy. These sources are labor intensive and thus green jobs are expected to rise. However a correct estimate of this rise is difficult as huge data gaps exist.

Excerpts from the Proceedings of the Conference on “Green economy: challenges and responses to changing condition”, 14-15 Dec. 2009, NISTADS, New Delhi

3.1.3 Skills response

Knowledge enhancement is a driving force of economic growth and social development of any country. The economy becomes more productive and competitive through skilled human potential. The composition of employment and growth in opportunities are the critical indicator of the process of development in any economy. During the last two decades the process of globalization and technological changes has provided growing opportunities for economic expansion and job creation. Therefore, for best possible exploitation of emerging employment opportunities by minimizing the social costs and dislocation the level and quality of skills that a nation possess are becoming critical factors. Country like India, predominantly agricultural economy, vocational training and apprentice may be best model to cope with future challenges because a large share of secondary and higher secondary educated labour force is unemployed due to lack of technical skill. According to National Sample Survey Organisation, the total labour force available in India is about 45.8 Crore as on June 2004. Moreover, educated (X Standard and above) job seekers constitute about 75 per cent of the total job seekers registered with the employment exchanges during 2003 and most of the job seekers (about 80 per cent) in employment exchange are without any professional skill. Consequently, Directorate General of Employment and Training (DGE&T) has initiated several initiatives in skill development through 500 ITIs spread over the country. Initiatives are being taken to improve training and development of faculty, placement of the trainees as apprentices, arranging on-the-job training and industrial visits. The 11th Five Year Plan Report proposed skill development based on Modular employable skills (MES). The target groups of the model are less educated/out of school youth/unemployed/ persons without employable skills, workers who have acquired skills informally and ITIs graduates. The curricula is being designed by identification of employable skills set in a sector based on division of work in the labour market, development of training modules corresponding to skills set identified so as to provide training for specific and fit for purpose and organization of modules into a Course Matrix indicating vertical and horizontal mobility. Since green job is a new and niche area so India has a big opportunity in to generate large number of jobs by identifying the proper areas where green jobs are more suitable.

The course in ITIs is designed in a way to impart basic skill in the trade specified. There are more than 4,650 vocational training institutes (among them nearly 500 ITIs) in India providing training in the following areas:

1. Craftsmen Training Scheme (CTS)
2. Apprenticeship Training Scheme (ATS)
3. Craft Instructors’ Training Scheme (CITS)
4. Advanced Vocational Training Scheme (AVTS)
5. Supervisory/Foremen Training Scheme

6. Staff Training and Research Programme
7. Instructional Media Development Programme
8. Women's Training Scheme
9. Hi-Tech Training Scheme

Hardly any institute provides training in green technology related technology. So, these institutions have enormous scope to design curriculum and syllabi for green technology related profession. The national Solar Mission may be the mile stone in this direction by opening opportunities for employment in solar and green technologies. Besides, ITIs polytechnic colleges also provide a variety of professional courses, at diploma level, which is mainly technical and vocational in nature. These polytechnics may be offering these courses on a part time or full time basis and there may be diploma courses as well as full-time courses. The ITIs and Polytechnics' are managed by the respective state governments.

With the process of globalization the economy is becoming more specialized and the demand for better levels of specific skills is increasing, vocational training has gained more significance. According to CYGNUS (Aug. 2008)²⁸ estimates during 2006-2010, 71 million youngsters will enter the working-age population in India due to shortage of skilled people and the talent deficit is already hampering the growth prospects of manufacturing and services sectors. Further, the domestic vocational training market stood at Rs 11.3 billion (USD250 million) in 2007, which has grown at a rate of 11 per cent over the previous year. The major segments in vocational education and training business in India include the IT (information technology) education and training, manufacturing (various trades related to ITIs) and hospitality management. IT education and training business is estimated to reach at Rs48.96 billion in 2011-12. It shows that India has huge potential of vocation training and the proper industrial policy could be helpful to promote sustainable development.

3.1.4 Case studies: Sectoral analysis

Case Study 1. The Barefoot College of Tilonia

Naresh Kumar and Vipin Kumar, Scientists, NISTADS, New Delhi

Solar systems have a huge source of energy which is converted into heat through thermal systems. The amount of energy produced varies according to the system's location, the time of year and the weather, although some energy is produced even on cloudy days. Solar energy can be used to heat water, dry crops or cook food and lighting. Indian geographical location is best suited for solar electricity and various success stories are reported in India. So, the government of India is taking several initiatives to produce solar energy for self sufficiency. The National Solar Mission is a major initiative of the Government of India and State Governments to promote ecologically sustainable growth while addressing India's energy security challenge. The objective of the National Solar Mission is to establish India as a global leader in solar energy, by creating the policy conditions for its diffusion across the country as quickly as possible. It will also constitute a major contribution by India to the global effort to meet the challenges of climate change. The objective of the Solar Mission is to create conditions, through rapid scale-up of capacity and technological innovation to drive down costs towards grid parity. To achieve the goals Jawaharlal Nehru National Solar Mission was set up. This will require a large number of skilled manpower for manufacturing, marketing/sales, installation, operation and maintenance of solar based technology. The manpower required will be trained in industrial training leading to diploma and certificate courses. To meet the desired manpower, it will require to open new ITIs

²⁸ http://www.cygnusindia.com/pdfs/Vocational_Education_Training.pdf

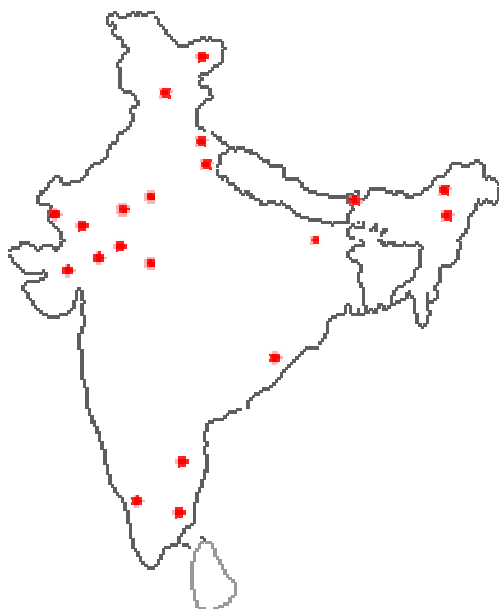
across the country. Consequently, it will generate huge employment opportunities for diploma and certificate engineers in India.

However, solar energy is currently high on absolute costs compared to other sources of power such as coal and hydro power. The Mission anticipates achieving grid parity by 2022 and parity with coal-based thermal power by 2030, but recognizes that this cost trajectory will depend upon the scale of global deployment and technology development and transfer. The Mission recognizes that there are a number of off-grid solar applications particularly for meeting rural energy needs, which are already cost-effective and provides for their rapid expansion. India is endowed with vast solar energy potential. About 5,000 trillion kWh per year energy is incident over India's land area with most parts receiving 4-7 kWh per sq. m per day. Therefore, conversion of solar radiation into heat and electricity, namely, solar thermal and solar photovoltaics, can effectively be harnessed providing huge scalability for solar in India. The case of The Barefoot College Tilonia, Rajasthan, is worth mentioned²⁹.

The Barefoot College began in 1972 with the objective to provide solutions to rural problems such as drinking water, girl education, health and sanitation, rural unemployment, income generation, electricity and power, as well as social awareness and the conservation of ecological systems within the community. The College serves a population of over 125,000 people both in immediate as well as distant areas. The college is spread over Orissa, Rajasthan, Uttarakhand, Tamilnadu, Assam, Kerala, Madhya Pradesh, Gujrat, Andhra Pradesh, and J&K. The Solar power in Tilonia was first used in 1986 to cater the needs of community and at present the College campus is totally self-sufficient with a 40 kilowatt solar energy unit meeting all its energy needs. Over 100,000 people have access to solar lights in 575 villages and 5,401 schools in 16 Indian states generating more than 530 kilowatts of solar energy through 7,300 individual solar units benefiting 11,000 families.

Figure 8. Network of Barefoot College in India

Indicative map not for reference



²⁹ Annual reports for different years, Barefoot College, Tilonia; www.barefootcollege.org

Barefoot solar engineers have installed solar photovoltaic (SPV) home lighting systems and fabricated produced solar lanterns across ten states of India. The results include:

- Solar electrifying 300 adult education centres.
- Solar electrifying 870 schools across the country.
- 3530 solar lanterns manufactured at the College.
- 28 remote and inaccessible villages in Ladakh have 40 Kws of solar panels that provide three hours of light in the bleakest winter to 1,530 families.
- In Leh and Kargil districts, solar energy initiatives have saved a total of 97,000 litres of kerosene.
- 392 rural youth including women trained as barefoot solar engineers with absolutely no aid from urban professionals.
- 350 villages and hamlets (clusters) have been covered where a total number of 12,000 households have been solar electrified.
- 195,000 litres of kerosene saved, by replacing generators and oil lanterns with solar power.
- All solar panels have been installed, maintained and repaired by the village people without the assistance of any formal trained and qualified engineer.

The Barefoot College has been providing training in solar technology by exposing it and decentralizing the use of solar equipments. The College has trained men and women who cannot read or write, so that they can develop skills and organize themselves to be gainfully employed while serving their own community. The main target of Barefoot College is to train illiterate or semi-literate middle aged women from villages all over the world. The College adopted a methodology of combination of traditional knowledge and modern skills. The training is provided in: a) Circuit Assembly (of solar lamps, lanterns and charge controllers), b) Circuit testing (of solar lamps, lanterns and charge controllers), c) Fabrication (of solar lamps, lanterns and charge controllers), d) Unit installation (of home lighting systems, lanterns and rural electronic workshop (REW)), and e) Unit Maintenance (of home lighting systems, lanterns and REW). The college has trained a number of technicians in villages of Tilonia, district Ajmer, Rajasthan. Main beneficiaries are from the villages Harmara, Buharu, Rampura, Faloda, Mundoti, Tilonia, Bawadi, Nohariya, Joginada. The college has trained a number of technicians and engineers from under developed and African countries. The Barefoot College trained about 20 semi-literate and literate rural women in solar technology at the Solar Workshop in Tilonia during 2007-08. The participants were from Bolivia, Cameroon, Mali, Sierra Leone and the Gambia. After getting trained they have solar electrified 414 households in 12 villages situated in their respective countries. Associations of Women Barefoot Solar Engineers (WBSEs) in Ethiopia, Afghanistan and Bhutan have been registered and in future will be responsible for implementing, monitoring and maintaining initiatives of solar electrification and rain water harvesting to sustain the barefoot approach.

Case Study 2. Green power plants: A case of conventional to renewable conversion

Vipin Kumar, Scientist, NISTADS, with inputs from PriceWaterhouseCoopers (PWC)

The greening of occupation is an outcome of implementation of energy efficient green technologies in the energy sector. The need for moving towards a green technology innovation has come from the need for complying with the regulatory/general risks of climate change to which an organization is exposed to, reduction of fuel cost and enhancement of competitive advantage. Carbon revenue enables these projects by marginally improving the internal rates of return of the project over the baseline options. It is a massive process in terms of number of the

workers involved, who need extensive training. The case study involves two projects in energy sector, i.e.:

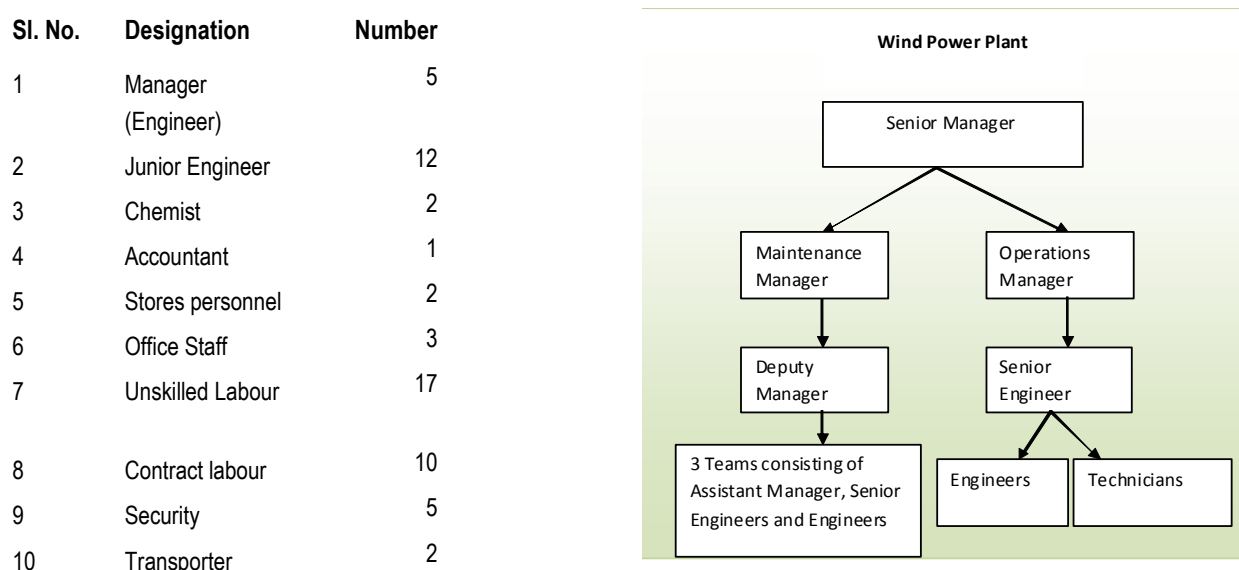
- (i) Biomass based power plant: The example project selected includes the construction, installation and operation of a 6MW, grid connected, and biomass based power plant. The project power plant is intended to export the generated electricity to the connected local grid, which is also a part of Eastern regional grid of India. This would enable the project to displace equivalent amount of electricity at the grid, which primarily sources electricity from the thermal power plants. The project proposes to fire rice husk as primary fuel for power generation. Thus the project leads to reduction of greenhouse gas emissions to the atmosphere.
- (ii) Wind power plant : 5 MW Wind Power Project at Baramsar and Soda Mada, district Jaisalmer, Rajasthan, India:³⁰ The project activity is an initiative by the Transport Corporation of India Limited towards clean energy generation by means of installation of four state-of-art Wind Electricity Generators of individual capacities 1.25 MW each, at two locations, village Baramsar (2.5 MW) and Soda Mada (2.5 MW), District Jaisalmer in the State of Rajasthan aggregated to a total installed capacity of 5MW. The generated electricity from the aforesaid wind farm is evacuated to the RVPN (State Electricity Utility) grid under a power purchase agreement and subsequently all the electricity generated is sold to the state electricity utility.

In these examples, technology change leads to mitigating climate change impacts and re-skilling of existing workforce as these are innovations that helped convert traditional coal based power generation to renewable biomass or wind based energy generation systems.

The wind project activity lead to the promotion of the then state-of-art 1.25 MW Wind Electric Generators (WEGs) in the region, demonstrating the success of large sized wind turbines, which feed the generated power into the nearest sub-station, thus increasing energy availability and improving quality of power under the service area of the substation with almost zero carbon emissions. Similarly the biomass based energy production inculcates renewable energy generation technology in a coal grid which leads to achievement of renewable energy targets set by the government for distribution companies. The number of current work force involved in the “greening” operation is around sixty. The age group is within 25 to 55. The employees are all male and are of various levels of education. Some are engineers or accountants by training while others are class 10 passed while the unskilled, contract, security, transporter and other staff may be without any formal education. The breakdown is as follows:

³⁰ <http://cdm.unfccc.int/UserManagement/FileStorage/G9IG9ELTJNIKUSIZJQXIF06ZGQ3LFE>

Figure 9. Breakdown of the manpower in the two units studied in the case study



Skill gaps and retraining needs

Biomass plant: Skills needed to operate a biomass based power plant were non-existent with the manufacturer's work force. Since the use of biomass is not significant in the region, it was dumped as waste and methane generation was the natural consequence. Therefore, the rice producing community needed to be trained in the manner biomass would need to be supplied for the project. Training needs were identified for the operator level such as for handling biomass and operation of the boiler as well as the turbine. Specifically, there was a requirement to balance fluidization due to use of biomass, and this required specialized training which the coal based boilers do not require. Besides, for transportation of rice husk, diesel model trucks specifically designed for transporting high volume rice husk were used and operation of these needed training of transporters.

Wind energy plant

The skill gaps in the wind project are related to:

- (a) Knowledge on intelligent control** required for maximizing yield, Unique Micro-Pitching Control for fine pitching with 0.1° resolution to extract every possible unit of power
- (b) Quality control procedure:** Grid interactive wind projects require rigorous QA/QC procedures in terms of operation and maintenance and also from the perspective of monitoring and verification of data quality as per the Clean Development Mechanism (CDM) guidelines. For example, the project activity described has the following QA/QC requirements:
 - The meters installed on substations (grid interconnection point) will be used to measure mentioned variables on a continuous basis. Every month these meter readings will be recorded by plant personnel, these records will be archived for crosschecking yearly figures. The meters at the substation will be two-way meters and will be in custody of State Electricity Utility (RVPN). SEB officials will take the readings in these meters and the same reading may be used to determine the net power wheeled to the user and determine the extent of mitigation of GHG over a period of time. When the main metering system and/or backup metering system and/or any component thereof is found to be outside the acceptable limits of accuracy or otherwise not functioning properly, it

shall be repaired, recalibrated or replaced as soon as possible by the project proponent or the state electricity utility.

- (c) **Working at height**-Working at heights may be required during construction activities as well as during routine maintenance, including the assembly of wind tower components and general maintenance activities during operations.
- (d) Proper disposal of hazardous waste-like lube oil, PCB etc.

For both the initiatives, the training needs were identified by the management and the project team along with the development of the project activity. A management system was put in place that accorded specific responsibilities to various personnel who oversaw the implementation, operation and monitoring of the projects and maintained training schedules to ensure that competencies were upgraded as per requirement. For both the initiatives, the training will be provided with structured training plan that included all the project specific important features (as discussed under point 3) required to close the skill gaps and to re-skill the workforce. The training will be provided by the skilled trainers hired by the project proponent.

The skill gaps are identified in the existing workforce. The training will be relevant and sufficient so that the identified gaps can be closed and the training plan is designed according to the identified need of the workforce.

Policy response

There is no dedicated policy highlighting the need of specific training. However both BEE (Bureau of Energy Efficiency) and National Enhanced Energy Efficiency Mission under National Action Plan on Climate Change have specified the training requirement for capacity building in the Energy sector. IFC and other guidelines are used to formulate training on EHS (Environment, Health and Safety) wherever required. The financial institutions and CDM validators require the project proponents to demonstrate due diligence with respect to EHS and project performance and adequate documentation on training is maintained at the project site.

Case Study 3. Water and sanitation-related occupations

Kasturi Mandal, Scientist, NISTADS and Taposik Banerjee, Fellow Scientist, NISTADS

In India, there is a pressing need to check open defecation in India. The Total Sanitation Campaign (TSC) personnel had identified this as the single biggest cause of rampant water-borne diseases that kill infants and young children, and many millions lost man-days. Deteriorating water quality is also a serious issue that needs attention. It is time to look into the sector in a job oriented perspective, in a sense that if the sector could generate occupations and thus income opportunities, the rural population perhaps could take more initiative on their own to judiciously use water filters, toilets etc. and convince others as well. The task of implementing sanitation program is not an easy one as it is more than changing one's habit, the challenge lies in changing mindsets.

The origin

Ramakrishna Mission Loksiksha Parishad (RKMLP) first started the sanitation promotion activities in 1981 as a part of its Integrated Child Development activities in seven villages in West Bengal. Later RKMLP conceived designed and initiated the first Demand Driven Sanitation Strategy (DDSS) of the country in Midnapore district in the year 1990 jointly with the United Nations Children's Fund (UNICEF) and implemented the same in collaboration with Government of West Bengal and Midnapore Zilla Parishad. With an area of 14,081 sq km and population of 97 lakhs, Midnapore is the largest district of India. RKMLP's associated and affiliated village youth clubs and cluster organizations of Midnapore district are the basic, grass-root level partners

in sanitation programme planning, implementation and follow up services. Now Midnapore Sanitation strategy has been recognized as role model for promotion of Central Rural Sanitation Programme (CRSP) in India. The Midnapore Model involves building community awareness through folk media and Information Education and Communication (IEC) material to generate a demand. A delivery network has been developed by establishing Rural Sanitary Marts and Production Centres in every block of Midnapore district in the state of West Bengal involving cluster organizations of RKMLP. Fifty-four such marts have been established in Midnapore district which have played a major role in reaching out and making the distribution of toilets easy and cost effective. As a result of this dedicated mission, household toilet coverage increased to 100 per cent in Midnapore district in 2007 from 4.47 per cent in 1991.

The present case study is for a sanitation implementation program in 4,686 villages in 54 Community Development (CD) blocks which were covered by 11 cluster organizations involving 1,027 youth clubs. Cluster organizations have been set up with community development blocks, each block has a population of around 150,000.

Occupations

Water and sanitation related activities and occupations can be broadly divided into three categories:

Table 3. Classification of water and sanitation related occupations

Categories	Function	Occupations
Production of hardware	Construction of wells, tube-wells, Filter making, sanitary pans, etc	Master masons, village masons, artisans, mechanical fitters
Operation, maintenance and monitoring	Timely inspection of the wells, tube wells and toilets and maintaining/repairing the same as and when necessary	Village masons, mechanical fitters, caretakers
IEC/Social mobilization	Motivating the local population and raising their awareness regarding the use of filters, toilets etc.	Trainers, motivators

Production of hardware

- Production of sanitary hardware: It consists of production of concrete rings for the pit lining, square and round plates for water seal latrines, pit covers, mosaic pans and traps. Village women are engaged for this purpose with the help of trained village masons.
- Production of water filters and drilling of hand pumps: To supply safe drinking water, a set of drillers are involved in drilling and installation of hand pumps.
- Construction of the low cost latrines at individual households: A set of village masons who are trained by Master mason are involved in this task which starts from digging the pit, constructing the low cost latrine, and ends in the superstructure.

Operation, maintenance and monitoring

- **Operation and maintenance (O&M) of pumps and water filters:** For each hand pump a seven member Water Committee has been formed with core women members from the beneficiary families. Two trained women for each hand pump are independently undertaking the O&M job voluntarily. Seeing the success of this venture Midnapore Zilla Parishad

introduced this strategy and mechanism in about 22,000 hand pumps installed by the Zilla Parishad from 1996.

- **Monitoring and upgradation of toilets:** Open defecation being an accepted practice amongst the villagers it requires regular monitoring so that pupils do not go back into their previous habit. Very much linked to it is the task of up gradation of the latrines, e.g. converting the single pit ones to the two pit model. These two tasks also create more occasions of green occupation generation.
- **IEC/Social mobilization:** In the task of keeping our environment clean from the perspective of sanitation, more than changing the habits the challenge lies in changing the mindset for which motivators play a very important role.

Following table gives an approximate estimate of workforce involved in water and sanitation related activities in one cluster organization:

Table 4. Workforce in water and sanitation related activities

Production of sanitary hardware	20-25 village women
Production of water filters	20-25 village women
Construction of the low cost latrines at individual households:	10-12 mason men
Operation and maintenance of pumps and water filters	300-500 village women (1-2 women per village)
Water quality testing	
▪ Sample collectors	3
▪ Chemist	1
▪ Lab Assistant	1
Monitoring and up gradation of toilets:	25
IEC/Social mobilization	20
Drilling and installation of hand pump	10

The Rural Sanitary Mart is staffed by two mart managers, two chief motivators with a network of motivators located at the Gram Sansad level (one for each Gram Sansad) and two to three head masons with a group of masons. The motivators are instrumental in implementing the sanitation programme and identifying the households not covered. At the block level, there is one sanitation supervisor, who guides seven Gram Panchayats (average ten villages in each Gram Panchayat). Each Gram Panchayat has a supervisor. For every booth, there is one motivator.

Skill gaps

The village people (mainly women) involved in motivational activity, hardware production and maintenance had no previous experience of the job and therefore had a major skill gap. However, acquiring the required skill was not difficult and it was easy for the workers to learn from the training they received.

The skill set that the women involved in hardware production required to develop was that of masonry. The people involved in Construction of the low cost latrines at individual households also had a very significant change in their skill set due to green restructuring in the sense that they were unaware of the technology to manufacture sanitary pans for which they received training.

High emphasis was given on intensive, area specific and time bound IEC/social mobilization activities for demand generation which again involved a different skill set.

Training

In order to achieve the targets set for promotion of rural sanitation activities in West Bengal, intensive human resource development programmes were designed and conducted for inculcating positive aptitude and development of skills at all level of functionaries, i.e. administration, panchayat and clusters for implementation of the demand driven sanitation.

There was regular organizational and motivational training for motivators. Orientation and training programmes were organized for project personnel, motivators, cluster and youth club leaders, and panchayat and WATSON committee members. Participants are familiarized with various 'software' aspects of the project. Steps were taken to develop efficient rural managers for smooth implementation of the programme.

For the women involved in hardware production the training program was informal. Mainly on job training was provided by the village masons.

Two women from beneficiary families selected and trained on operation and maintenance by the RKMLP.

Keeping in tune with the project's integrated approach to sanitation, technical training is provided in addition to training on organizational and motivational aspects. Courses are held to train village masons in the construction of latrines, drilling of tube wells and the installation and maintenance of TARA hand pumps.

As a skill policy response to the situation Ramakrishna Mission Lokasikha Parishad has been recognized as one of the four National Resources Institutes by the Government of India in the year 2004-05 for capacity development of key functionaries of TSC programme in the country. RKMLP is now called for any decision making meeting from the Department of Drinking Water, Government of India at national level to zilla parishad level.

RKMLSP, State Institute for Panchayat and Rural Development (SIPRD) and UNICEF tie-up and a concerted and well-coordinated effort among the three partners helped in accomplishing the initial master trainers trainings required to establish the trainers network at various levels in the district. UNICEF assistance was focussed on imparting training to mart managers, masons and motivators.

Various training modules have been gradually put in place for panchayat members, NGOs, teachers, and other development workers to develop capacity, promote and create demand among communities.

The State Sanitation Cell, located at SIPRD, coordinates all training activities. After the initial training at SIPRD, further training of motivators and masons are conducted at the Rural Sanitary Mart. The SIPRD also conducts orientation programmes for panchayat representatives and district coordinators at the centre and facilitates district level sensitization workshops for district level officers. District level officers further conduct block and village level sensitization workshops. RKMLSP played pivotal role in conducting training programs in the district. A table of such trainings conducted by RKMLSP is already mentioned earlier.

Several international, national and state level training/ orientation on water and sanitation have been conducted as skill provision response. They are as follows:

1. One International Learning Exchange Programme on sanitation has been conducted in collaboration with UNICEF, Government of West Bengal and Government of India. Nineteen international participants from six countries participated in the programme.

2. Another International Learning Exchange Programme on water and sanitation has been conducted from 13-18 February 2007 for nine senior Officials of BRAC, an International NGO of Bangladesh. The delegation visited water and sanitation programmes in different villages in Purba Midnapore district.
3. An Orientation cum exposure on TSC programme has been conducted for 42 government officials of Maharashtra state. The team was taken to different cluster organizations of Purba Midnapore for field exposure on sanitation.
4. Sanitation Resources Team of Lokasiksha Parisad extended technical support to the State Sanitation Cell of Government of West Bengal to conduct training programmes for the technical persons and master masons on construction of new model of school toilet in different districts of West Bengal.
5. Field demonstration and training on construction of household toilet models for hilly areas conducted in Darjeeling by District Rural Development Agency (DRDA). RKMLP has extended technical support for developing manufacturing unit at Kalimpong.

3.2 New and changing skills needs

3.2.1 New green collar occupations

Agriculture

About 60 per cent of the working population in India are engaged in agriculture and thereby makes it the most employment generating sector. Crop production in India is critically dependant on the summer monsoon. A rise in global temperature due to climate change may have an adverse effect on Indian agriculture by changing the monsoon precipitation dynamics. As a result production of climate sensitive crops would suffer drastically. Adapting to this new and changing scenario is the need of the hour. As M.S. Swaminathan points out, anticipatory analysis and action hold the key to climate risk management and food security. For that, India needs to develop new set of professionals with technical knowledge.

Agricultural meteorologist: An agricultural meteorologist applies meteorological information and data to enhance crop yields and reduce crop losses due to adverse weather. This has linkages with forestry, horticulture and animal husbandry. Such a professional requires not only a sound knowledge of meteorology, but also of agronomy, plant physiology and plant and animal pathology, in addition to common agricultural practices.

Agricultural technicians: This involves several occupations with different skills and knowledge base. They assist the agriculturists in their work with regard to:

- plant breeding,
- animal husbandry,
- irrigation schemes,
- soil conservation,
- agricultural mechanisation,
- efficient use of electronics and electricity,
- site-specific pesticide application,
- yield mapping, and variable-rate irrigation,
- efficient use of water,
- use of seed and fertiliser etc.

These professionals may come from a wide ranging background like - botany, agricultural microbiology, analytical chemistry, agriculture economics, zoology, veterinary science, food technology, agricultural meteorology, soil science, engineering etc.

Climate Risk Managers: Such professionals need to be well-versed in the art and science of Climate Risk Management and help to blend traditional wisdom with modern science. They would be trained for mitigation, adaptation and developing drought, flood and good weather codes with a view of being prepared to minimize the adverse impact of aberrant weather and to maximize the benefit of good monsoons.³¹ Such an initiative will benefit both the resource-poor small farmers, and national food security.

Forestry

No job can possibly be greener than planting a tree. Forestry is an area where large number on green jobs can be generated by undertaking reforestation and afforestation projects. In India through National Rural Employment Guarantee Scheme (NREGS), which has a strong natural resource management component, several afforestation projects have been taken in different states. People employed under this scheme for planting and preserving trees - both men and women - acquired their skills either traditionally or through informal on field training. Under the National Mission for a Green India an ambitious plan for afforestation has been declared. Although the occupation of tree planting is not new (as people are planting trees from time immemorial), it has reemerged as an important green collar occupation to mitigate the negative impacts of climate change.

Box 8. National Mission for a Green India (2008)

A National Mission will be launched to enhance ecosystem services including carbon sinks to be called Green India. Forests play an indispensable role in the preservation of ecological balance and maintenance of bio-diversity. Forests also constitute one of the most effective carbon-sinks.

The Prime Minister has already announced a Green India campaign for the afforestation of 6 million hectares. The national target of area under forest and tree cover is 33 per cent while the current area under forests is 23 per cent.

The Mission on Green India will be taken up on degraded forest land through direct action by communities, organized through Joint Forest Management Committees and guided by the Departments of Forest in state governments. An initial corpus of over Rs 6,000 crore has been earmarked for the programme through the Compensatory Afforestation Management and Planning Authority (CAMPA) to commence work. The programme will be scaled up to cover all remaining degraded forest land. The institutional arrangement provides for using the corpus to leverage more funds to scale up activity.

Energy

NAPCC focuses on National Solar Mission as well as other renewable energy technologies. National Solar Mission document talks about creation of 100,000 jobs in solar energy area within next 10 years. There is a convergence of opinion among government officials, trade unions and entrepreneurs that India urgently needs to focus on renewable energy production.

Other than solar energy, emphasis was given on hydro energy and wind energy. The Central Electricity Authority (CEA) has estimated India's hydropower potential at 148,700 MW. Fifty-six sites have been identified by the CEA for pumped storage schemes with an estimated aggregate installed capacity of 94,000 MW. In addition to that a potential of 15,000 MW in terms of installed capacity is estimated from small, mini, and micro-hydel projects. This sector will be generating a large number of employments in near future. As a result professionals who will be in demand are:

- hydro-electric plant technicians,

³¹ http://www.mssrf.org/events_conferences/content_events/february_2010/round_table_Feb_10.pdf

- engineers and
- Production managers.

During the last few years the installed capacity for using wind energy has gone up rapidly. The capacity utilization factors, however, are low due to the variations in the wind flow. Action is required to design, develop and manufacture small wind energy generators (WEGs) up to 10 kW capacity, that can generate power at very low speeds. Effort is also required for the development of low weight carbon fiber and other new generation composites, etc. for use in wind turbines. Professionals who would be in demand are:

- wind energy operations managers
- wind energy project managers
- wind energy engineers
- wind turbine service technicians.

Buildings

The Energy Conservation Building Code (ECBC) was developed by India's Bureau of Energy Efficiency (BEE) and launched in 2007. It specifies the energy performance requirements for all commercial buildings that are to be constructed in India. National Mission on Sustainable Habitat talks about promoting energy efficiency as an integral component of urban planning. One of the initiatives of the Mission is – “the Energy Conservation Building Code, which addresses the design of new and large commercial buildings to optimize their energy demand, will be extended in its application and incentives provided for retooling existing building stock.”

A green building is one that requires less depletion of natural resources during its construction and operation. It minimizes the use of non-renewable resources and efficiently uses energy, water and natural resources. It maximizes the use of environment friendly construction materials. It generates less waste and provides a healthy interior to the occupants. It requires less energy to power itself and tries to be self sufficient with respect to its energy needs. Making of a green building is therefore different from that of a conventional building. Designing a green building requires additional scientific knowledge and architectural skills. Workers also require special technical knowledge and skills in addition to conventional skills. Construction of green buildings is a new practice in India and offers a whole range of new opportunities. Some new occupations that would be created or have been recently created are –

- energy engineers
- green architects.

Manufacturing

The manufacturing sector is one of the major sources of environment pollution. In the absence of clear environmental standards manufacturing units were not interested in using green technologies. The products were also not environment friendly and hazardous chemicals were used in the production process. Introduction of environmental standards and green economic activities would compel these units to use green technologies and produce eco-friendly products. This would require them to look for experts like biochemical engineers who may help them develop or evaluate green technologies or may collaborate with manufacturing or quality assurance staff to prepare several things like - product specification and safety sheets, standard operating procedures, user manuals, qualification and validation reports etc. Biochemical engineering is an emerging occupation that would be playing a major role in transforming this sector into a less hazardous sector by applying their knowledge of biology, chemistry, and engineering to develop usable, tangible products.

Services

Energy audit means the verification, monitoring and analysis of use of energy. The objective is to conserve and reduce the amount of energy input in a building, process or system without negatively affecting the output(s). It involves submission of technical reports containing recommendations for improving energy efficiency with cost benefit analysis and an action plan to reduce energy consumption. The Energy Conservation Act was passed in 2001 but so far not been taken seriously by the government. However, once the act gets properly implemented, there would be an increased demand for Energy Auditors. Within the framework of the Energy Conservation Act, 2001 it establishes the Bureau of Energy Efficiency (BEE) under subsection (l) of section 3 and empowers the Bureau to introduce energy managers as well as energy auditors.³² The powers and functions of the Bureau are expressed in Chapter IV, Section 13(o) (p) (q) (r) and (s) of the Act.

(o) maintain a list of accredited energy auditors as may be specified by regulations;

(p) specify, by regulations, qualifications for the accredited energy auditors;

(q) specify, by regulations, the manner and intervals of time in which the energy audit shall be conducted;

(r) specify, by regulations, certification procedures for energy managers to be designated or appointed by designated consumers;

(s) prepare educational curriculum on efficient use of energy and its conservation for educational institutions, boards, universities or autonomous bodies and coordinate with them for inclusion of such curriculum in their syllabus;

In order to support implementation of these sections of the Act, the BEE is developing a pilot scheme to test advanced and cost effective ways to provide information and training to energy managers as well as auditors. Since 2004, BEE regularly conducts National Certification Examination for Energy Managers and Energy Auditors.

Environmental Audit is an exercise of self-assessment to minimize the generation of wastes and pollution potential. A gazette notification on environmental audit has been issued by the Ministry of Environment and Forests on 13 Mar. 1992 (amended vide notification GSR 386 (E) dated 22 Apr. 1993). This notification applies to every person carrying on an industry, operation or process requiring consent to operate under Section 25 of the Water (Prevention and Control of Pollution) Act, 1974 (6 of 1974) or under Section 21 of the Air (Prevention and Control of Pollution) Act, 1981 (14 of 1981), or both, or authorization under the Hazardous Waste (Management and Handling) Rules, 1989, issued under the Environment (Protection) Act, 1986 (29 of 1986). The notification requires that an Environmental Statement for the financial year ending 31 March be submitted to the concerned State Pollution Control Board (PCB), on or before 30 September of the same year. In the coming years, demand for environment auditors is expected to rise.

Carbon Trading is a market based mechanism for helping mitigate the increase of CO₂ in the atmosphere. India's dominance in carbon trading is expected to be driven, not so much by the domestic industry, but more by its huge tracts of plantation land. India has generated approximately 30 million carbon credits and approximately 140 million in run, the second highest transacted volumes in the world. India's carbon market is growing faster than even information technology, bio technology and BPO sectors as 850 projects with a huge investment of Rs 650,000 million are in pipeline. As per the Prime Minister's Council on Climate Change,

³² <http://www.bee-india.nic.in/index.php?module=tri&id=1>

the revenue from 200 projects is estimated at Rs. 97 billion till 2012. In future there will be manifold increase in demand for Carbon Credit Traders and Carbon Trading Analysts.

3.2.2 Greening existing occupations

Forestry

Apart from reforestation and afforestation programmes there is a need to preserve the existing forest cover in the country. Presently in the country area covered with forests is approximately 23 per cent. It is of great importance to preserve this forests and the wildlife. Professional like Forest Officers, Forestry and Wildlife Managers and Forestry Conservation Workers would be playing a major role in this respect.

Industry

Industrial pollution is one of the major sources of environment pollution. The Central Pollution Control Board (CPCB) has found that 85 per cent of big industrial clusters in India are causing major health hazards through air, water and land pollution and are unfit for human habitation. Greening of the existing industries therefore assumes utmost importance.

Jute industry

Jute is a natural fiber and also the cheapest and strongest of all natural fibers available for commercial use. India is the largest producer of jute goods in the world and is one of the major industries in the eastern region, particularly in West Bengal. Due to the emerging green consumerism, concern for Occupational Health and Safety in the sector and the increasingly more stringent environmental legislations in India, the conventional jute sector occupations are also undergoing a discernable shift in their skill set requirement. Recently in Kolkata the Union Textiles Minister, Mr. Dayanidhi Maran mentioned that there is a very large potential for expanding the use of foodgrade jute bags for packing various food products such as cocoa beans, coffee beans, shelled nuts within India and abroad. He has emphasized on the need for the constitution of National Green Council to promote research for adoption of improved practices in jute fibre to safeguard eco-viability of the crop and protect farmers. The Textile Ministry has also proposed a hike in subsidy to the jute mills for acquiring new and modern machines at a cost ranging from Rs 70 lakh to Rs 3.5 crore a mill. With an increase in the demand for different jute products workers require skill sets to produce those products. The DGE&T under the Ministry of Labour and Employment provides several short term courses³³ to develop employable skills in this respect. Minimum qualification required to avail these courses are mostly 5th standard.

Leather tanning

Leather tanneries cause serious health hazards through their untreated wastewater discharge. In a landmark judgment, the Supreme Court³⁴ has directed that tanneries need to take measures to make the tanning process more environment friendly. The tanneries in India now require to relocate them in clusters outside residential areas. They also need to reduce the use of water, use of hazardous chemicals and to treat the wastewater before discharging. The leather tanning industry and tanning as an occupation are currently going through a phase of transition.

³³ <http://dget.gov.in/mes/annex4.pdf>

³⁴ M.C. Mehta v. Union of India, WP 3727/1985 (1996.12.19) (Tanneries Case: Calcutta)

Energy

Biomass based power

Biomass based technologies include those involving primary biomass combustion, and those that do not involve direct biomass combustion, but may involve conversion to a secondary energy form. In India where millions of people rely on energy based on fossil fuels it is imperative that alternative cleaner energy sources be developed. Biomass energy is one such green and renewable source of energy. The biomass energy produced can be used for lighting, pumping drinking water and cooking; as well as to pump water for irrigation purposes and agro-processing.

Technology Informatics Design Endeavour (TIDE) along with ETC Foundation have been organizing training programmes³⁵ for women on biomass based drying technologies. There has been organizations and institutions like The Energy and Resources Institute (TERI), Indian Institute of Science (IISC) that provide training programmes on biomass gasification for manufacturers, technicians, local service providers and state nodal agencies.

As more biomass energy production plants come into existence in the coming years professionals like - senior and junior engineers, chemists, accountants, office administrative staff, skilled and unskilled laborers, stores and security personnel, contractual laborers and transporters would be in demand. All the people under these occupations who would be working in this sector will then have a green collar job.

Construction

Brick kiln

The traditional Indian brick manufacturing industry is one of the largest employment-generating industries in India. The conventional brick manufacturing technology, however, involves very large scale consumption of coal, firewood, and other biomass fuels. Almost 30-40 per cent of the production cost is the cost of fuel. Manufacturing (burning) of bricks account for 27 per cent of the total emission resulting from manufacturing of construction materials. With a high growth trajectory that India is presently moving on it is expected that more and more new development projects would be taken up and demand for construction materials would increase in near future. As a result emission may increase in leaps and bounds.

The Vertical Shaft Brick Kiln (VSBK) technology project was promoted by the World Bank to improve the thermal performance of the brick manufacturing units in different parts of the country. The VSBK technology is claimed to be cleaner and energy efficient compared to the traditional technology used in India. The workers, however, need to develop some skills and change their working pattern in order to adapt to this technology. There is a need for specially trained firemen and fire-masters for proper operation of VSBK.

Transport

Pollution due to the use of petroleum products for the purpose of transportation is an ever increasing problem in modern society. Compressed Natural Gas (CNG) and Liquefied Petroleum Gas (LPG) are alternative fuels for automobiles and are also the cleanest transportation fuel available today. It is claimed that apart from being less hazardous, they are also environment friendly, can help in reducing the levels of pollutant emissions and is quite cost effective. Delhi was the first state in India where entire public transport system switched over to CNG run

³⁵ <http://www.tide-india.org/projects/06%20W&L%20biomass%20based%20drying.html>

vehicles. This was a major initiative in the country for greening the transportation related occupations. Today India is one of top five countries with the highest number of vehicles running on natural gas in the world. Over the years CNG has grown into one of the major fuel sources used in car engines in India. The occupations that are becoming green due to this initiative are Bus drivers, auto and taxi drivers, mechanics of CNG run vehicles, workers on fuel stations. These drivers need to develop different skills to operate the vehicles running on CNG, LPG etc. For example, drivers need to have an understanding of the basic gas system with the help of a diagram. They need to know how to correctly operate safety equipment, understand emergency actions, and purpose and function of emergency shutdown equipment. They need to understand different types of fueling stations and how the vehicle is refuelled. They need to know how to change fuel over switch operation if bi-fuel system is fitted and understand starting procedure for cold and hot start. The Ministry of Road Transport and Highways offers short term courses³⁶ to train the drivers on these aspects. Ashok Leyland in collaboration with the Delhi government set up the Driver Training Institute in Burari in 2005. With new low-floor CNG buses being introduced in Delhi this institute provides training to 2.5 drivers per bus on an average³⁷ according to the spokesperson of Ashok Leyland.

Rail transport is another energy efficient transportation system with immense employment potential. As more rail tracks are being laid and Metro Rails are getting introduced in different metropolitan cities demand for professionals like Locomotive Engineers, Rail Track Layers, Railroad Conductors Station controller train operator etc. are increasing.

3.2.3 Identification of skill needs

Green initiatives in this country are at a nascent stage. Initiatives are taken in bits and pieces and in a rather arbitrary manner. There is a lack of comprehensive strategy to identify skill needs. India has a big potential for green jobs creation from India's National Action Plan which constitute eight modes of development, which would require a massive expansion. As discussed earlier at present Solar Mission and Water Mission are on utmost priority. For such a massive expansion of infrastructure, there needs to be a comprehensive policy towards the Human Resource development. Special curricula at Institute level has to be built which will include the specialized courses in solar energy at Bachelors, Masters and PhD levels. Some IITs and Universities are already teaching solar energy at graduation and post graduation level. In addition, a countrywide training programme and specialized courses for technicians will be taken up to meet the requirement of skilled manpower for field installations and after sales service network. The Directorate General of Education and Training under the Ministry of Labour has agreed to introduce training modules for course materials for technicians in order to create a skilled workforce which could service and maintain solar applications. MNRE (Ministry of New and Renewable Energy) has already initiated this activity with the Ministry of Labour and a short term training module is to be introduced during the current academic session. In addition, industry is also working with some of the ITIs to create a skilled work force.

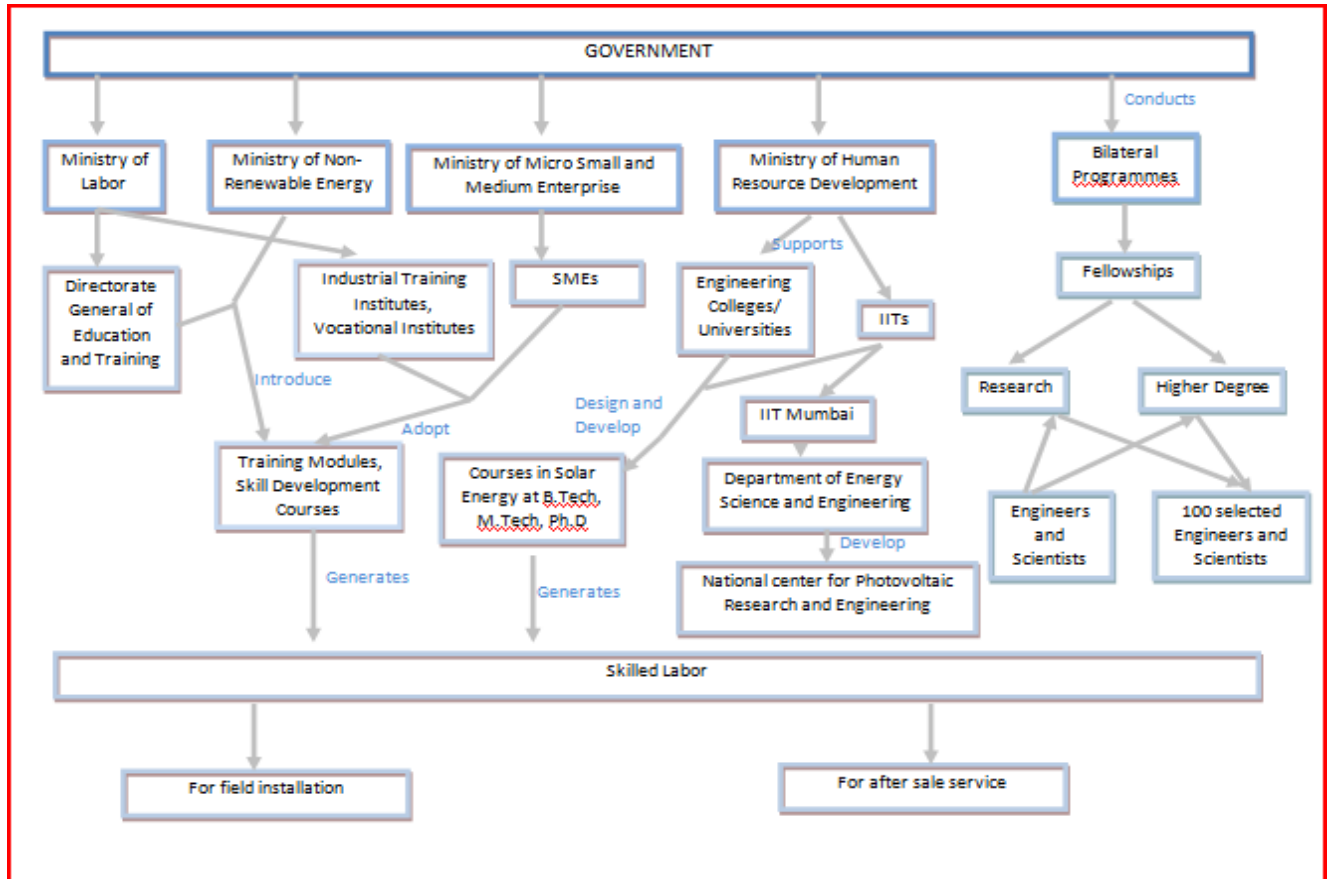
A Government Fellowship programme to train 100 selected engineers /technologies and scientists in Solar Energy in world class institutions abroad will be taken up. This may need to be sustained at progressively declining levels for 10 years. This could be covered under the ongoing bilateral programmes. Institution to institution arrangements will also be developed. Fellowships will be at two levels (i) research and (ii) higher degree (M.Tech) in solar energy. MNRE is already implementing a fellowship programme in this regard, which will be expanded to include students from a larger number of academic institutions. This may be done in consultation with

³⁶ <http://morth.nic.in/index1.asp?linkid=135&langid=2> ; and <http://morth.nic.in/index2.asp?sublinkid=462&langid=2>

³⁷ <http://www.indianexpress.com/news/200-lowfloor-buses-on-way-1000-drivers-head-for-training/430997/>

industry to offer employment opportunities. Setting up of a National Centre for Photovoltaic Research and Education at IIT, Mumbai drawing upon its Department of Energy, Science and Engineering and its Centre for Excellence in Nano-Electronics. A schematic of the human resource setup being created for the solar mission is depicted in Figure 10.

Figure 10. The structure of the manpower management as discussed in the national solar mission



In the agricultural sector M.S. Swaminathan Research Foundation has identified the need for certain skilled professionals (as mentioned in subsection 3.2.1) to adapt to a changed climatic situation. The National Missions under NAPCC have identified the need for greening sectors like energy, water, buildings, forestry etc. They have also realized that large amount of human resource needs to be generated. However, specific estimation of skill needs in quantitative terms is absent. Although terms like 'green jobs' are becoming more and more audible in the corridors of ministries and trade union offices, very few information is available about green jobs and that too are at a very superficial level. In case of leather tanning, the Central Leather Research Institute (CLRI) has identified certain areas where skill requirement is needed for greening the occupation; however, the methodology they used is not in public domain. They possibly identified the skill gaps through their regular interaction with the tanners.

3.2.4 Skills response

With very little progress made in identifying skill needs it is not surprising that there are hardly any skill responses in different sectors of the economy. The Ministry of Labour and

Employment is planning for additional requirement of skill or training for the workers to adapt to the technological changes in respect to green technology. The trade unions although vaguely realized that there could be a need for some additional skills, they nevertheless do not think that it would be a major hindrance to the process of greening some occupation. In case of leather industry, however, the CLRI offers a number of training programmes to introduce new technologies:

- **Academic programmes:** CLRI offers national level academic programmes where they award B.Tech., M.Tech., M.S. and Ph.D. degrees.
- **Vocational programmes:** They have several vocational programmes which were recently been upgraded into Diploma level. These programs are autonomous programs of CLRI. From early 1993, these programs have produced around 1500 promising vocational candidates.
- **Specialized programmes:** They also have several specialized short term programmes. These Industry-specific executive programs target top personnel from leather industry like the entrepreneurs, executives, technicians and supervisors. CLRI claims that more than 500 entrepreneurs, industrialists and executive personnel benefited by these programmes till date.
- **On-site demonstration:** CLRI also organized on-site demonstration programmes to help the workers adapt the new technologies. These programmes also contributed to increase awareness among the managers and workers of the tanneries about the new and clean technologies.

IGBC has initiated certain training programmes³⁸ in different metropolitan cities in the country. In the transport sector in the absence of any formal training programme we observe mushrooming of country based non-formal training arrangements by the garages and the mechanic shops. These entities suffer from proper quality assurances in training.

The BEE is developing a pilot scheme³⁹ to test advanced and cost effective ways to provide information and training to energy managers as well as auditors. Since 2004, BEE regularly conducts National Certification Examination for Energy Managers and Energy Auditors.

The Ministry of Road Transport and Highways offers short term training programmes (as mentioned in subsection 3.2.2) for the drivers. Ashok Leyland in collaboration with the Delhi government set up the Driver Training Institute in Burari in 2005. With new low-floor CNG buses being introduced in Delhi this institute provides training to 2.5 drivers per bus on an average⁴⁰ according to the spokesperson of Ashok Leyland.

Technology Informatics Design Endeavour (TIDE) along with ETC Foundation have been organizing training programmes⁴¹ for women on biomass based drying technologies. There are organizations and institutions like The Energy and Resources Institute (TERI), Indian Institute of Science (IISC) that provide training programmes on biomass gasification for manufacturers, technicians, local service providers and state nodal agencies.

³⁸ <http://www.igbc.in/site/igbc/progcal.jsp?desc=23041&event=23024>

³⁹ <http://www.bee-india.nic.in/index.php?module=tri&id=1>

⁴⁰ <http://www.indianexpress.com/news/200-lowfloor-buses-on-way-1000-drivers-head-for-training/430997/>

⁴¹ <http://www.tide-india.org/projects/06%20W&L%20biomass%20based%20drying.html>

3.2.5 Case studies on new green collar occupations

Case Study 1. Green buildings' Architects

Vipin Kumar and Naresh Kumar, Scientists, NISTADS

Definition of green building

Green building refers building structures that are environmentally sound; consume less energy, are durable and can be recycled and such buildings leads to sustainability. This building save resources and places fewer burdens on the environment, protects workers and minimizes health exposures. Thus a green building is a practice of increasing the efficiency of buildings and their use of energy, water, and materials, reducing building impacts on human health and the environment, through design, construction, operation, and maintenance.

Also green building help to reduced operating costs by increasing productivity and using less energy and water, improved public and occupant health due to improved indoor air quality, and green building brings together a vast array of practices and techniques to reduce and ultimately eliminate the impacts of buildings on the environment. The impacts on environment are listed below:

Table 5. Impacts of the built environment

Aspects of built environment	Consumption	Environmental effects	Ultimate effects
▪ Siting ▪ Design ▪ Construction ▪ Operation ▪ Maintenance ▪ Renovation ▪ Deconstruction	▪ Energy ▪ Water ▪ Materials ▪ Natural resources	▪ Waste ▪ Air pollution ▪ Water pollution ▪ Indoor pollution ▪ Heat islands ▪ Storm water runoff ▪ Noise	▪ Harm to human health ▪ Environment degradation ▪ Loss of resources

Development of a "New India"

India's economic growth is only sustainable with the equivalent infrastructure. Indian cities will be the loci and engine of the economic growth in the next two decades. The realization of an ambitious goal of 10 per cent growth in GDP depends fundamentally on making Indian cities much more liveable, inclusive, bankable and competitive. Presently the growing demand is not been met by the crumbling infrastructure, such as road networks, city transport, water and Sanitation etc. This requires a massive enlargement of urban infrastructure. Government is equally aware of this fact and therefore several initiatives have been taken recently. Eleventh plan document has a clear strategy on the urban infrastructure development. The massive amount of fund (Rs 1292.37 billion) has been made available to improve upon the basic services in the 60 major cities of India. In continuation of tenth plan, Jawahar Lal Nehru National Urban Renewal Mission (JNNURM) has been successfully initiated under which following will be catered which are linked with green constructions process:

- Water, sewage and sanitation

- Solid waste management including hospital waste.
- Construction of drains and storm water drainage systems
- Road networks
- Urban transport
- Construction of bus/truck terminals
- Redevelopment of inner city areas
- Preservation of water bodies
- Integrated development of slums
- Provision of basic services to urban poor
- Street lighting

Green architects: The constructors of “Green India”

The massive infrastructure development discussed in JNNURM (most of which talk about clean and green technologies) a large scope of architectural profession in India exists at present. India has a plenty of resources for green building moreover Indian climate and economy is suitable for such constructions. Apart from government initiatives, private initiatives in green building is emerging in India as a result several project are in pipeline in cities like Gurgaon, Chennai, Bangluru and Gulmarga. Many professions are associated with green building but Architecture is one of the most important professions. Architectural profession is more sensitive due to the recent surge of interest in energy conservation, climate change, and environmental degradation. With rapid changes in technologies and with easy excess of global best practices, concepts of green architecture are no longer only textbook knowledge — many architectural practices are sensitive to the growing need to adopt methods which are energy efficient i.e. leaving an air gap in hollow walls while building in concrete to using thermocol and polyurethane waste materials in walls and ceilings for energy conservation, and trying more traditional methods like clay shells on the roof, innovation in green architecture are emerging fairly rapidly in many parts of the country. For example, In Gujarat, an architectural firm has devised a method to use glass for sandwiching window blinds in the gap between two panes of glass, and moving these blinds with tiny electrical motors. Similarly, advances in evaporative cooling systems are more feasible for green building which needs good architectures. Further, older methods of building thick walls and high roofs are now not possible because of rising land values, market proximity and demand for energy efficient buildings. Such innovative developments have led to a revolution in architectural practices.

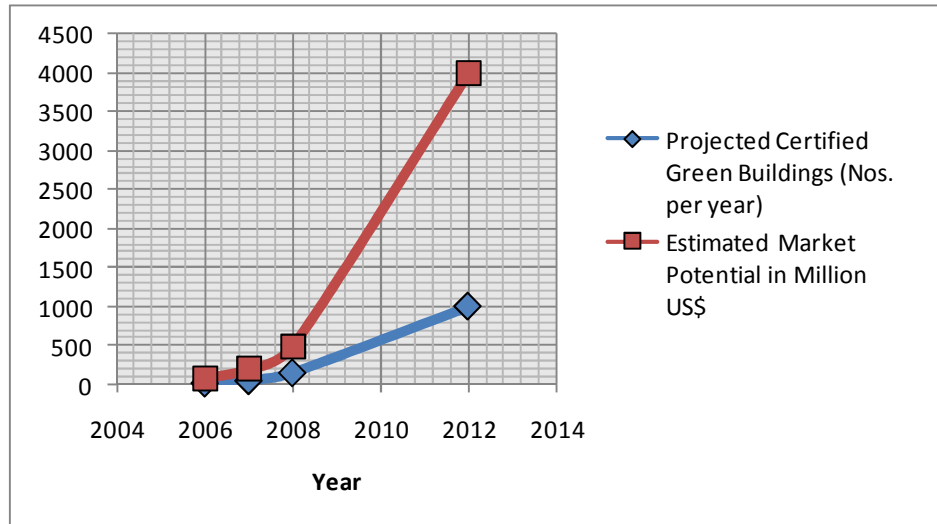
So, experiencing the need of green buildings, IGBC has taken initiatives to promote green building concept in India. The Council is represented by all stakeholders of construction industry - corporate, Government and nodal agencies, Architects, material manufacturers, institutions, media, etc. The vision of the Council is to serve as single point solution provider and be a key engine to facilitate all green building activities in India. Initiatives taken by the council are as:

- Catalyze registration of 1,000 green buildings per year by end 2010
- 5,000 IGBC-accredited green building professionals by end 2010
- Tap green building materials and equipment market of Rs.15,000 Crores (Rs 150 Billion) by 2010
- Tap service opportunities for green building consultants in India and other countries
- Develop LEED India as robust green building rating system

- Enable reduction in cost of constructing green buildings. The ultimate goal is to work towards reducing the cost of green buildings as compared to conventional buildings

It is obvious that there is a significant potential for green buildings in India. This could create an opportunities for several stakeholders like construction industry, architects, material, equipment manufacturers etc in India and abroad. The projected growth potential for green buildings in India is shown in Figure 11:

Figure 11. Projected potential of green building market in India⁴²



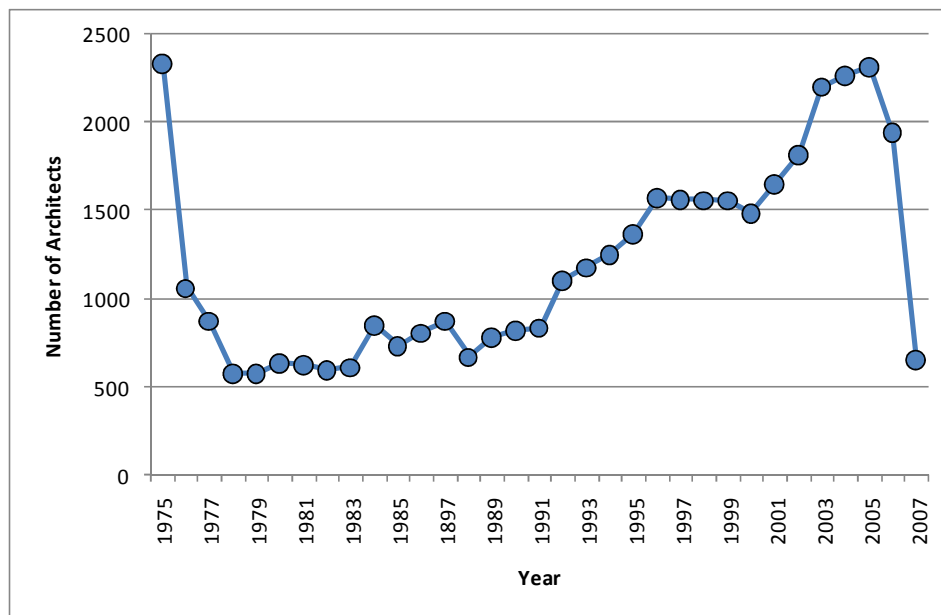
This will create a substantial job opportunities in the country. Currently, there are more than 150 universities, colleges and schools in India⁴³ where both Undergraduate Degree Programmes and Postgraduate Degree Programmes are offered. Some institutions also offer doctoral programmes in Architecture. Total intake capacity of these institutions in 2009 was nearly 9,600. However, registered numbers of architects are less than the total intake capacity as shown Figure 12.⁴⁴

⁴² *Green buildings in India*, Emerging business opportunities, Indian Green Buildings Council, 2008

⁴³ <http://www.coa.gov.in/STATUS.pdf>

⁴⁴ <http://www.coa.gov.in/home/regstats.htm>

Figure 12. Year wise registration of architects in India (as at 1 Apr. 2007)



Skills need

As discussed in the last section there is going to be a several fold demand for the Architects who must be well versed in the “Green Codes”, we need to develop our manpower right from the bottom of the pyramid.

- The present skill sets of a fresh graduate architect severally lack the requirement. For example most of the Architecture schools and Civil Engineering courses taught at engineering colleges seldom teach a course on “green buildings”. There is no dedicated course curricula devoted to green aspect of architecture at present.
- We require dedicated departments in the architecture schools/Engineering colleges on “green buildings” or “green architecture”.
- The conventional Architect does not fit into the shoe of “green Architect”. A green Architect will essentially have the knowledge about the all the aspects like; effect to human health, environmental impact, loss of resources, waste, air/water/indoor pollution, energy/water/material consumption; while designing a building.
- This will essentially require our Architecture schools to have massive expansion in terms of faculty and course development.

Skill gaps and training needs

Figure 12 shows a significant gap between intake capacity and registered professionals. It is a matter of concern which needs attention of the policy makers. Still, green architect is a new profession so it is not possible to identify and quantify green architectural professionals in India. However, a few institutions like Indian Institute of Technology (IITs) have started to offer short term courses on green architect.

As projections show emerging demand of green construction in India and present paucity of architect professional will result gap in future. It may further widen if proper policies are not devised in the directions. Therefore, Ministry of Rural Development and Urban Planning must take initiatives in designing appropriate course in green architect. The following are key issues needs to be addressed in regard to green architectural profession.

- Lack of knowledge of the technology to be implemented, its operation and maintenance
- Lack of knowledge on monitoring of different parameters, quality control of data such as maintaining regular calibration schedule of the meters in line with the requirements of a clean development mechanism (CDM)
- Design details of the technology
- Operation and maintenance
- Understanding of quality control measures
- Optimizing energy performance
- Handling seasonal variation
- Trouble shooting
- Health and safety issues
- Overview of how the system is environmentally responsive
- Monitoring requirements in line with the guidelines of CDM

Policy response

To attract the attention of policy makers and to attract the available skills in the green construction profession, the Government of India has initiated the following policy response:

- Government of India has launched “the energy conservation building code” (ECBC). This code is voluntary and applicable to all buildings or building complexes that have a connected load of 500 KW or a contract demand of 600 Kilo Volt-Ampere (KVA), whichever is greater.
- International rating programmes like LEED (Leadership in Energy and Environmental Design) developed by US Green Building Council
- Energy Conservation Act, 2001 on reduction of energy consumption using efficient and conservation measurements
- Besides, the department, organization, some NGOs and ministries such as Ministry of Rural Development, Ministry of New and Renewable Energy and Ministry of Labour and Employment are making efforts in this direction.

Case Study 2. CNG in Delhi

Tirthankar Mandal, PhD Scholar, Jawahar lal Nehru University, New Delhi

Origin and situation

Based on the Supreme Court (SC) directives, on July 1998, the Delhi Government was directed by the SC to convert the whole of Delhi Transport Corporation (DTC) fleet of buses to CNG by 2001, in response to the Mehta Public Interest Litigation (PIL). During 2001, there were only 350 DTC buses and 200 private operated buses serving the population of Delhi in different routes. By 2008, there has been scaling up of the buses for the DTC and the private owned operators. Subsequent decisions of the government saw scaling up of Government’s fleet of buses run on CNG and also the increasing usage of CNG in the commercial transport for the public. Currently as per the Delhi Government statistics, there are 3,559 CNG buses plying in the road in total and by the middle of 2010, the government are planning to introduce 3,500 more buses. Two companies, Ashoke Leyland and Tata Motors have been given the contract of these buses. Already the first lot of the buses has been seen plying in the road. In all currently there are 10,000 buses ply everyday in Delhi. In addition to these, there are 12,000 taxis and 55,000 CNG run autorickshaws. Based on these developments, there has been a substantial improvement in the

air quality standards in the city, according to the Central Pollution Control Board (CPCB) report, SO₂ has reduced by 57 per cent, and CO has been down by 72 per cent between the period 2000-2008. This drive by the Government of Delhi has set the ball rolling for other major changes in the metro cities of India. Currently at least nine metro cities have been directed by the Supreme Court of India to switch their commercial transport system for masses to natural gas based fuel options. These moves are set to affect the transport sector in positive way towards greening.

Role of technology support

The shift from diesel based mass transport system to CNG has involved a new type of technological change essentially based on the modification of the engines. The largest CNG manufacturing companies have been Ashok Leyland and Tata Motors. Tata Motors has collaborated with the Canada based CNG bus manufacturing company to start manufacturing of fuel efficient buses for its new order received by the Delhi Government. According to the company briefings, these would be advanced Cummins Westport Inc. (CWI) developed CNG engines in the buses, which will be more energy efficient and the new cylinders will be 60 per cent lighter than the old ones⁴⁵. The maintenance and operation of these buses would be carried out by the respective companies from where the buses have been bought for the 12 years since the date of inception. This leaves a number of options for training and retraining and some cases new options for employment.

Workforce

The workforce engaged due to the CNG usage has been a varied one. Currently there are mainly two types of broad classifications where the workforce are engaged in. A major share of the workforce is engaged in the CNG filling stations which have come up a new due to the introduction of the CNG in the city. Currently, there are 367 CNG filling stations in Delhi, and by the year 2010, another 100 are going to be added. In all of the existing stations there are in total 8 points to fill the gas. Each of them is managed by two persons. These stations run round the clock. In addition to these workers, there are two security guards round the clock. This gives a rough of 32-34 people being freshly employed to each of these stations on a contractual basis. In total this creates a total of around 12,500 additional employments just for manning the stations. Further, according to the primary survey based on interviews of the personnel, there are another set of filling stations, which have two filling points and run for 18 hours a day. This adds up to another 10,000 of the employment according to the interviews approximately. The other set of employed personnel belong to the section of mechanics. They are primarily involved in the maintenance of the vehicles and servicing purposes. This involves essentially three types of mechanics, the mechanics for taxis and private cars fitted with the CNG, autorickshaws mechanics, and the bus mechanics. Most of them had actually shifted from the existing diesel based to the CNG system. The transformation of the mechanics to the CNG based autorickshaws is nearly total. Interviewing almost 23 respondent-mechanics show that the number of persons involved in the job runs into nearly 100,000 people in and around the city.

Skill gaps

The current skill gaps have been mainly in the second form of the employment opportunities, i.e. the people who are involved in the maintenance of the vehicles. For the DTC this is not much of a problem in the short run, as the DTC has agreement with the manufacturing

⁴⁵ <http://www.business-standard.com/india/news/tata-motors-ashok-leyland-rush-to-increase-bus-supply/375287/>

<http://www.cleanairnet.org/caiasia/1412/article-70605.html>

http://www.tatamotors.com/our_world/press_releases.php?ID=67&action=Pull

company of the necessary maintenance. However, this is going to be an issue in the long run, as it is learnt that the agreement is for a maximum period of 12 years from the date of inception of the buses. In case of the privately owned buses plying in the city, the major problem is the lack of company authorized servicing centres. Currently there are only few company authorized service centres. Given the fact that there would be a total of more than 10,000 buses in the city running on CNG, plus the recent order by the supreme court that the small trucks and other commercial vehicles plying in the city would have to use CNG as the only source of fuel, the demand for the mechanics is going to rise manifold. Currently though DTC has a contractual arrangement with the companies supplying the buses, the private and commercial vehicles segment is bound to face problem. Therefore, there is need for trained mechanics in this sector who can handle and fix the CNG tools and machineries. Further, there is need for the quality training institutions. The current infrastructure is inadequate for meeting the future demand. There has to be expansion of training institutes on an immediate basis.

The lack of institutional training has opened up the opportunity for mushrooming of country based non-formal training arrangements by the garages and the mechanic shops. The mechanics already know the hand in experience of servicing and maintenance of vehicles. So the generic knowledge remains the same, what they learn from their peers who do the CNG vehicles are the specialties of the CNG engines. It is based on the learning by doing process as most of it is soft knowledge based on interpersonal interactions. However they suffer from proper quality assurances in training. Further, the many of the companies has started the production of the CNG variant of the models—Hundai, Maruti, Honda are to name a few. If the number of mechanics having formal training increases then there is ample scope of employment in near future.

Potential and policy for the future

Those involved in the CNG, needs specialized training in broadly two areas. First, the ones involved in the maintenance of the gas stations, any preliminary services required at the stations, and the second is the maintenance of the CNG run vehicles. The Indian Army has this policy of training its retired personnel under their scheme of training the persons who owns the permit of running of gas stations. The Delhi government has not institutionalized such a training mechanism. In the case of training the mechanics for CNG run vehicles, the ITIs around NCR (National Capital Region of Delhi) has started the training process. But the admissions to those institutes require completion of minimum number of formal schooling years. Since most of the mechanics do not possess that, it would be helpful if this could be modified to aptitude based training courses. The main reason behind such an attempt is that these persons have the basic knowledge of maintenance; the only thing they want is the knowledge and techniques needed for the CNG engines and their maintenance. A pilot project can be initiated by the State Government based on the aptitude based re-training purposes in the city.

Box 9. Recent reports of DTC bus catching fire: Nine incidents in last one month

The Delhi State Government has received a fleet of 950 buses from Tata Motors during this year. The maintenance contracts of these buses were the responsibility of Tata Motors for the next 12 years according to it. However, since last month 9 buses caught fire due to apparently poor maintenance of the buses. Most of these buses caught fire due to technical snags. News paper reports suggested that these snags were mainly in the form of short circuits, and other technical snags. Also some of the reports suggested that there are problems in manufacturing as well. But mostly the government has been pulled by the poor maintenance quality. This is mainly because of the poor infrastructure as well as trained manpower. According to some of the reports in the electronic media, the lack of trained manpower is also a reason for not being able to provide with able hands to address the situation.

Sources:

1. <http://timesofindia.indiatimes.com/city/delhi/Tatas-fined-Rs-4-crore-for-DTC-bus-fires-/articleshow/5338529.cms>
2. http://www.telegraphindia.com/1091215/jsp/nation/story_11865158.jsp
3. <http://www.hindustantimes.com/News-Feed/newdelhi/Another-DTC-bus-catches-fire-manager-suspended/Article1-490341.aspx>

Apart from introducing an aptitude based training programme, it is also required to scale up facilities for training. There has to be an increase in the number of the institutes in and around the NCR region because the government has undertaken a decision to expand the CNG across the region. Therefore, to tackle this situation we need a scaled up supply of trained mechanics.

There is a huge scope of increasing the infrastructure and providing quality services through the proper utilization of the respective automobile company infrastructure. This could be part of the Corporate Social Responsibility (CSR) for the company itself. In Gujarat, the Gujarat Gas Corporation Limited (GGCL) has successfully implemented the process of training the personnel for the making them equipped with handling the CNG vehicles. This is in addition to the existing government infrastructure. Two purposes are being served through this process. First, these arrangements serve in closing the infrastructure gap of the requirement of training institutes. Secondly, it provided the much needed quality services. Because the CNG vehicles use compressed gas, the requirement of properly trained mechanics will be of utmost requirement for shifting towards this fuel. Due to the proximity of large industrial units around the NCR region of Delhi, this venture can be a fruitful one. The likes of Honda, Maruti, etc can be motivated to start the training schemes as part of their CSR activities which would in turn lead to generation of labour force able to provide quality services. In the wake of recent reports of the fires in CNG buses in Delhi, the government should think of these options so that the quality services can be provided for regular maintenance of the vehicles.

In future, quality servicing is going to be the key for a vehicle mechanics. The norms are going to be stricter, with the recent regulations being initiated by the government on air quality. Therefore, we need to ensure that the mechanics get the proper training so that the servicing is proper and this can only be done through formal training process through the training institutes. Thus a training module which can accommodate those personnel who have on hand experience of vehicle mechanics maintenance, could be an important step for future supply of trained personnel in this area.

3.2.6 Case studies on greening existing occupations

Case Study 1. Tanners of West Bengal

Taposik Banerjee, Fellow Scientist, NISTADS

Calcutta Leather Complex (CLC), situated at Bantala, on Kolkata-Basanti highway, 14 km from the Science City, is spread over 1,100 acres of land and is one of the world's largest integrated leather complexes. CLC was set up by M. L. Dalmiya & Co. Ltd on the build-operate-transfer basis in a joint venture with the West Bengal Government. The objective behind the formation of such an integrated leather complex was to bring in greater investments in the leather industry, scientifically and technologically advanced manufacturing and management practices, generation of additional employment and substantial reduction in the pollution load.

Origin of the occupation and the need for greening

Leather and hide tanning is one of the major employment generating occupations in West Bengal; more specifically in Kolkata. There are around 550 tanneries and 2,000 leather goods units in and around Kolkata. Majority of these tanneries were located earlier in Tiljala, Tangra, Topsia and Pagla Danga in eastern part of Kolkata. The technology used in most of these tanneries to process hides and skins and convert them into leather is predominantly traditional. Leather tanning process requires huge amounts of water. In the process at different steps several chemicals are added in the water and leather is treated with the same. At the end of the process

when the waste water is drained along with the harmful chemicals it causes serious environmental, health and hygiene problems.

In a report⁴⁶ of the National Environmental Engineering Research Institute (NEERI), dated 30 Sep. 1995, highlighted the fact that the chrome-based tanning method followed by the tanners in Kolkata along with inappropriate wastewater drainage and collection systems, was causing serious environmental, health and hygiene problems. The report also indicated that the highly congested habitations offered little or no scope for future expansion, modernization or installation of effluent treatment plants.

In December 1996, Supreme Court directed⁴⁷ all inner city tanneries to relocate there production units to CLC. As of July 2007, 433 of 550 tanneries have been allocated land inside the complex. However, till date approximately 260 tanneries has shifted inside the CLC. Several units in and around tangra are still running but only units within the Bantala complex have been given consent to operate by the pollution control board.

The situation of the occupations in leather tanning

In India about 2.5 million people work in leather industry. About 30 per cent of these workers are women. However, in tanning the proportion of women workers would be much less and they are mainly unskilled workers. Approximately 700,000 workers are directly or indirectly employed in the leather sector in West Bengal. After talking to the trade unions we have come to know that direct employment in the tanning process in Kolkata would be somewhere around 25,000. Inside the CLC, this number would be somewhere between 12,000 to 14,000. Leather sector is amongst the top eight export earners for India. India's share in world leather market during 2004-2005 was around 2.5 per cent which makes it eighth largest leather product exporter in the world. Establishment of the integrated leather complex was considered to be a step towards India's goal of capturing 5 per cent of world trade in leather products in near future. West Bengal accounts for almost 25 per cent of the country's leather exports. At the end of 2003-04 the eastern region recorded a 6.3 per cent growth over the previous year. Though in recent years some of the leather products have shown negative growth rates, smaller products like, belts, wallets, industrial gloves etc. have shown positive growth rates. The following table shows India's export of leather and leather products for the last six years.

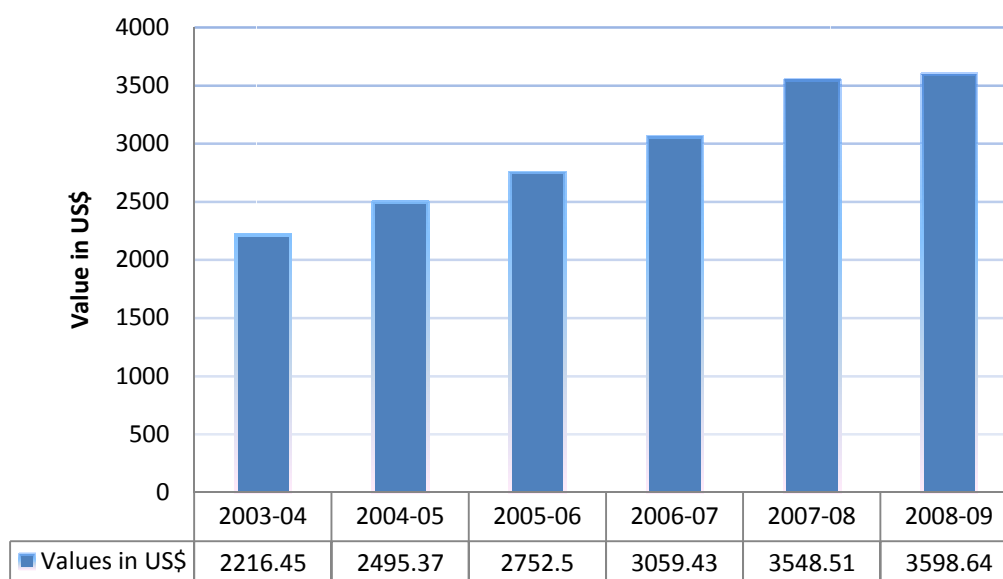
⁴⁶ The NEERI report was referred to in the judgment of the case, M.C. Mehta v. Union of India, WP 3727/1985 (1996.12.19) (Tanneries Case: Calcutta)

⁴⁷ M.C. Mehta v. Union of India, WP 3727/1985 (1996.12.19) (Tanneries Case: Calcutta)

Table 6. India's export of leather and leather products (in million US\$)⁴⁸

	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09
Finished leather	555.71	607.73	636.27	724	807.19	673.37
Footwear	767.73	910.77	1,045.24	1,236.91	1,489.35	1,533.66
Leather garments	301.08	329.44	333.3	309.91	345.34	426.15
Leather goods	539.21	585.72	660.17	706.28	800.46	873.3
Saddlery and harness	52.71	61.71	77.52	82.33	106.18	92.15
Total	2,216.45	2,495.37	2,752.5	3,059.43	3,548.51	3,598.64
% Growth	18.20%	12.58%	10.30%	11.15%	15.99%	1.41%

Figure 13. Export scenario in leather sector for the last six years



⁴⁸ Directorate General of Commercial Intelligence and Statistics (DGCI&S), Kolkata, under the Ministry of Commerce, Government of India

Technology support for greening

Greening methods of the leather tanning industry may fall into three broad categories:

- First category involves use of technologies and equipments that reduces the use of water in the tanning process. The effect of this is twofold. First, water is being used more efficiently. Secondly, as the amount of some chemical to be used in the tanning process is determined as the amount per litre of water, the reduction in the requirement of water automatically reduces the requirement of the chemical.
- The second category involves low-waste technologies which reduce the effluent pollution load by avoiding use of harmful chemicals in the tanning process and produce solid wastes which can be used as by-products. The CLRI is promoting a whole range of technologies that fall in this group.
- The third category consists of technologies related to treatment of waste water. This involves establishment of effluent treatment plants where separation of sludge from the waste water is done and then the waste water is treated in a way that the final water that comes out become reusable.

A new greener and cleaner chemical process could revolutionize the leather-tanning industry. The process known as 'Reverse' leather tanning has been developed by CLRI, Chennai; essentially works backward from the point where conventional tanning ends, saves time, money and energy while drastically slashing water use and pollution. CLRI through its programme has successfully introduced this technique and also provided skill enhancement of the leather industry workers.

The CLRI has demonstrated some environment friendly technologies in selected tanneries. These include:

- less salt curing system,
- sludge-free liming,
- sulphide-free enzymatic de-hairing,
- Ammonia free deliming of hides etc.

Although some tanneries are using these technologies, many of the tanneries are still following the conventional process.

Chrome recovery and reuse is one of the major changes that took place in the tanning process in CLC. The conventional method of chrome tanning results in very poor exhaustion of chrome and adds toxicity to the waste water. The chrome recovery methodology recovers the chrome from the waste water and reuses it. It has been shown that 98-99 per cent of chrome can be recovered by this technology. Tanneries inside the CLC recover chrome before draining the waste water to the effluent treatment plant.

CLC has a state-of-the-art Common Effluent Treatment Plant (CETP) equipped with latest technology. It was envisaged as a six modules project of which four are presently working and treating 20 million litres of water per day. As and when new tanneries come inside the complex, two more modules will open up.

Skill gaps

The biggest skill gap observed for the occupation of tanning is in terms of water use efficiently. Leather industry is a highly water intensive industry and a tanner needs to learn to use

water more efficiently. With only half of all the tanneries moving inside the CLC there is already a huge demand for water. The CLC Tanneries Association (CLCTA) has allocated quota for the use of water to every tannery working inside the complex. The allocation was done on the basis of the production capacity of the units. Most of the units, however, fail to keep their water usage level inside the limits. These units are supposed to introduce new technologies to save both water and energy. Unfortunately, many of them are still following the traditional methods of tanning. As a result not only water is being over used the CETP also has to bear extra load.

The conventional paddle soaking and liming needs to be replaced with drum soaking and liming. This would substantially reduce the requirement of water. As a result lesser amount of chemicals would be used. The biggest barrier to this move seems to be the prepossessed mindset of the producers who believe that the conventional paddle soaking technology is better than drum soaking. A change in the mindset is required for both tannery owners and managers. They need to understand the benefits of the clean technologies.

Every tannery in the CLC needs to have its own chrome recovery system. Recovered chrome can be reused for future production. Maintenance of these chrome recovery plants needs technical knowledge. The maintenance of the Central Effluent Treatment Plant also requires technical expertise. Also there is a clear lack of knowledge among the tanners about the use of cleaner chemicals in the process of tanning.

Training programmes

Apart from offering regular academic and vocational training programmes, CLRI organized on-site demonstration programmes to help the tanners adapt the new technologies. The Council for Leather Exports, India has signed memorandum of understanding (MoU) with the National Association of Italian Manufacturers of Footwear, Leather Goods and Tanning Machinery (ASSOMAC). According to the MoU, ASSOMAC has agreed to part with its expertise for the modernization of tanneries, quality and design improvement, and the development of a leather goods park, a fashion-cum-design centre of excellence, and a training institute for workers in the leather goods industry.

Remarks

It was observed that lack of skills and knowledge about cleaner technologies is not due to unavailability of training programmes but due to the prepossessed mindset of the owners and managers of the industry who fail to realize the benefits of these technologies. In most of the cases simple on-site demonstrations would be sufficient for the workers to adapt to the new technologies. Some sort of awareness drive coupled with strict administrative action to force the owners to embrace cleaner technologies is the need of the hour.

Case Study 2. Green farmers of Meghalaya

Bikramjit Sinha, Fellow Scientist, NISTADS

Globally, agriculture accounted for 10-12 per cent of global GHGs emissions or about 5.1 to 6.1 Gt of CO₂ equivalent (e) per year in 2005 (IPCC, 2007). In India, though agricultural emissions of CO₂ are below 1 per cent of the country's total CO₂ emissions, agriculture dominates emissions of *other* greenhouse gases, accounting for 50 per cent of India's methane (5 million MT) and even a large share of N₂O emissions (0.31 million MT). As on 2000, agriculture accounted for about 34 per cent of total GHG emissions in India⁴⁹. In terms of CO₂ equivalent

⁴⁹ <http://cait.wri.org>

emissions, the contribution of agriculture is estimated to be around 28 per cent as on 2000⁵⁰. Nevertheless, it is hard to find data on the contribution of pesticides (manufacturing to use and after-use) to the total GHGs emission; both globally as well as at national levels because of the non-availability of relevant data. However, according to one of the most recent optimistic estimation⁵¹, global pesticide manufacturing and usage represents about 3 per cent of the 100-year Global Warming Potential (GWP) from crops. Adopting greener pesticides can substantially reduce the overall emission of GHG per hectare of cropped area. This is possible through reduction of GHG emissions associated with the production of chemical pesticides⁵². Amount of energy consumed in pesticide manufacturing accounts for about 9 per cent of the energy usage in arable crops (Audsley *et al.*, 2009). In addition, adoption of greener pesticides would avoid the contamination of natural ecosystems which upset the normal process of carbon-sequestration by these systems, and whose sanitization efforts also lead to emission of GHGs.

Production and usage of biopesticides would contribute to the national economy in more than one way. Manufacturing can be undertaken by existing pesticide firms, thus, greening their occupation. In contrast, new entrepreneurs can begin new start-ups creating also green employment opportunities for others. Next, reduction of crop loss anticipated due to the usage of biopesticides would increase food security, thus reducing malnutrition. Further, the amount of resources that would have been utilized for manufacturing chemical pesticides as well as mitigating its ill-effects will be saved, and can be channelized for other much needed developmental activities such as providing affordable basic amenities to the communities.

- ‘Greening the farming occupation of pest management in Meghalaya’. The case study undertaken here is that of the development of an eco-friendly trap for controlling rice bugs in Meghalaya, India. The technology for developing the trap is available and already in use but needs substantial interventions to ensure its mass usage. This would serve two purposes: increasing crop yield and help reducing GHG emissions from agriculture and related activities.
- Meghalaya is a small tiny state in the north-eastern region of India. It has a dominantly agrarian economy providing livelihood to 70 per cent of the population. By virtue of the traditional nature of its farming practices, use of external inputs like fertilizers and pesticides has remained negligible in the state as compared to the national average rate of usage. However, over the years, demand of foodgrain has increased due to an increasing population. This has seen the introduction of terrace cultivation, a form of settled paddy cultivation, in the state during the 1980s. Adoption of this type of monoculture came along with the associated problems of pests. The crops were attacked by a number of pests, and Rice bug is one of the major pests of paddy. Rice bug (*Leptocoris* sp.) is a serious pest of paddy crop. The pest attacks the standing paddy crop during the milky stage period of 10 to 15 days. Loss by this pest may go up to 70-80 per cent if left uncontrolled. It is encountered both under upland and lowland conditions in Meghalaya. The government response was encouragement of the use of chemicals such as malathion, endosulfan, ‘pheromone lures’, which were provided to farmers at subsidized rate.

Pheromone lures are costly and the communities have to depend on extension workers for their supply. Further, as expected the communities started to realize the impacts of continuous

⁵⁰ Sharma S, Bhattacharya S & Garg A. 2006. Greenhouse gas emissions from India: A perspective. *Current Science*, 90 (3): 326-333.

⁵¹ Audsley E, Stacey K, Parsons DJ & Williams AG. 2009. Estimation of the greenhouse gas emissions from agricultural pesticide manufacture and use. Cranfield University, Cranfield, United Kingdom, 244 pp.

⁵² Paustian, K., B.A. Babcock, J. Hatfield, R. Lal, B.A. McCarl, S. McLaughlin, A. Mosier, C. Rice, G.P. Robertson, N.J. Rosenberg, C. Rosenzweig, W.H. Schlesinger, and D. Zilberman, 2004: Agricultural Mitigation of Greenhouse Gases: Science and Policy Options. CAST (Council on Agricultural Science and Technology) Report, R141 2004, ISBN 1-887383-26-3, 120 pp.

use of pesticides. Their sources of drinking water were contaminated; livestock which are an important supplement to their livelihood and protein uptake started falling sick, and reduction of fish stock in the streams. This made the communities to be innovative and find an alternate means of controlling the pests, mainly the rice bug using decomposing crabs as attractant.

- The traditionally designed trap was not that efficient in that it involved manual removal of the bugs after they congregate on the crabs and constant monitoring of the traps. This drawback somewhat reduced the wide scale usage of the method though it had the potential of controlling the pest below the economic injury level. The trap, however, lacked efficiency and potential of commercialisation because of its very crude nature. There was an opportunity to improve the efficacy of the traditional method of trapping gundhi bugs. For example, in the traditional trap, the bugs are collected and killed manually which does not guarantee the elimination of all insects from the paddy field. Because, the bugs used to fly after their meal and only the bugs those will be feeding the dead crab soup at the time of trapping could be eliminated. Further, the crab needs to be replaced as soon as they dry up as dried carcasses do not attract any bug.
- Shri. KD Kharkongor, an agronomist with the Department of Agriculture, Government of Meghalaya has witnessed both drudgery and helplessness of the communities as well as the potential of the traditionally developed trap for attracting rice bug. He also had the scientific knowledge of how pheromone lures works. He then blended the traditional technique with the scientific one and came up with a new modified low-cost method of using Baffle Traps with dead crabs to attract rice bugs instead of 'Pheromone lures'. Using this technique, an average of 170-180 bugs per trap could be eliminated. When four dead crabs are placed in each trap, a total number of 900-1,000 bugs were recorded in each trap during the entire milky stage to the grain formation stage.

However, the traditional farmers lack the skills necessary for preparing the modified Baffle trap which can be imparted through hands-on trainings. The farmers also lack the exact requirement of the number of traps to be employed per unit area of cropping. The modified trap require careful placing of the crabs in appropriate position in the trap such that the bugs fall down in the below tied sac as they try to fly after their meal.

- This green technology is very simple in construction and operation. Simple hand-on training on construction of the traps, positioning the crab in the traps and the principles of agronomic practices such as the number of traps to be placed in the field based on the level of infestation are needed to be imparted to the traditional farmers which can go a long way in sustaining wide scale usage of this green technology and realisation of sustainable production. Further, this technology has the potential to generate employment by starting up new small enterprises for mass scale production of this trap. This technique has also the potential to be replicated in similar agro-ecological areas at the individual farmer level as well as at the entrepreneur level.
- Impressed by the efficacy of the newly developed trap the Government of Meghalaya has started propagating this technique within the state as a cost-effective method to trap rice bug. This technique has also been incorporated as one of the components of Integrated Pest Management (IPM) for rice bug in the state. The government is also taking the help of NGOs to impart the training to progressive farmers about the procedure of preparing the new and modified trap and its application and monitoring. So far, necessary skill development training has been imparted to more than 5,000 farmers of the state. Though the government has responded with some policy initiatives as mentioned above, more concrete policy measures such as offer of incentives to farmers using the method in the field, are needed to be formulated and implemented to ensure wide-scale application of the method.
- At the moment, information about the impact of skill development trainings, actual implementation by farmers and increase in food grain production could not be ascertained.

Further, information about coming up of new business enterprises based on this green technology is also not available right now.

Case Study 3. Green entrepreneurs in Foundry Sector

*Sanjeev Kumar, Project Co-ordinator, Foundation for MSME Clusters and
Vipan Kumar, Scientist, NISTADS*

Summary

The impetus of Foundry Sector in India was given by machinery manufacturing for Jute Industry in Bengal and textile machine cotton Industry in Mumbai in late 19th century. It is estimated around 4,750 units are operating all over India with total casting output of approximately 7.2 million tonnes consisting of 4.9 million tonnes of Gray Iron casting, 9,14,000 tonnes of steel castings, 62,300 tonnes of malleable iron castings and 7,62,000 tonnes of ductile iron casting (41st Census of World Casting Production - 2006). The industry is labour intensive and employs around 5 lakh people directly and around 1.5 lakh indirectly. India is one of the leading producer of castings in the world. Typically, each foundry cluster is known for catering to some specific end-use markets. For example, the Coimbatore cluster is famous for pump-sets castings, the Kolhapur and the Belgaum clusters for automotive castings and the Rajkot cluster for diesel engine castings. A number of units range from 100 to 700 at different foundry cluster. The foundry produces a wide variety of castings used in Automobile Industry, Flour Mill Parts and Components, Electric Motor, Manhole Covers, Oil engine, Pump sets, Sanitary items, Pipe and Pipe fittings, Sugar Machinery etc. According to an estimate there are 700-800 units in the north India out of which about 500 are on the belt of 400 K.M across the GT road starting from Delhi to Batala in Punjab scattered in and around Delhi, Samalkha, Panipat Karnal, Ambala, Goraya, Jalandhar and Batala. Jalandhar and Batala have the largest concentration of foundry units and are producing agricultural implements as their major (35 per cent) product. Energy is one of the important inputs in the Foundry industry. The present case study will look into how optimal utilization of energy was undertaken and its impact on the labour force in Samalkha, a small town in district Panipat (Haryana). Introduction of an energy efficient divided blast cupola, a technology from TERI and SDC (Swiss Agency for Development and Cooperation) changed the working conditions, reduced occupational hazards and attracted labour force to continue with their job, who otherwise had a shifting tendency.

Of the 97,000 foundries existing worldwide, India accounts for 4,500. 95 per cent of these are MSMEs and the remaining are large units, with the traditional and obsolete technology being in predominant use. There is a potential to save 40,000 Tonnes of coke per annum. It was demonstrated that using a divided blast cupola as opposed to a conventional cold blast cupola could result in these savings. The technology was demonstrated 15 years back but has not diffused in the expected manner. The reasons could be barriers like awareness, investment, technology implementation and a dearth of consultants that could work with the MSMEs. These barriers constitute a weak ecosystem but as has been shown in the Samhalka cluster, the ecosystem can be strengthened. Energy consumption in the foundries was reduced by replacing the conventional cupola by the divided blast cupola and adoption of best practices. Furthermore, to sustain these changes, local industry associations were strengthened, documentation and reporting systems were adapted and linkages with new markets were established. Also stakeholders need to work collectively in order to bring about these changes.

Introduction

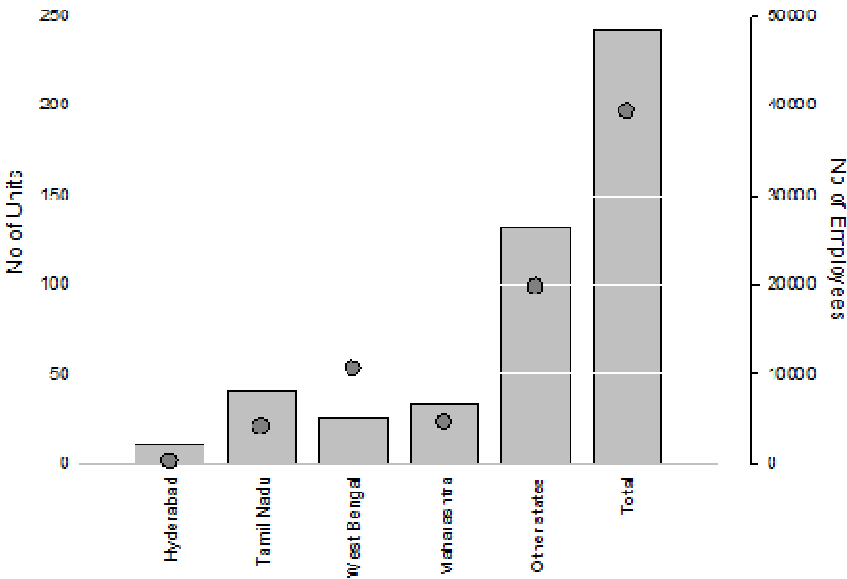
There are an estimated 48,300 foundries globally in the organized sector and together the organized and unorganized sector constitutes 97,000 foundries. Out of total number of foundries, China has 30,000 foundries, Europe around 8,000, India about 4,550 foundries and CIS constitutes 4,000 foundries. Globally the registered units have an estimated production of over 95

million MT per annum. The overall annual production (both organized and unorganized) is around 120 million MT in 2008.

Figure 14. Distribution of foundry clusters in India



Figure 15. Foundry cluster employment trend⁵³



⁵³ UNIDO Report, *Diagnostic Study: SME Foundry clusters in Hyderabad, 2002*

The foundry units in India are clustered in 21 clusters with cluster size ranging from 30-500 units. 95 per cent of the foundries in India are MSMEs and the balance 5 per cent are large units. Out of the total foundries in India, Northern India constitutes around 1350 foundries. **The technology used is traditional and obsolete.** The energy cost comprises of 30 per cent of production cost (70 per cent in melting) through coke, furnace oil and natural gas. One MT of coke melts 4-6 MTs of metal (Best 10 MT). Potential to save coke approx. 40,000 tonnes per annum.

Green entrepreneurs of Samalkha Cluster: A success story

Samalkha is a small industrial town, near Panipat. It has about 30 small / medium size cast iron foundry units, most of them producing castings for 'chaff-cutters'. These foundry units are owned by entrepreneurs mostly from the *Bania* caste (Traders) and the business is running in the families from the three to four generations. These entrepreneurs most of them not highly educated have understood the significance of a shift from the traditional foundries to green foundries. The reasons may be several; though many of them do not understand the environmental consequence; the monetary benefit is the sole motivating factor. Total production in this cluster is about 3,000 tonnes / month and it employs approximately 1,500 workers. The workers are non-technical with traditional and manual methods of production and produce products with poor quality. They used inefficient single blast cupola furnaces and unplanned product mix. The unit owners lack technical knowhow.

Foundation for MSME Clusters, a Delhi-based not profit organization (NGO) took the initiative to modernize the age old traditional technology with the divided blast copula. The funding for the process came through Ministry of Science and Technology.

Figure 16. A comparison of New Blast Copula furnace with the conventional cold blast furnace

Note the slight modification of design at the base of cupola.



Conventional cold blast cupola

Divided Blast Cupola

The technology intervention in this case is the improved design of the cupola with a better design fan and improved efficiency. The following table shows the saving of coke (annual) in Samalkha sector because of the technology intervention. The total amount of CO₂ reduction is estimated to be 1,136 tonnes.

Table 7. Estimation of coal and CO₂ emissions with the technology intervention

Single Blast Cupola (operational improvement)	5	203	20,340,000
Divided Blast Cupola	7	237	23,690,000
Pollution reduced		440 tonnes of coal approx.	1,136 tons of CO ₂
Total	12	440	44,030,000

Skill needs of a green entrepreneur

- (i) The new cupola design cost the entrepreneur around Rs 100,000.00. This was a whopping sum for an entrepreneur to shift his earlier technology. Part of the initial cost was borne by Government of India (Department of Science and technology). They soon understood the benefit as there was a fuel saving of around 40 per cent.

- (ii) The proper measuring technique was part of the training. The earlier technique was traditional and margin of error was large. The new technique had a net effect of saving the material.
- (iii) The poisonous gases do create respiratory diseases which get reduced immensely. They were educated about their well being. Entrepreneurs were encouraged to provide jaggery (raw sugar) to the workers which is a traditional method to reduce the ill effects of poisonous gases.
- (iv) Entrepreneurs were trained to implement proper documentation. Earlier they did not have proper skill for documentation. Therefore they were not able to ascertain their input cost; thereby they are unable to do pricing of the product. As a result the product pricing is the hands of financiers who exploit them to an extent of no margin.
- (v) Entrepreneurs are not aware of the impact of pollution generated by his unit on the environment and also his own health. He is more motivated by the savings due to reduced raw material quantity. Environment related issues were not very significant in their mindset.
- (vi) An expert was identified who provided guidance to the labours on better machine shops – sand mixing, preparing better moulds etc.
- (vii) Initially the labour feared that the suggestions by the expert may not give the appropriate result but the hand holding support and the confidence of the expert made them work as per his suggestions and achieved better results.
- (viii) Expert is made available in the unit during the first run so to provide support in any kind of problem.
- (ix) Charge hands were educated during the first cupola run in every unit.
- (x) Linkages are being established with the institutes like ITI in Panipat to provide trained and skilled labour to the units.

Training and capacity building: Bridging the skill gaps

There is need to develop a cadre of effective development professionals who can apply the knowledge for holistic and inclusive development. MSME Foundation has developed a range of training curricula and runs class and field based training initiatives to bridge the gap. Moreover, through this division, the Foundation undertakes the responsibility of training the trainers to strengthen the capacities of a number of resource institutions in India and abroad to help build their capacities for long term sustenance.

- Conceptualization and implementation of training programmes
- Industrial capacity building for cluster based development
- Capacity building initiatives for industrial associations and non-governmental organizations (NGOs)
- Developing new methodology for cluster development
- Training on product pricing, product quality and product design is required. Presently Foundation for MSME clusters is taking a lead in consultation with the market experts and funding from the government.
- There is a need of dedicated incubation centres for foundry sector entrepreneurs, where they are taught the environmental impacts also.
- They are totally dependent on contractual/traditional workers for the technological aspect.

Findings in the sector

- Substantial reduction in energy from present consumption by approx. 40 per cent
- There is a shortage of manpower in the market.

- No impact on labour in majority of cases. In few cases labour has reduced for increasing the efficiency by mechanization
- Strengthening of eco system of cluster is crucial for its development.
- Prospects of new jobs – technicians, consultants etc.

Case Study 4. Vertical Shaft Brick Kiln (VSBK)

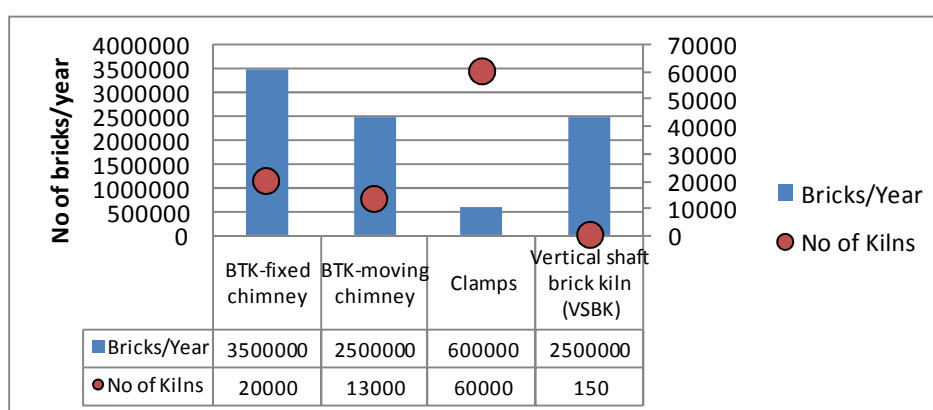
*Vipan Kumar and Naresh Kumar, Scientists, NISTADS
with feedback from Development Alternatives, New Delhi*

VSBK: Greening the fireman's occupation

Origin and the status of greening of the brick industry

Bricks have been used for construction since Indus civilization in Indian subcontinent and use of bricks has gradually increased due to urbanization process in India. Though the process of urbanization is slow and nearly 33 per cent population resides in urban areas in India. Thus demand for bricks for building construction has is increasing continuously. Currently, India is the second largest producer of bricks after China. The estimated brick production was about 160 billion bricks during 2002–2003 in India. The Indian brick industry comes under unorganized sector with small production units clustered in rural and around urban areas. There were around 100,000 authorized production units and more than equal number of rural enterprises in the unorganized sector. As a result brick sector provides direct employment to more than 8 million workers. Evidently, it is the single largest source of employment generation in India in unorganized sector. However most of the engagement is seasonal with around 6 months of employment. Figure 17, shows brick production in India, technologies used and production capacity.

Figure 17. Brick kilns in India



Brick industry is an energy intensive sector and consumes about 30 million tonnes of coal and several million tonnes of bio fuels per year. Coal consumption by the brick industry is approximately 8 per cent of the total coal consumption in the country. The share of energy in total costs of brick production is 35 to 45 per cent. Therefore, fireman role is very important in the firing of bricks in kilns. The choice of technology depends generally on factors such as scale

of production, soil and fuel availability, market conditions and skills available. The brick producing regions in India can be categorized into two major zones i.e Indo-Gangetic and Peninsular; based on nature of soil availability.

Thus the greening of the brick sector in India is a massive process.

Brick industry under fire

The Government of India is aware of the impact of brick industry on environment and growing demand of bricks is a matter of concern. Accordingly, the Ministry of Environment and Forests on 26 Feb. 1992 made a major policy statement with the objectives to prevent pollution at source, and to encourage, develop and apply the best available technological solutions to brick industry. The Central Pollution Control Board (CPCB) studied the pollution problem in brick industry in India and recommended among other things, the following:

- Installation of fixed chimney in place of moving chimney in the existing brick kilns.
- Installation of gravity settling chambers and other pollution control measures
- Increase of height of chimneys etc.

The crucial point in the notification was that moving chimney Bull's kiln operators would have to convert to fixed chimney kilns with some stipulated conditions before 31 Dec. 1997 or find alternative technologies with lower emissions. The deadline given by the Supreme Court kindled a vigorous drive to look for alternative technologies. Thus, the time was ripe for introduction of energy efficient technologies to affect energy savings and demonstrate lower levels of emissions to meet new environmental standards. This led to the birth of Eco Kiln or the Vertical Shaft Brick firing process.

Effect of greening on proportion of existing occupations

In a classic brick industry consisting of fixed chimney Bull's Trench Kiln (BTK) operation, following is the breakdown of the typical workforce involved considering a yearly seasonal production of around 60 lakhs bricks.

Table 8. Workforce requirement for yearly brick production of 6 million

Job description		Number required	Special training requirement
a.	Soil transporters	10-20	Nil
b.	Moulders	80-100	Nil
c.	Transporters	20-30	Nil
d.	Firemen	8-10	Yes
e.	Loaders/un-loaders	20-39	Nil

Eco-Kiln description and working principle

The Eco-Kiln has vertical shaft of rectangular or square cross-section. The gap between shaft wall and outer kiln wall is filled with insulating materials – broken bricks and burnt coal ash. The kiln works as a counter-current heat exchanger, with heat transfer taking place between the air moving up (continuous flow) and bricks moving down (intermittent movement). Green bricks are loaded in batches from kiln top. Bricks move down the shaft through brick pre-heating, firing and cooling zones and unloaded from bottom. The combustion of coal (added along with

bricks at the top) takes place in the middle of the shaft. Combustion air enters shaft from bottom, gets preheated by hot fired bricks in the lower portion of the shaft before reaching the combustion zone. Hot combustion gases preheat green bricks in upper portion of the shaft before exiting from the kiln through shaft or chimney.



Figure 18. A typical eco-kiln



Figure 19. Fireman adding coal to unfired bricks

This process is unique to eco-kiln.

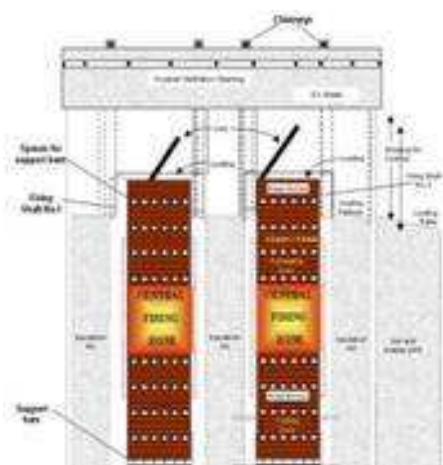


Figure 20. A schematic of eco-kiln



Figure 21. Fireman arranging bricks in the eco-kiln

The brick setting in kiln is kept on support bars at bottom of the shaft. Unloading of bricks is done from bottom of the shaft using a trolley. The trolley is lifted (using single screw mechanism) till the iron beams placed on the trolley touches the bottom of the brick setting and the weight of bricks is transferred on to the trolley. The freed support bars are taken out. The trolley is then lowered by one batch (equivalent to four layers of bricks) – support bars are again put in place through the holes provided in the brick setting for the purpose. With slight downward movement, the weight of the brick setting is transferred to support bars. The trolley (with one batch of fired bricks on it) is further lowered till it touches ground level and then pulled out of the kiln on a pair of rails provided for the purpose. At every 2 - 3 hours, one batch of fired bricks is

unloaded at bottom and a batch of fresh green bricks is loaded at the top simultaneously. At any given time, there are typically 11 to 12 batches in the kiln depending on the green brick quality.

Two chimneys located diagonally opposite to each other in the shaft remove flue gases from the kiln. A lid is also provided on the shaft top which is kept closed during normal operation. Flue gases are directed to pass through chimney thus not polluting working area on kiln top. The provision of shaft lid, better ventilation of working area on kiln top and higher and bigger chimneys are some of the highlights of Eco-Kiln and its related process.

The heating cycle for the green bricks is raw material specific (pre-heating, vitrification and cooling down) and is normally completed within 24-30 hours. A batch of bricks is loaded and unloaded every 2-3 hours; requiring round the clock operations and supervision. This requires special skills and the firing operator needs to maintain a correct balance between:

- Energy Controlled by amount of coal feeding
- Airflow Controlled by stacking density and damper position
- Unloading speed Controlled by the operator

Greening of the brick industry through technological interventions will involve changes in both the soil winning process, green brick fabrication systems and also the firing technology. Thus all of the existing occupations enumerated above will need to change their way of work. There will be a need of greater skills for operations. In some cases like the Eco Kiln, local rural population can be trained for operation creating local jobs also, albeit in a greener way.

Role of firemen in the brick sector

Firemen play a very significant role in the brick industry. Table 8 shows that if the existing brick industry is shifted to the VSBK model, then “firemen” is the only occupation which requires training for the shift from traditional to green. India being the second largest producer of bricks in the world also consumes around 25-30 million tonnes of coal every year. Most of the brick kilns in the present times depend on the use of coal as the principal fuel for firing, moreover the situation will remain more or less same in the coming years too. In India, the use of alternative fuels i.e. gas or high speed diesel does not seem to be a possible option due to the reasons such as: India does not have adequate reserves of natural gas, the use of any other fuels compared to coal are costly, majority of the brick enterprises are small and do not have access to alternate technologies and brick firing technologies using alternate fuels are not suitable for small brick producers due to high capital cost of the same. Thus brick firing in coming years in India and the neighboring sub-continent will be depending on coal and on the existing technologies with demonstration of alternate technologies in selected areas.

Present status of firemen in India

The presence of firemen in India is mostly confined to Uttar Pradesh especially in the areas of Pratapgarh, Rai Bareilly, Varanasi, Allahabad etc. Many of them migrate to the neighboring states such as: Punjab, Haryana, Bihar and some to even Nepal and Bangladesh. There are other states too such as: Gujarat, Assam, Meghalaya among others where the firemen may be found, however skills of these firemen are not properly developed and they do not match the quality of the firemen from UP and neighbouring areas. Thus firemen from UP are the most sought after for brick firing because of the reasons such as: Quality of service provided. In technical and operating terms they provide the most number of Class 1 bricks ensuring enhanced profitability, the firemen from UP move far off places as a result they do not absent or go out of site. This is an important aspect since firing in brick kilns is a continuous process and the presence of the person responsible is crucial. Entrepreneurs are averse to employ local firemen since they often become absent from work due to holidays and personal reasons. The firemen from UP are most

experienced and have the capability to deal with problems that come in firing on a day to day basis and they have a mentality of providing service and are proactive in approaching their clients.

Impact on skills needs change and skills provision

Any technological change in the brick sector will be driven by the business and not actors, the drivers of change are depicted below and would be driven by entrepreneurs:

- With the recent trends, and the future predictions, it is predicted that change in the brick sector will be in the following areas: Increased automation in the entire aspects of brick production with special interest in green brick production and firing, Use of alternate fuels other than coal and Introduction of new firing technologies.
- Consequently a more scientific and industrial nature will come into force in brick firing. Therefore for firemen, the number of jobs will decrease with an increased skills requirement. The knowledge of firing bricks will slowly move towards a more traditional knowledge to a scientific basis. Examples of the same can be seen through the new technologies being increasingly adopted by new entrepreneurs. VSBK is being accepted across the sector as major alternate in brick making. Large industries e.g. Weinburger (the largest brick manufacturer in the world) have already started production using VSBK technology.
- Over the period of time the brick making sector will observe: Creation of a new profession (brick kiln operators) as per tradition with ceramic firing, improved skill development in firemen and supervisors in non-UP areas and up gradation of existing knowledge into a more technical based for existing firemen bases e.g. UP.

Gaps identified in firing profession in India

India is seen as the next ‘big player’ in terms of the available human resource but major problem is the proper planning in terms of capacity building of more and more personnel to take up different skill based jobs. Firing being one among those requiring skill bases, there is very limited opportunity available for the individuals interested to join the sector. It has also been learnt by facilitating the VSBK in the northern regions as well as other regions of the country that there is a huge in terms of a professional approach among the firemen across the country, there are gaps that exist in formal knowledge and ways and means of transmitting the same to young people willing to take up the profession as a source of income. Although there is a large number of unemployed youth to take up this profession, they suffer from lack of knowledge and absence of any proper formal education system or vocational training programmes.

Skill need

Taking lead from what is mentioned above one of the immediate concern area is to change the mindset from “brick kiln firing” to a “Brick Plant Operation”. Change from the mentality of “firemen” to “Kiln operator”. This is possible and can be done through extensive awareness and training programs. Recognition of “Brick Kiln Operation” as a formal or vocational course curriculum is another area that needs to be given importance to promote a certified course for the individuals who are willing to take up this job. Initiation of a formal education system for “Brick Plant Operation” through Rural Institutes, Industrial Training Institutes (ITIs) could be another possibility in the same lines. Development of training manuals, course curriculums, and reference materials will be required to meet the above mentioned options. For improving the existing skill short term courses and on work/job training could be a very fruitful mechanism. These courses or training programme can be conducted by ITIs or NGOs. Further, the Ministry of Micro Small and Medium Enterprise (MSME) must provide adequate number of incubation centres in the proximity of the brick kiln clusters.

4. Conclusions

This project was commissioned to NISTADS under the sponsorship of the ILO to identify major challenges and priorities related to climate change and environmental degradation and the subsequent greening policies and strategies to create a green job environment in India. The study is part of a major programme on “green jobs” by ILO, under which 23 countries are participating. NISTADS undertook this short study to explore potential of green occupations/jobs in India. We collected relevant information and data for the study through (i) meeting with several stakeholders which included, Ministries, trade unions, academia, industry and NGOs; (ii) brainstorming workshop/conference on green economy to understand current scenario on emerging areas related to green technology/occupations and (iii) Case Studies.

The subject of green jobs is at a nascent stage and sufficient literature is not available except a few reports. So, it was understood that by the meaning of “green jobs” is about a job being “green and decent”. According to the recent report² on green jobs all the existing occupations in the world fall in the matrix of four quadrants viz. green and decent; decent but not green; green but not decent and neither green nor decent. The development model based on “green economy” can only sustain if all the jobs converge to “green and decent” occupations.

4.1 Main “greening” shifts in economies and labour markets

India is facing the challenge of rapid economic development and at the same time obliged to the international commitments towards the climate change and environmental issues. The balance can only be maintained if fossil fuel based economy be shifted substantially to the “green economy”. The following are the key issues identified.⁵⁴

- India is basically an agrarian economy with more than 60 per cent of working population engaged in agriculture without vocation skill or below primary/secondary level of education. The yield of crop is also primarily dependent on monsoon.
- A decline of technical/scientific education system requires a massive expansion of human resources in technical education. The process of expansion is already started with the up-gradation of 500 ITIs into centres of excellence (CoE), 15 new Indian Institutes of technology (IITs) and 20 world class universities. Besides, private technical education has taken a several fold growth after the process of economic reforms.
- A severe problem of trained manpower at all levels in the industry. According to Annual Survey of Industries, 86 per cent of the manpower in unorganized (which comprises most of MSME sector). This puts India into a very difficult situation as for as the skill set of workers is concerned.
- A trade-off between development and environment is required.
- Several initiatives related to green economy are discussed in the 11th Plan. The major being *National Action Plan on Climate Change* which have set of eight missions to develop this “green restructuring” of the nation. A complicated network of several stakeholders which includes, Ministries, Departments, Academia, Industry and NGOs to work together.

⁵⁴ Report of the Working Group on Skill Development and Training set up for preparation of XI plan, Government of India, Planning Commission, New Delhi

4.2 Skills implications and development

4.2.1 Anticipation and identification of skill needs

- Since the phenomenon of green economy is still at its incubation stage, very little progress has been made in identifying skill needs. It is not surprising that there are hardly any skill responses in different sectors of the economy.
- There are more than 4,650 vocational training institutes (among them nearly 500 ITIs) in India providing training in several areas of skilled manpower. Out of nine of their programmes, not a single one is devoted to the green technology area.
- 71 million youngsters will enter the working-age population in India due to shortage of skilled people and the talent deficit is already hampering the growth prospects of manufacturing and services sectors.
- The major segments in vocational education and training business in India include the IT education and training, manufacturing (various trade related to Industrial Training Institutes (ITIs)) and hospitality management. Most of employment generated in these sectors fit into the “green jobs” area.
- The massive expansion in the form of capacity building is required as the part of the eight national missions. It has been already understood that implementing the National Solar Mission itself require participation from the several stakeholders (See the network diagramme Figure 10).

4.2.2 Response policies and programmes

Following programmes/policies are in place:

- Eight national missions under NAPCC towards the green economy.
- Twenty initiatives taken recently by Ministry of Environment and Forests towards the sustainable development and green economy (Table 3).
- A thirteen point action plan given in the 11th Plan for Employment in Unorganized Sector, most of the employment being generated in the green aspect of the economy.
- Directorate General of Employment and Training (DGE&T) has initiated several initiatives in skill development through 500 ITIs spread over the country.
- The 11th Five Year Plan report proposed skill development based on Modular employable skills (MES). The target groups of the model are less educated/out of school youth/unemployed/ persons without employable skills, workers who have acquired skills informally and ITIs graduates.

4.2.3 Effective delivery mechanisms

Government of India has formulated several concrete programmes and National Action Plan to ensure effective delivery mechanism at national level. The objectives of these are to integrate strategies for achieving key goals in the context of climate change and environmental degradation on long term basis. Some of the multi-facets programmes are as:

1. **National Missions**, form the core of the National Action Plan, representing multi-pronged, long term and integrate strategies for achieving key goals in the context of climate change and environmental degradation:
 - National Solar Mission,
 - National Mission on Enhanced Energy Efficiency,

- National Mission on Sustainable Habitat
 - National Water Mission
 - National Mission for Sustaining the Himalayan Eco-system,
 - National Mission for a Green India
 - National Mission for Sustainable Agriculture and
 - National Mission on Strategic Knowledge for Climate Change.
2. **National Rural Employment Guarantee Act (NREGA)** is an Indian job guarantee scheme, enacted by legislation on 25 Aug. 2005. The scheme provides a legal guarantee for one hundred days of employment in every financial year to adult members of any rural household willing to do public work-related unskilled manual work at the statutory minimum wage of Rs.60 per day. The Central government outlay for scheme is Rs. 39,100 crores (approx. US\$8 billion) in FY 2009-10. Keeping in view that most unskilled workers at the grassroots level work in primarily “green occupations”, this scheme has a massive implication.

3. National Knowledge Commission

School education

- Under the Scheme for Universal Access and Quality at the Secondary Stage, 6,000 high quality Model Schools are being set up, with at least one school in each Block. The first stream will consist of 2,500 public funded schools (2,000 in KVs and 500 in NVs template) in the Educationally Backward Blocks which have a significant SC, ST, OBC and minority population. The second stream of about 2,500 schools would be set up through Public Private Partnership in other Blocks with emphasis on geographical, demographic, gender and social equity. Modalities for the remaining 1,000 schools have yet not been finalized.

Vocational Education and Training (VET)

- For expansion, redesign and quality enhancement of VET in the country a three tier structure has been constituted in July 2008 under the National Skill Development Mission (NSDM) consisting of:
 - a) National Council on Skill Development: The functions of the Council under the Prime Minister would be to lay down policy objectives, strategies, financing and a governance model to promote skill development.
 - b) National Skill Development Coordination Board: The Board will enumerate strategies to implement decisions of the Prime Ministers National Council on Skill Development. It would develop operational guidelines and instructions for meeting larger objectives of skill development needs of the country and also make appropriate practical solutions and strategies to be adopted by the Union and State Governments.
 - c) National Skill Development Corporation: It will develop a system of institutionalizing measures to this end.

Higher and technical education

- To expand capacity and improve quality of higher education, the Government has sanctioned the setting up of 15 new Central Universities and 14 new Universities based on world-class standards.
- The Government is in the process of setting up eight Indian Institutes of Technology (IITs), ten National Institutes of Technology (NIT), 20 Indian Institutes of Information Technology (IIITs) as far as possible in the Public-Private Partnership mode, three Indian Institutes of Science Education and Research (IISERs), seven Indian Institutes of Management (IIMs) and two Schools of Planning and Architecture (SPA).

- The Committee for Rejuvenation and Renovation of Higher Education has been set up for the review of UGC/AICTE.
- The Science and Engineering Research Board Bill 2008 has been introduced in the Parliament.
- The National Mission on Education through Information and Communication Technology (ICT) has been launched to leverage the potential of ICT in the teaching learning process with an aim to enhance the GER in Higher Education by 5 percentage points by the end of the XI Plan. Under this Mission 20,000 institutions of Higher Education and nearly 10,000 University Departments will be provided connectivity, beginning with a minimum of 5 Mbps for each one of them. The Central Government will bear 75 per cent of the connectivity charges for 5 years, even for institutions not belonging to it. The estimated cost of the Mission is Rs. 4612 crore.

5. Recommendations

5.1 Policy recommendations

1. There are several ministries and departments working mutually exclusively on the issues of green economy. For example Ministry of Labour, who should be in forefront of the “green jobs” mission have just ventured into the process of green occupations. Similarly, Ministry of Human Resources is participating in National Solar Mission. There is a requirement of a single umbrella Ministry/Department (e.g. Ministry of Energy) under which all other ministries/departments related to “Greening Economy” report. Since most of the ministries are working independently so, there is a need for co-ordination among different such ministries and organization.
2. Trade unions are aware of consequence of “green economy”; but they have a vague understanding of “green jobs”. During the interaction with one such trade unionist, it was observed that their understanding about green jobs was limited to information technology related occupations. Therefore educating trade unionists is necessary as they are the better channels to convince the labour engaged in organized sectors.
3. A green job audit may be carried out in each industry and department. The identified green job holders may be recognized by some code (i.e. green uniform). This will immediately kick start the culture of green jobs in every segment of job markets.
4. To start with all the jobs in Public sector/Public funded institutions may be classified into the four quadrant system as discussed in the first chapter. Further the effort (funding) required to shift one job to “green and decent” category may be estimated on priority basis; and target the shift in next plan period (2012-2017)
5. In some cases it was observed that the owners and managers of industry with their prepossessed mindset fail to realize the benefits of the clean technologies. In such cases it would be useful to initiate some organized awareness drive along with training programmes.
6. Strict administrative steps towards establishing and enforcing standards could be essential to force unwilling entrepreneurs to adapt green technologies.
7. Providing incentive through appropriate pricing strategy could be a way for the market to respond in favour of a green economy.
8. In social sectors like health and sanitation it would be essential to first generate awareness among the masses. For that selecting and training local people as motivators would be essential.

5.2 Recommendations for education and training

India is a country with largest youngest population in the world, comprises nearly 24 per cent population in the age group 5-14 years as per 2001 population. Most of this population is deprived of schooling and other vocational skill due to lack of proper resources. It needs comprehensive strategy to bring all the population to school and to improve their skill through vocational training. Since India has a large network of ITIs spread over the country. So to meet the future challenges regarding environment protection and adaptable to green jobs related occupations, India needs:

- Restructuring of syllabi and curriculum of ITIs and polytechnics to suit the green economy, as presently there is hardly any course or programme on the subject
- Identification of emerging requirements of training pertaining to green occupations

- Improving effectiveness, efficiency and relevance of training
- Emphasizing skill development in unorganized sector as more than 23 per cent of the male and 40 per cent of female population in unorganized sector is below primary level. The combined figure for below secondary is still more alarming as more than 83.5 per cent of the workers fall in this category. This situation is extremely disturbing as the vocational skill development programmes start after secondary level
- Again same situation prevails at higher level engineering and technology institutions as there is no comprehensive programme/curriculum on green technologies, except few initiatives by some IITs and TERI. It would be imperative to establish new units/department/faculties at higher technical institution preferably compulsory
- Training of Instructors / Trainers in the new environment.
- Facilities for lifelong learning
- In several sectors in the economy in the absence of formal training programmes people have developed informal on-site training initiatives. These people now have on hand experience of newly adapted green technologies. Their knowledge and experience can be very useful for the nation. Establishment of formal training programmes is necessary with a mechanism to accommodate these personnel.
- While several institutions have already began offering short term courses on green architecture, it is important to include these courses in the syllabi of formal architecture courses.

5.3 Recommendations for further research and data collection

To address issues of skill development needs an integrated policy framework for the existing traditional knowledge in conjunction with stakeholders across different ministries, the private and NGO sectors. Ministry of Labour could be a nodal agency however; expertise from International Organizations could be invited. This may future course of action and strategies to stimulate training for the unorganized sector in particular. Moreover, short term courses in ITIs and vocational institutions for school drop-outs, unorganized sector workers should be introduced. This will be helpful to provide facilities for the life-long learning and continuous up-gradation of skills. To ensure quality of training State Governments who have administrative control of the ITIs should take necessary measures for starting courses. Therefore, to identify niche areas in green economy the Government of India must review the syllabi to meet local environment needs in consultation with the state governments. Further, comprehensive research is required to study the impact of green jobs on environment and climate.

As discussed, no formal data and information is available in India so relevant data may be collected by sample survey only. Sample survey is beyond the scope of the present study due to the paucity of time. However, data may be in the scattered form with the various concerned institutions and organizations. Since, there is no common platform for integrated data but In future empirical data may be available.

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