



# INSTEK

**A national network for**

**Indian-Swedish Cooperation  
on Technical Research and Education**

announces a

**Mobile Workshop**

March 30 to April 6, 2008  
at three different locations in India,  
Hyderabad – Pune – New Dehli

The workshop will focus on the aspect of sustainable urban development, comprising system and technology aspects. Sustainable urban development comprises areas of energy, transportation, water, sewage, waste and ecosystem services.

The purpose of the workshops is to:

1. Make a benchmarking of the present status of research in the field of sustainable urban development in Sweden and India
2. Determine joint research and/or development projects of mutual interest that can be funded by Indian and Swedish agencies
3. Form an Indo-Swedish platform/network of actors in the field of sustainable development and environmental technology, consisting of universities, government institutions and private industry.
4. Investigate the possibilities of establishing regional focal points for Indo-Swedish cooperation within sustainable development and environmental technology.

# Report from INSTEC tour to India 29/03-2008 – 15/04-2008

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## Background

The effects of the globalisation process are leading to the movement of people, capital, goods, services, information and technology across regional and national borders, resulting in a growing global competition. Investments in R&D are also becoming more and more internationally mobile seeking the regions and countries that offer the best conditions. This means that not only production and services are outsourced, but also research. Companies that wish to carry out research can now establish facilities in any part of the world and they are more prone to base their decisions on available local capabilities, costs and availability of qualified researchers. The development of new knowledge and innovations is increasingly taking place in different partnerships between research organisations and enterprises in different countries. Cross-border flows of research and development are now changing from USA, Europe and Japan towards emerging economies like China, India and Brazil.

Industry and the business community need incentives to collaborate in research networks and better information about how such collaboration can be brought about. If Sweden shall be able to continue to compete successfully in a knowledge-based economy, it is of fundamental importance that Swedish research and education are of world class.

With its emerging economy and a rapidly growing technical base, India is becoming an increasingly interesting potential partner in the area of education, research and joint ventures. The traditionally good technical educational level, neutral geopolitical positions and more recent significant technological advances in the two countries, point to many potential areas for active and fruitful collaboration between India and Sweden.

In this context it is of particular importance to point out that collaborations within science and technology are based on long term interests and can act as doorways for contacts between industries. Expansive and knowledge-intensive industries, traditional industries and the public sector all need access to new knowledge in order to develop technological innovations and modernize their operations. Research provides the basis for developing new knowledge.

On its path of rapid economic growth, India has a unique opportunity to become a leading nation in environment technology and system solutions for sustainable development. Several facts make India potentially a strong force in implementing innovative approaches for sustainable development, taking into account its great biodiversity, variety of its climatic and other conditions, and huge human capital but relatively lean per capita natural resources, on the basis of its increasingly powerful technology and economy. Sweden and India can be viewed as natural partners in the global effort towards sustainable development. Sweden has a unique tradition among the industrialized nations regarding development and implementation of environment technology. The particular strength of the Swedish model, which maintains a balance between state, industry and basic research, is striking. India can expand its know-how by its collaboration with the Swedish experts and in turn offer them the benefit of Indian experience and tacit knowledge. An active collaboration can lead to breaking new grounds in developing and implementing technology for sustainable development on a large scale.

Sustainable Development is an overreaching goal for Swedish Government policy and the Swedish Policy for Global Development clearly emphasizes sustainable use of natural resources and protection of the environment.

In December 2005 Sweden and India signed a Memorandum of Understanding (MoU) on cooperation on Science and Technology. Another MoU on sustainable development and environment will be signed in February 2008. These agreements form a basis for the Indo-Swedish cooperation through the Swedish network **INSTEC (Centre for Indian-Swedish Cooperation on Technical Research and Education)** with the aim to provide a long-term basis for expanding exchanges of human resources between India and Sweden on technical/engineering research as a platform for joint ventures and expanding industrial collaboration. The three specific objectives of INSTEC are to:

- Promote and support collaboration between Indian and Swedish academic/research institutions and industry in **research** (development of joint research projects, exchange of researchers/ post-graduates, etc).
- Promote and support exchange between Indian and Swedish academic/research institutions and industry in **education** (MSc, continuing and distant education programmes, exchange of students, teachers and teaching materials)
- Stimulate and help establish **industrial contacts** and promote **joint ventures** between interested Swedish and Indian enterprises and research institutes in all areas of technological and natural resource development.

INSTEK aims at collaboration between India and Sweden in all areas of mutual interest and benefit, creating competitive cross-boundary research environments taking advantage of the international competitiveness of Swedish and Indian industry to create value for users. In 2006 it was decided that the network should start within the area of sustainable development and environmental technology followed by other areas in due time.

In order to take better advantage of this potential for both countries, and significantly expand the collaboration over the next decade, we proposed the following actions for future cooperation with India to enhance sustainable development and cutting edge environmental technology for mutual benefits:

- *To establish a platform in India for the Swedish network INSTEK*
- *To conduct a Mobile Workshop (Road-show) visiting 3-4 Indian cities*
- *To develop an Indian counterpart network on Sustainable Development and Environmental Technology including the establishment of regional focal points for Indo-Swedish cooperation*
- *To participate in the creation of an academic research/development centre at an Indian IIT or University focussing on Sustainable Development and Environmental Technology*
- *To Carry out Indo-Swedish workshops on environmental technology and sustainable development, as step-stones towards the Millennium Development Goals*
- *To work for the development of an Indian Institute for Sustainable Development and Environmental Technology (IISDET)*

#### **Areas considered for cooperation and joint projects/activities within the environmental sector.**

Through contacts between Sweden and India during 2006/2007 a number of areas of importance, within sustainable development and environmental technology, both for India as well as Sweden have emerged.

However, in order not only to focus on details and technicalities it is important to apply system approaches to the environmental problems and their solutions. It is proposed that also broader concepts are developed like **Sustainable Urban Development** including for example the Sustainable City concept where all environmental technologies are systematically applied.

The intention is to start with the Urban Environment since this includes most of the more specific environmental problems to address. This does not, in any way, exclude in depth research within specific topics identified by Indian and Swedish partners. As areas of interest for further development the following have been identified:

#### **Waste management**

Clean technology: Clean production and waste minimisation

Hazardous waste: Recycling, E-waste, landfills – remediation

Industrial waste management

Municipal waste management: Recycling, management plans, integrated systems

Incineration

**Water management**

Surface water: IWRM, river and lake pollution

Ground water: soil and ground water contamination and remediation

Ground water resources management – quality and quantity

Waste water: Municipal wastewater treatment

Decentralised waste water treatment technologies and systems

Industrial wastewater treatment

**Energy**

Energy production

Renewable energy: Wind-, solar-, wave-, water-, geothermal-,

Energy from waste: Incineration of waste, biogas from waste and wastewater sludge

Bio-fuels

Energy management:

Municipal energy management, energy saving

**Air pollution**

Pollution abatement – strategy development and monitoring

Interventions related to climate change

**Ecosystem services**

Ecosystem services are the free services provided by nature that benefit human beings, but these services are presently being exploited in unsustainable ways.

**Our way forward - To conduct a Mobile Workshop (Road-show) visiting 3-4 Indian cities**

The network decided that sustainable development and environmental technology will form the first area of cooperation with India. KTH and IVL jointly agreed to act through, the centre CUH, as a coordinator for the INSTEC activities. A set of meetings has been held during 2007 and 2008. Following the discussion within the network, funding agencies and our contacts in India it was decided as a first step, to organise three workshops at three different places in India during the week March 30 to April 6. The cities chosen were Hyderabad, Pune and New Dehli. The mission was extended with a visit to Trivandrum upon an invitation from the Kerala Government. Five participants were able to join this visit.

The workshops focussed on sustainable urban development, comprising system and technology aspects. Sustainable urban development comprises areas of energy, transportation, water, sewage, waste and ecosystem services.

The purpose of the workshops was to:

1. Make a benchmarking of the present status of research in the field of sustainable urban development in Sweden and India
2. Determine joint research and/or development projects of mutual interest that can be funded by Indian and Swedish agencies
3. Form an Indo-Swedish platform/network of actors in the field of sustainable development and environmental technology, consisting of universities, government institutions and private industry.
4. Investigate the possibilities of establishing regional focal points for Indo-Swedish cooperation within sustainable development and environmental technology.

**Members of the Swedish mission were:**

**Prof Per Angelstam**, School for Forest Engineers Faculty of Forest Sciences, SLU

**Tomas Aronsson**, International Collaboration and Networks Division, VINNOVA

**Göran Baurne**, Dept. of Land and Water Resources Engineering, KTH

**Prof Christer Bengs**, Dept. of Urban and Rural Development, SLU

**Assoc Prof Hans Blomkvist**, Dept. of Government, Uppsala University

**Assoc. Prof. Philip Chiverton**, International Secretariat, SLU  
**Dr Peter Hagström**, Dept. of Energy Technology, KTH  
**Prof Rajni Hatti-Kaul**, Dept. of Biotechnology, Lund University  
**Dr. Stefan Jonsson**, (ITPS, Embassy of Sweden, New Delhi  
**Prof Björn Karlsson**, Dept. of Architecture and Built Environment, Lund University  
**Prof Hans Lundberg**, IVL Swedish Environmental Research Institute  
**Prof Lars-Christer Lundin**, Dept of Earth Sciences, Uppsala University  
**Prof Bo Mattiasson**, Dept. of Biotechnology, Lund University  
**Dr. Baboo M. Nair PhD**, Dept. of Applied Nutrition, University of Lund  
**MSc Lennart Nilsson**, Industrial Ecology, KTH  
**Dr Sven Nimmermark**, Dept. of Agricultural Biosystems and Technology / Rural Buildings, SLU  
**Dr Jonas Röttorp**, IVL Swedish Environmental Research Institute  
**Prof Seshadri Seetharaman**, Dept. of Materials Science and Engineering, KTH  
**Prof Ramon Wyss**, Nuclear Physics, Advisor to the President, KTH  
**MSc Josefin Wangel**, Dept. of Urban Planning and Environment, KTH  
**Dr Lars Öberg**, Dept. of Chemistry, Umeå University

SLU - Swedish University of Agricultural Sciences  
 KTH - Royal Institute of Technology  
 VINNOVA - Swedish Agency for Innovation Systems

### The Hyderabad workshop



Host in Hyderabad was CII - Sohrabji Godrej Green Business Centre and the workshop took place in their excellent premises at CII - Sohrabji Godrej Green Business Centre on March 31. After the workshop a visit to the Jawaharlal Nehru Technological University was made. On April 1:st there were some possibilities for private meetings between the Swedish participants and Indian colleagues.

### **Workshop programme**

0930 hrs - 1020 hrs: Inaugural Session

0930 hrs	Welcome Remarks	Mr S Raghupathy, Senior Director & Head CII - Godrej GBC
0940 hrs	Indo - Swedish Cooperation on Technical Research and Education	Dr Ramon Wyss, Head - Swedish Delegation, KTH
0955	Special Address	Mr Ramesh Datla, Chairman, CII SME Forum & Managing Director, Elico Ltd
1015 hrs	Concluding Remarks	CII - Godrej GBC
<u>1035 hrs - 1305 hrs: Sustainable Development and Environmental Technology</u>		
1035 hrs	Opening Remarks by Session Chairman	
1040 hrs Univ.	Hydrological Modeling and water management	Prof. Lars - Christer Lundin, Uppsala
1100 hrs	Ecosystem Services Prof.	Per Angelstam SLU
1120 hrs	Energy & Building Design, Solar Energy	Prof Bjorn Karlson, Lund University
1140 hrs	Remediation of toxic chemicals in waste water	Prof Bo Mattiasson, Lund University
1200 hrs	Initiatives by CII - Godrej GBC Counsellor, CII -	Mr K S Venkatagiri, Principal Godrej GBC
1220 hrs	Presentation	Dr Vishal Garg Indian, Institute of Information Tech, Hyderabad
1240 hrs	Question & Answer Session	
1300 hrs	Lunch	
<u>1350 hrs - 1600 hrs: Sustainable Development and Environmental Technology</u>		
1350 hrs	Presentation Manager	Dr Razia Sultana, Scientist C & Capacity Building, EPTRI, Hyderabad
1410 hrs Rao	Presentation	Dr K Mukkanti & Dr B Venkateshwara Jawaharlal Nehru Technological University, Hyderabad
1430 hrs	Question & Answer Session	
1440 hrs	Group Discussion (Areas of joint interest, E.g. Water and sewage, ecosystems, systems studies and sustainable city, energy and waste) and Concluding Session	
1540 hrs	Tea Break	
1600 hrs	CII-Godrej GBC Building visit & Close	

### **Workshop notes – INSTEC Mobile Workshop I**

31 March 2008

CII – Sohrabji Godrej Green Business Centre, Hyderabad

The first out of three workshops was hosted by the Confederation of Indian Industry (CII) who also, in cooperation with IVL, had put together the programme for the day. The participants coming from different kinds of organizations, namely universities, research institutes, industry and NGOs actively involved in presentations and discussions. Altogether nine presentations were made, out of which five were held by Indian representatives. More information on the presentations can be found in the draft programme.

During the workshop a number of areas of particular interest crystallized. These were

- **Green buildings**  
The green building movement is rapidly growing in India. At the time of writing, close to 200 green buildings are coming up. The area of green buildings includes technologies, building materials, rating and certification systems and incentives.
- **Water issues**  
Being one of the more acute problems in India, different aspects of water issues repeatedly came in focus during the day. Water scarcity, whether this depends on an actual shortage or managerial problems, and sanitation was discussed. Sweden has a long history of water treatment and management and should be able to export both knowledge and technologies.
- **Eco-technologies**  
To some extent included in both of the aforementioned areas, eco-technologies was also discussed in other fields such as ICTs, biodegradation, biogas production and infrastructures. There was a clear demand for best practices-transfer and demonstrations projects (in India).
- **Research, education and training**  
Joint research and/or educational programmes were of interest to all parts. Furthermore, capacity building by training and education for professionals and the general public was demanded.

Other issues that were raised during the workshop was ways of funding projects and the need of actively including more stakeholders in development projects, i.e infrastructure organizations, NGOs and civil society.

Altogether the workshop seemingly was rewarding for both Indian and Swedish participants. A number of areas of joint interest were identified and somewhat elaborated and many interesting contacts were made. The host organization CII would gladly collaborate with INSTEC to identify partners for co-operation.

### **Conclusion from the Hyderabad workshop**

The workshop generated a number of contacts between Swedish and Indian scientists and ideas for future cooperation.

As stated above, CII- Godrej is interested to take on a position for coordinating activities in the region as a focal point.

The Andra University in Visak is very interested in starting up a cooperation with Instec.

The city of Hyderabad is most probably interested in a future cooperation/twinning with a Swedish water company regarding water supply and sanitation development.

Fyll på med mera möjliga ideer

### **The Pune workshop**





Host in Pune was Department of Environmental Sciences and International Students Centre at the University of Pune. The workshop took place on April 2:nd while on the 3:rd, a meeting with the Maharashtra Chamber of Commerce was held as well as a visit to the College of Engineering in Pune.

The programme for the workshop.

Time	Particulars
9.00 to 9.30 am	Registration and Tea
9.30 to 10.30 am	Inauguration Welcome Speech by Prof. Vikram S. Ghole, and Speech by Prof. Ramon Wyss regarding the purpose of the workshop etc. Followed by vote of thanks
10.35 am to 1.00 pm	Technical Session I
1.00 to 2.00 pm	Lunch (typical Maharashtrian style)
2.00 to 4.00 pm	Technical Session II
4.00 to 4.30 pm	Tea Break
4.30 to 5.30 pm	Discussion / Feedback session
5.30 to 6.30 pm	Individual Interaction

The workshop started with a number of presentations in plenum and this block was then followed by two sessions where three group discussions took place focusing on different subjects. During these group discussions also presentations were made by the participants. The discussions from these sessions are described separately below.

In plenum 5 presentations were made:

1. Prof. Ghole presented the history of the University of Pune.
2. Prof. Wyss described the background on how Instec was formed and the aims of the network.
3. xxx spoke about sustainable cities and how the high growth have made the situation critical and the great need for good governance, democratization of city management, introduction of ecosystem approaches.
4. Prof. Daxxxxxxxx spoke among other thing of how Pune have become a very polluted city due to this unplanned growth.
5. Prof. Lundberg presented the new Swedish concept for sustainable city development called "Symbiosis City". The concept has been developed by the Swedish Trade Council to present Swedish knw-how in this area and to market Swedish industry active in this field.

**Summary of group discussions in Pune over the topic Wastewater and solid waste.**



It is obvious that there are many problems within these fields in India. It was soon realized that two types of problems are dominating:

- lack of management and resources
- lack of knowledge

The latter one is the part that was focused on in the discussions, even if complaints about poor management appeared every now and then.

Solid waste was divided into municipal solid waste and industrial waste.

When a similar discussion came up concerning wastewater, the general opinion from the Indian side was that the municipal wastewater is the major problem, while industrial wastewaters were attracting less attention. When analyzing this issue a bit closer, it soon became obvious that the municipal wastewater problems were due to lack of management, while the industrial wastewater problems are due to lack of knowledge.

Today there are few dedicated treatment plants for handling industrial wastewater. It is often mixed with municipal wastewater. This situation is not good. Specially designed treatment plants at the site where the wastewater is generated would be far more efficient.

When discussing water, freshwater for human consumption turned out to be a hot topic. Besides huge losses of water in the distribution system, there is also a lack of quality. Since the piping system is operating under reduced pressure, pollutants from the surroundings, e.g. wastewater is sucked into the piping system.

It was also concluded that the raw water that is used for producing drinking water often is contaminated with heavy metal ions, pesticides and other recalcitrant pollutants. Many of the pollutants are present in trace concentrations but since they are not properly removed, the population will get exposed to the pollutants over long time, and therefore the situation is problematic.

The piping system and sanitation were two big problems that need to be addressed.

To build trust between customers and water distributors, one could consider the possibility of doing frequent analyses of the water, and also to have an analytical kit to analyze the sample at the tap.

In the area of solid waste it was obvious that there are needs almost everywhere. Poor management was one factor, but there is also need for more and new knowledge.

Electronic waste was identified as a future problem area where there are no good treatment strategies. Concerning organic waste it was discussed to digest it anaerobically in order to produce biogas and a biofertilizer. Much can be gained from the Swedish waste management organizations with regard to collection and biocells where the waste material is placed on a well prepared site (to avoid leakage to the ground water) and when the pile of waste is full, then it is covered. Anaerobic conditions will lead to formation of biogas, and that can be pumped out via a tubing system that was placed in the garbage heap when it was formed. The biogas can be used for electricity generation. Since one is sucking out the gas, there may be risks of sucking air into the biocell, and then nitrogen will be present in the biogas formed. The small amounts of oxygen that is introduced will be rapidly consumed within the pile.

Recycling of material when that is possible should be favoured. It was discussed if one could use some material for making building materials. However, no expertise in this area took part in the discussion, and the question was left unanswered.

Waste handling places occupy large areas and they fill up rapidly. It was discussed a possibility to do landfill mining, i.e. to dig out old sites and to sort the material. In most cases all organic material is gone (maybe except for wood) and one could foresee that mineral material could be separated from plastics and maybe metals. The recovered space could be reused as waste handling place (upgrade it to waste handling place from garbage dump!).

One needs to introduce treatment of leachate from waste deposits. Such waters are often very complex and difficult to treat.

Sludge from wastewater treatment plants need to be digested for volume reduction, sludge stabilization and biogas production.

Some specific industrial waste waters were discussed: Textile industry is producing large quantities of polluted water, and the ethanol distilleries are releasing large quantities of water polluted with persistent coloured products.

A range of possible activities could be identified:

- Training module for WWTP personnel
- Recovery of heavy metals from electroplating etc.
- Inventory of POP in wastewater (ANALYSIS)
- Water for consumption - analysis before treating. Analysis at the tap
  
- Water management course for management for reducing water losses
- International training programme
- Waste deposits
- Leachate treatment
- Land farm mining
- Sludge to biogas
- Process optimization
- Phytoremediation
- New building materials from waste material
- Sanitation
- H<sub>2</sub>S-removal from sludge treatment
- Removal of coloured products from alcohol distillery waste/paper mill
- Electronic waste

One can summarize that we had lively discussions and there are obvious points of interaction between Indian scientists and their Swedish counterparts.

### **Summary of group discussions on Energy Systems, University of Pune, 2nd April 2008**

#### Background

The workshop in Pune was part of a mobile workshop in Hyderabad (31st of March), Pune (2nd of April) and Delhi (4th of April) arranged by INSTEC and Indian partners at the spot.

#### Participants:

Dr Peter Hagström, KTH  
 Dr Hans Blomkvist, UU  
 Prof Björn Karlsson, LU  
 Dr Lennart Nilson, KTH  
 Prof Sven Nimmermark, SLU  
 Prof Praveen G. Saptarshi, Dept of Environmental Sciences, University of Pune  
 Dr S.V. Ghaisas, School of Energy Studies  
 Dr R.V. Kharul, WISE  
 Dr Poosa Keskar, Dr. Bhanuben Nanavati, College of Architecture for women  
 Dr Deepah Kankere, Shashwat Oorja PVT Ltd, Pune  
 Dr Anshuman Lath, Gram Oorja Solutions Private Ltd, Pune  
 Dr Patrap Raval, College of Engineering, Pune  
 Dr Sharad Pustake, Science and Technology Park, University of Pune

In the afternoon discussion group on Energy about 12 participants from INSTEC and Indian universities, organisations and companies discussed the research and development of the energy systems needed to provide sustainable energy solutions for the future. There were 4 Indian and 3 Swedish presentations during the group session.

1. Dr. S.V. Ghaisas, Director of the School of Energy Studies at the University of Pune presented education and research at the school.

#### Education:

The School offers a specialisation in Energy Studies at MSc level as well as a M.Tech course in Energy Studies. It also offers short term vocational training courses for manufacturers and entrepreneurs.

Research:

Research activities at the School are focused on the following areas:

- Solar Thermal Energy with focus on Hot water systems, Solar Dryers, Evacuated Tube Collectors and Solar Concentrators
- Photovoltaics in particular Material Development, e.g. Transparent Conducting Coatings and new PV materials.
- Bioenergy with focus on Biogas generation from waste and wood based gasifiers

The School of Energy Studies also undertakes a number of Extension Activities in a Regional Test and Technical Back-up Centre that is accredited for testing Solar Thermal Collectors Solar Cookers, Improved Chulha, Solar Concentrators and Solar Hot Water Systems.

The School also offers training programmes for manufacturers and consultancy on energy related issues.

The School of Energy Studies has an exchange program with SLU.

2. Peter Hagström, Dept of Energy Technology, KTH reported on Current Developments in Sweden in Energy Conversion and Use.

Over the last 40 years Swedish electricity generation has shifted from relying on fossil fuels and hydropower to nuclear power, The Swedish electricity mix is now roughly 50/50 between nuclear and hydropower.

Heat generation, mainly as district heating has shifted from fossil fuels to MSW and Biofuels, mainly as waste and recycled materials from forest and construction industry. In small-scale heat generation applications, oil firing is continuously replaced by pellets firing and heat pumps. Almost all petrol used in Sweden is blended with 5% of ethanol. Diesel oil is also to some extent blended with renewable diesel fuels, as e.g. Fatty acid methyl esters (FAME). The use of E85 (85% of ethanol blended with 15% of petrol) is increasing, due to bonus from the Swedish state to buyers of cars running on alternative fuels.

Some projects are now running in pilot or demonstration scale, which aim at developing the technology for producing 2nd generation vehicle fuel. One pilot plant in Piteå is developing technology for black liquor gasification. In Örnsköldsvik, hydrolysis of wood for fermentation to ethanol is developed in a pilot plant. In Värnamo, a gasification unit in demonstration scale is available, where the plans were to develop the process for producing synthesis gas. This development will now be performed in laboratory scale at the Royal Institute of Technology in Stockholm, as the reconstruction of the demonstration plant never was co-financed by any companies.

3. Hans Blomkvist, Director of Development Studies, Uppsala University presented the project URGENT, a research project on renewable energy use at the Uppsala University. URGENT stands for Uppsala Research ProGramme on Our Common ENergy FuTure and is a cooperation between the departments Government, Psychology, the Ångström Laboratory at UU and the School of Natural Resources and Environment the University of Michigan

In the project a number of issues regarding the use of renewable energy sources are addressed, e.g. different technologies used in different countries, the varying capacities for renewable energy in different states/countries and the institutions involved in managing energy use and the role of cultural differences e.g. in conceptions of rationality and fairness and dispositions for cooperation. Differences in rules and institutions, is the most important determinant explaining the difference between industrialized and developing countries. In the global arena we have a situation of interdependence where the benefit goes to the individual actor but the costs are borne by all; from nuclear armament to littering in the street (Prisoners' dilemma, Free-rider problem, Collective action problem).

The choices individuals make in different situations depend on how they explain and interpret the world around them. Their perceptions are partly a result of their cultural heritage, partly a result of the local everyday problems they confront and must solve, and partly a result of non-local learning. The implication is that individuals from different backgrounds will interpret the same evidence differently; they may, in consequence, make different choices. This suggests that technological choices, e.g. in energy systems, can be strongly affected by political institutions and the cultural background of the actors.

4. The World Institute of Sustainable Energy, WISE, was introduced by R.V. Kharul.

The presentation gave an account of the renewable energy development in the state of Maharashtra in particular projects and consultancies undertaken by the WISE organisation in areas as wind power,

energy policy forming, vision documents for renewable energy, legislation for renewable energy, energy management and industrial ecology related projects. WISE is also involved in vocational and continuing education assignments for governmental and industrial clients.

5. As a contribution to the discussion, Lennart Nilson highlighted the necessity for energy conservation as a compliment to investing in new energy production utilities and gave a number of alternatives for saving energy, particularly in industrial production and electricity distribution.

6. Poosa Keskar from the Dr. Bhanuben Nanavati College of Architecture presented an over-view of the Sustainable Urban Development research at BNCA. Research projects covered topics on policies for Sustainable City development, Bioclimatic Architecture, Envelope Design and Renewable energy.

7. The final Indian presentation in the energy group was made by Deepah Kankere of Shashwat Oorja PVT Ltd, a consultancy company in Pune that is working with development and implementation of energy production solutions from household waste.

8. Sven Nimmermark, Swedish University of Agricultural Sciences, SLU, Alnarp talked about SLU is doing in the area of Sustainable Production and Consumption, defining the concept as " ... the use of goods and services that respond to basic needs and bring a better quality of life, while minimizing the use of natural resources, toxic materials and emissions of waste and pollutants over the life cycle, so as not to jeopardize the needs of future generations."

The strategic areas of SLU are

- FOOD - Quality in the food chain,
- ANIMALS - Animal husbandry and animal health
- FORESTS - Forests, forestry and forest products
- RURAL - Rural development, nationally and globally
- URBAN - Sustainable urban development

Examples of research areas are:

- Environmental odours, detection, analysis and how odours affect the wellbeing and health of people
- Minimizing ammonia and climate gas emissions from systems with animal production, e.g. milk production
- Use of solar energy within agriculture and horticulture, e.g. solar drying and solar desalination
- Minimizing the use of pesticides and fungicides – Biological control, pheromones for attracting insects damaging crops etc
- Biofuel crops, e.g. plant oils as a future industrial raw material

During the discussion after the presentations a number of issues were mentioned including

- Collaboration in R&D on:
  - Urban waste utilisation for district heating and power plants
  - Solar technology development in
  - Architecture and the built environment
  - Industry, e.g. in solar concentrator development
  - Combined PV/solar collector development
  - Energy conservation.

### **Summary of group discussions on Systems, Pune 2nd of April 2008**

#### Background

The workshop in Pune was part of a mobile workshop in Hyderabad (31st of March), Pune (2nd of April) and Delhi (4th of April) arranged by INSTEC and Indian partners at the spot.

Place: University of Pune, Department of Environmental Sciences

Participants:

Avinash Madhale, CEE	avinash.madhale@ceeindia.org
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The discussions during the workshop were very vivid and most participants expressed their views on various subjects. During the morning session all the participants presented themselves and their interests, and during the afternoon session the decisions of the workshop were confirmed. In addition, two Indian colleagues (Prof. Aneeta Gokhale-Benninger and Prof. Pratap Raval) delivered very interesting lectures.

The following is not a summary of all the discussions of the workshop, but rather a review of decisions made including additional motivations. The author is of course solely responsible for the ideas expressed in this memo.

### 1. The question of knowledge and knowledge production

Knowledge is directly connected to civilised collaboration between people of different kind, status and cultural aspirations. In Europe, the idea of civilised relations emerged as the fundament of the polis, the Greek city states of the Antiquity (from 8th century BC). The tenet was that civilised collaboration implies discussions and arguments instead of crude force, and this was actually the basic character of the polis even before the introduction of democracy (c. 500 BC). Any rational discussion as a means for promoting understanding between people requires the ability to convince one's opponents by putting forward rational (truthful and relevant) arguments and to shape one's performance in an appealing manner. Consequently, both science and rhetoric emerged as particular forms of skilful knowledge already in the polis.

Now, claiming that knowledge is a crucial part of civilised collaboration does not exclude the fact that knowledge is part of power relations as well. Actually the case that crude force was substituted for speech and words indicates that knowledge is part of any social contest. Francis Bacon, the English philosopher of the early 17th century, is connected to the allegation that knowledge implies power. In a fairly trivial sense, increased knowledge can promote power. With regard to technology, the European universities were developed into research institutions in the wake of the industrial revolution in Europe. This was done in order to establish a formalised system for the production of useful knowledge. Concerning political power, knowledge of societal processes enhances the potential for affecting and manipulating people, and the task of social sciences has been, at least to some degree, to provide means for social engineering.

There is, however, another aspect of knowledge as power. Leaders do not only as a rule possess superior knowledge compared to the subdued, but they are also in the position of defining what counts as knowledge. Many NGOs are convinced that they possess relevant knowledge about controversial matters within their own field of activities, but the political elite does not necessarily recognise that knowledge as relevant or truthful. Institutions such as universities with an approved and formalised status as knowledge producers are therefore in an elevated position. They do not only have the widely accepted task to produce knowledge, but also the status of being the possessors of recognised knowledge. That status is of course anchored in factual evidence, and can easily be spoiled by bad research.

The Swedish government has decided that the country shall take a leading position with respect to sustainable development. This implies a great variety of measures directed to technical development and innovation as well as economically viable and socially acceptable solutions. For years, research has been geared to comply with these requirements, and many practical solutions have been implemented as a result of applied studies. In the face of climate change and other threats, matters are not approached only from the point of technical solutions but also with respect to governance as well as spatial development.

The idea of governance encompasses of course various political institutions at different geographical levels (national, regional, local), but also a stakeholder approach. Those affected by political decisions should have a saying, which would exceed the mere poll at regular intervals. Spatial planning is understood to be something that surpasses traditional land use planning at the local or regional level. It is supposed to be an activity, which does not only produce plans and various land use strategies, but includes and analyses any political decision with spatial implications. Consequently, one could say that spatial planning provides services for bridging land use with governance and policy making.

During the workshop many speakers made evident that India possesses very advanced knowledge as well as technologies for facing environmental challenges in the future. During the whole tour, it became evident that a huge number of institutions work with sustainability matters in a very professional manner. It seems that much of required knowledge and technologies is available in India, but not necessarily utilised at the moment. In this respect, India does not differ from most other countries. Cooperation between India and Sweden in the field of sustainable development could address this very question. How to get knowledge available for all who really need it, without discriminating thresholds? How to arrange knowledge and how to give it a form that renders acquisition possible for different stakeholders? The two countries could definitely learn from each other in this respect.

The issue of knowledge and knowledge production concerns the question of democracy in the sense that discussion, rational argumentation and the free flow of information promote equity among different groupings in society far more than any other forms of governance.

## 2. Cooperation in the near future on knowledge production

The participants of the workshop agreed to start cooperating in the field of environmental improvements and sustainable development. The focus of the common endeavour at this stage would be knowledge and knowledge production. An initial project would be to write a report or book together within the coming six months. Each author would through her/his contribution define a position of expertise and/or interest in knowledge production. All the writings should stick to the overall topic of what kind and form of knowledge is needed in the face of future environmental challenges. All the writers do not necessarily have to come from the group of participants of the workshop, and a distinct academic profile is not required, albeit it is not rejected either.

As the participants of the workshop represented different fields of interest or professions such as politics, civil administration, consultants, planners and architects, engineers, university teachers and researchers, independent research institutes and NGOs, it was thought that when each one writes from her/his point of view, a multitude of various interests of knowledge would be expressed. Such a common endeavour will get the involved persons to know each other a bit better and conditions will be set for further cooperation. It was agreed that Christer Bengs and Praveen G. Saptarshi should function as editors of the forthcoming book.

As stated above, the idea of focusing on knowledge springs from the demand for knowledge that is publicly available in a form suitable for many. This idea deserves some comments.

Firstly, knowledge may concern professional matters within different fields of technology or social sciences, planning or the humanities. As a rule, the results of university research are public, but not necessarily in case they are commissioned by external funding and the results are agreed to be the property of the commissioner of the project. A major difficulty with university research is however something else. Research reports may simply not be accessible for outsiders due to limited issues or because the mode in which results are presented is inconceivable for laymen. Even other professionals within the same field of science may find it easier to apprehend research results, which are expressed in a fairly non-technical way. There is a constant demand for producing knowledge that is publicly available, preferably on the web, and expressed in a form that is comprehensible for laymen, i.e. in a non-technical form.

Secondly, knowledge is constantly produced by public authorities, e.g. planning agencies, and much of such material is not public in case it is related to forthcoming political decisions or classified for other reasons. Different countries have of course very different legislations in this respect. Sweden is renowned for promoting its citizens to access public documents, and has advocated the principle of enlarging the bulk of documents labelled public in the context of the European Union. The idea behind such claims is that taxpayers should possess the right to information, which they are, as a matter of fact, financing. The claim is also based on the fact that governance cannot be improved and stakeholders

cannot respond unless relevant information is available. An inspiring example of an elaborated information system concerning cities and city regions is the Urban Audit initiated and promoted by the European Union (see <http://www.urbanaudit.org/>). The Urban Audit enables politicians and citizens to compare the profile of their own city with those of some 250 other cities in Europe. The number of cities will be extended to 350.

The writers are urged to analyse their respective field of expertise and their experience in terms of knowledge they would need if they would live in the best of worlds. As each one is to some extent a producer of knowledge, the writers are also requested to consider how their own knowledge could be made available for a larger circle of stakeholders and citizens. The contributions could include examples of obstacles to the free flow of information or views with respect to structural properties of the society, which hampers information flows. The contributions could hopefully also deal with cases of best practice and constitute a kind of benchmarking with regard to country, region and field of knowledge.

### 3. Case study Pune region

It was decided that the region of Indian Pune would be chosen as a case study. The reason for choosing the region of Pune and not only the city as such is that cities have a symbiotic relation with their surrounding region. There is a constant flow of people, material and assets between the city and its rural hinterland. Much of the necessities of life (clean water, food, energy) are flowing in and problems (rain water, sanitation, solid waste) are exported to the near surroundings. To get a comprehension of the local totality of various flows and functional relations, the whole region has to be considered. Swedish cases, which could function as regions of reference are the greater region of Stockholm (Mälardalen) and the Malmö region. In both these cases, newly built city blocks have been erected with the aim to promote sustainable development and test advanced environmental technology.

The decision what to study and how to do it was not discussed during the workshop mainly due to lack of time. It was thought that the initial writing exercise would set the scene for further cooperation. Of importance though is to get this work started as soon as possible, and one possibility is to link up the study with progressive planning activities in the case regions. Of course the study should not be subdued to singular planning problems, but a systems approach is needed and the bridging of technology with governance and spatial planning is essential. The needed expertise is manifold, including civil engineers, social scientists, anthropologists, economists, architects and planners.

The availability of suitable technologies is of course always relative to the global supply of various technologies as well as local needs and means. Therefore, supply and demand is in constant flux. Any solution should be judged according to size of investments and implications for the future. Such implications are not only technical, but economical, social and cultural as well. Future flexibility is definitely a foreseeable asset. A minimum requirement when applying new solutions is that the effects of various technical applications should not counteract one another. Therefore a systematic view should be applied and the various subsystems should be investigated in relation to overall effects.

### **Research proposals/ideas presented by Indian participants.**

1. \_\_\_\_\_ Proposals from Sandeep Joshi, Environment Technologist, SHRISHTI ECO - RESEARCH INSTITUTE, E3T - Effective Economic Ecological Technologies For Pollution Control, B-106, Devgiri, Opp. P. L. Deshpande Garden, Near Ganesh Mala, Sinhgad Road, Pune - 411030. [www.seriecotech.com](http://www.seriecotech.com).

As discussed in the work shop herewith we are proposing some themes based on our earlier work in the field of river monitoring and evaluation of impacts of urban development on river and ecosystems in western Maharashtra.

A. Study of present practices of solid waste management (SWM) in cities, towns and agricultural areas.

Compilation from the outcomes from this study will be useful in developing strategic action plans for tackling the issues of solid waste disposal and its impact on serene environmental resources in vicinity of human settlements. This work will be very useful for government agencies industries local authorities technology



developers or suppliers to help in improving the environmental quality for the people.

B. Monitoring of Pune's five rivers (Mula, Mutha, Pavana, Indrayani, and Ram) to assess the critical water quality parameters depending upon the establishments in catchment areas.

The outcomes of such studies will be useful in improving quality of urban life with up gradation in Human Development Index (HDI). The work has been initiated by SERI based on evolving Urban Environment Index. The findings will be helpful for urban local bodies, state departments, industries, farmer cooperatives, equipment and technology developers. The study will involve extensive sampling and analysis of critical physico-chemical parameters including persistent organic pollutants (PoP's) and microbiological parameters.

Based on above two concepts /themes, detailed project proposals can be developed for collaborative work in immediate future.

2. Making Pune city (not only) sustainable, but really worth living in! (Proposals for INSTEC)

Indo-Swedish co operation can most certainly create a huge knowledge base, as well as a wide variety of interaction amongst the numerous players, but unless we move to actual execution and implementation, all this intellectual activity will not even dent global warming or the impending climate change. With this end objective in mind, we can look at the four following targets, both realistically and critically, so they can be achieved within a limited time frame of less than one year. The only prerequisite is a united effort with sinking of all differences and a clear recognition of the common enemy.

i/ PUBLIC TRANSPORT: The current existing state of already widened roads in Pune proves beyond doubt that the additional road widths have facilitated continuous parking of private four wheelers and not helped either the public transport system or the welfare of the pedestrian or cyclist. Priorities need to be understood - the majority of citizens need to be served and even without a subway, metro or tram systems, the existing buses with additional and improved vehicles and dedicated routes, can radically change the scenario within a few months as against all the long term options that still need to be designed, detailed and executed – a task that will take at least a few years.

ii/ OPEN SPACES: Open plots in the entire Pune Metropolitan Region (PMR) need very special protection and subsequent monitoring to ensure that they remain open. Money driven demand for built up space has forced all such peripheral and marginal open areas into becoming dust-bins and garbage dumps of urban prosperity. The potential use of these common public spaces is corrupted by the installation of generators, transformers, parking sheds, concrete structures for housing idols, fancy security cabins and tin sheds or cubicles for various trades and services. All these ad hoc and non-plan structures have destroyed space that would have been used by children, servants and the elderly. Housing societies and entire communities in Pune have lost such open spaces that ought to be their fundamental right as enshrined in any town planning document.

iii) URBAN FORESTS: The ratio of minimum open space required per person of urban populations is grossly inadequate; several studies have already been carried out by environmental groups that indicate an excess of built up concrete surfaces and a severe shortage of natural landscape – not urban parks with paved ground and decorative plants, but ecologically valid natural reserves. It is no longer adequate to isolate an area and to let 'nature' do the rest. A concept of urban forests and urban agriculture is most desperately needed and this cannot happen without aggressive campaigns and strict monitoring to ensure compliance. The Pune Municipal Corporation has already taken the lead by declaring hill tops as biodiversity parks, but as Anita Gokhale Beninger explained during her presentation, the battle is not over and powerful political forces continue to seek a minor FSI provision that will then open the flood gates for roads, walls, parapets, paved areas, car parking and all the urban illnesses that need to be offset with open spaces. Luckily, we have numerous examples of intense green responses to congested cityscapes. What Havana, Cuba has done (in urban agriculture) out of compulsion, can be done in Pune by choice – the result will be a holistic contribution to fighting pollution, climate change, food distribution, employment generation, waste recycling and so on.

iv) MASS HOUSING: The traditional (though largely theoretical) path to housing of the poor has been the sites and services program. Hassan Fathy in Egypt and scores of others all over the world,

have already proved how 'self-help' housing can create cheap, safe and healthy domestic environments. In addition, this process empowers the poor and helps make the city a happy place to live in. Though multistoried, middle and high income housing dominate the skyline as well as the news, it is the lower 50% of city populations that need the most attention. Slums need not be perceived as 'problems' but should be recognized as easy do-able solutions for a number of urban problems that could include health and child care, employment generation, education and recreation, waste recycling and so on. The existing 'slum' resettlement policy however, is being hijacked by the builders lobby with active participation of Government agencies. Ready-made concrete multistoried homes (without the option of light weight additions as and when needed,) is a solution that suits the builder (because he can extract maximum FSI benefits for himself.) This does not help the users / occupants who find themselves in high rise 'permanent' slums that hugely damage the environment as against the hand made slums that have tremendous potential for growth as well as sustainability.

WHO WILL BELL THE CAT ? Though all the above four issues can be (theoretically) taken up as well as executed within one year, I do not know of any organization that can carry out the various individual tasks with reasonable integrity and efficiency. One of the options would be to create ward level committees that are manned by professionals, (lawyer architect doctor) students (architecture, arts, management etc.) as well as NGO and Municipal personnel. Such 'mohalla committees' are known to be capable and efficient in times of crises, like earthquakes, riots or floods. The prospect of climate change and global warming is indeed one such crises that calls for almost any desperate response. The entire future of even this Indo Swedish initiative is endangered if left entirely to Government agencies that are almost always too large to handle and manned by individuals pursuing private and personal agendas.

As an individual and as an architect and a film maker, I have been a victim as well as a participant in this declining condition of State and Central Government agencies, Municipal offices and University departments that are empowered for delivering public benefits through transparent and democratic governance, but fail even before the commencement of a project. There are exceptions to this general reality and the first task of the INSTEC team should be to establish this path and to create a reliable route map that can be built and strengthened over the years by the users and beneficiaries alike.

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### **Meeting with Dr L Ramakrishnan, Regional Environmental Coordinator, Philips Lighting, Asia Pacific Region.**

A small group meeting took place between Dr Ramakrishnan and H Lundberg, S Jonsson, G Baurne and XX to discuss networking with Indian industry within the field of sustainable development and environmental technology. Dr Ramakrishnan expressed his willingness to act in this respect.

**3 april**

**A meeting with the Maharashtra Chamber of Commerce.**



Mrs Lila Poonawala had arranged this meeting where we met some representatives from Swedish industry present in Pune as well as people from Indian industries. There is a great interest from the chamber to cooperate with Instec and MCC is willing to take the lead. The possibilities to arrange a fair for SME:s in India where also academia participates including seminars and an exhibition relating to sustainable development and environmental technology.

#### **Meeting at the College of Engineering in Pune.**



(picture from the coep homepage)

A brief visit was made to the college and a meeting at the Department of Civil Engineering with Dr. S R Sathe Professor and Dean Academic Affairs and colleagues. The College of Engineering, Pune, was established in 1854, long before any of the formal degree awarding universities started in India. It started as a training school for the officers involved in public works like buildings, dams, canals, railways and bridges. The first batch of the B.E. (Civil) degree students came out in the year 1912 and in 2003 the Government of Maharashtra gave the college an autonomous status.

#### **The Delhi workshop**



Host in Delhi was TERI and the workshop was held in Casurina Hall, IHC Complex, Lodi Road, New Delhi..

### **Minutes of Indo-Swedish Workshop on Sustainable Urban Development at TERI in New Delhi, the 4<sup>th</sup> of April 2008**

Summarized by: Peter Hagström, Dep. of Energy Technology, KTH

#### **Inaugural session**

Dr Leena Srivastava, Executive Director of TERI, welcomed all to the workshop. She introduced it by discussing important issues being on TERI's agenda right now, as e.g. ecological footprint, green architecture and transportation. Carbon footprint is e.g. a focus area when dealing with the environmental impact from transportation.

Mr Stefan Jonsson, Embassy of Sweden in New Delhi, mentioned that he, and also the rest of the Swedish Embassy in India, is happy for that this event is taking place now. He also mentioned that the Embassy will put up a unit being responsible for Energy and Environment. Sweden's aim is to climb on the ranking list of countries cooperating with India in these issues.

Prof Ramon Wyss, Royal Institute of Technology, Sweden, introduced his speech by saying that it was a pleasure to be back at TERI. The previous Swedish academic delegation was at TERI two years ago. Prof Wyss said that now, it is time to discuss how to go from talking to acting. Prof Wyss continued with presenting INSTEC and the delegation, and the mission of the workshops. He introduced the suggestion of studying Pune in the aspects of a Symbios city.

Mr R Sethuraman continued with discussing urban water supply and the sanitation sector. He discussed that the number of larger cities in India are increasing and become larger. The depletion of fresh water resources and decreasing availability per capita of fresh water is a large problem in India. The unit cost of production of water is increasing day by day. Right now, 91% of the population in the Indian cities has access to water supply, while 63% of the corresponding population has access to sewerage.

Mr Sethuraman pointed out that there is lack of:

- will to charge.
- Willingness by the politicians.
- Accountability at the institutional level.

Finally, Mr Sethuraman indicated some possible areas for cooperation, e.g.:

- Mapping of urban utilities using GIS. This has been done only for a few cities in India (e.g. Bangalore and Delhi).

- Micro-tunneling and trenchless technology. To be used for construction of pipelines for water distribution. Education software modelling in this area.
- Accounting for Water Management. One primary aim may e.g. be to reduce the leakage to 15%.
- Technological option in Wastewater Treatment, e.g. Flow Anaerobic Sludge Blanket.
- Preservation of water bodies and flood management. Software and hardware use in this area. Training of engineers and of trainers.

After Mr Mr Sethuraman's speech, both Dr Leena Srivastava and Prof Wyss commented that education is as an important issue as research and development.

### **Role of Green Infrastructure in sustainable urban development**

Prof Christer Bengs from the Swedish University of Agricultural Sciences introduced this session by a presentation on "The Concept of Sustainable Cities". He pointed out that there are three aspects of sustainability to be considered, namely environmental, economic and social/cultural aspects. There are also three scales to be considered: city, region and urban.

Prof Bengs continued with mentioning that local environmental problems seem to increase with increasing wealth. He also mentioned that urban-rural relations are crucial when dealing with environmental issues.

123 cities are involved in a EU project titled cities in the urban audit. It contains nine domains: demography, social aspects, economic aspects, civic involvement, training and education, environment, travel and transport.

Prof Bengs finalized with saying that sustainability is drawing on local assets. It must also be understood as an interplay between various geographic levels.

The title of Dr Gaurav Shorey's presentation was "Green Design Initiatives in Urban Infrastructure – TERI's role".

In 2001, 28% of India's population lived in urban areas. The growth of the population living in urban areas is estimated to be 31% in 10 years.

Dr Shorey said that there is a huge gap between demand and supply on energy and water. Changing of lifestyles leads to increased demand of e.g. electricity and infrastructure. However, 2 billion kWh can be saved annually by new construction of buildings. Green design can save 40 – 50% of the energy used. Pune Municipal Corporation (PMC) is collaborating with the International Institute of Energy Conservation on this issue.

There is a goal to make Hyderabad a global leader in sustainability. TERI is aiding Hyderabad Urban Development Authority on issues on sustainable development. Education on green building design practises is increased. Higher building costs due to environmental building design are influenced to decrease.

The title of Ms Shikha Gandhi's (TERI) presentation was "The Challenge of Sustainable Urban Development in India". In 2026, the urbanization is estimated to be 40%. In 2001, there were 35 cities with more than 1 million habitants. The urbanization leads to socio-economic environmental challenges. Economic reformation for urban management and financing in 1991 signalled a systematic shift to a more open economy with a greater reliance on market forces.

Ms Gandhi mentioned Jawaharlal Nehru National Urban Renewal Mission (JNNURM) as one of the flagships programme financed by the Indian government. It contains e.g. redevelopment of inner city areas to reduce congestion and performance of city development plans.

Another flagships programme financed by the Indian government is "Provision of sustainable infrastructure – Services in India. The aim of that programme is to plan, deliver, monitor and assess the identified service sectors in the light of sustainability matters.

In the final discussion of the session, Dr Shorey pointed out that we also have to look on the needs. Which demand do we have on different resources?

### **Energy Management for Urban Sustainable Development**

Prof Rajni Hatti-Kaul, Lunds University, Sweden, started this session with a presentation with the title "Utilization of Renewable Resources for Production of Chemicals and Energy". Referring to B. J. Frost (2005), Prof Hatti-Kaul said that chemicals and materials provide higher economic value than energy. The aim of an on-going project, Greenchem, is to produce target products from biomass. These target products are lubricants, surfactants, wax esters, epoxides and bioplastics. This project is preformed in collaboration with the companies Akzo Nobel, Astra Zeneca, ACO, AAK and Perstorp.

Biogas can be produced from all kind of biomasses. The biogas potential in Sweden is estimated to be 17 TWh, where crop residues are the largest feed-stock.

Dr A. K. Singhal from MNRE had a presentation with the title “Solar Energy for Urban Areas (Government Policies and Programmes)”. He discussed different kinds of solar systems of present interest, as solar water heating systems, solar air heating and steam systems, solar photovoltaic devices/systems and passive and low energy architecture.

Mr Shirish Garud, TERI, had a presentation with the title “Role of Renewable Energy in Urban Environment”. He mentioned that renewables in India started in the 1970s, while schemes for urban users started in the 1980s.

Urban poor areas/slums are a major problem in India. 14% of the households are located in slum areas. Mr Garud continued with presenting recent trends in utilising renewable energy in urban areas. These are solar for heating water and space, cooling and electric power generation, solar desalination for water treatment, resource assessments, wind power, bioenergy and land use and land cover assessment using GIS.

TERI is working with technological development in different areas, as e.g. thermal gasification, enhanced acidification and methanation technology, solar ICT and solar lanterns. Within the fields of policy and regulatory, TERI is working with renewable energy technology schemes, renewable energy policy and renewable energy tariff policy.

Mr Garud suggested some topics for Indian-Swedish co-operation:

- Biomass utilisation
- RDF fuel production technology
- Hydrogen and fuel cells
- Solar thermal district heating and cooling for new urban areas
- Technological development on Biomethanation

Dr Meenakshi Munshi from DBT had a presentation with the title “Bio-technological Interventions for Improved Biofuel Production”. He listed some goals and targets for production of ethanol and biodiesel:

- Ethanol produced from biomass by 2012. If the petrol used in India would be mixed with ethanol, 500 million litres per year of ethanol are required.
- Biodiesel will be produced from various feed-stocks, as e.g. the Jatropha plant and algae. A mix of 5% of biodiesel in the petroleum diesel used in India would require 2.62 million tonnes per year of biodiesel.

### **Management of eco-systems and environment**

Dr Lennart Nilsson from the Royal Institute of Technology, Sweden, introduced this session with a presentation on “Environmental Management and Environmental Systems Analysis”. He mentioned that the aims with Environmental Management System (EMS) are monitoring and continually improve the environmental performance of the organisation. An environmental audit is first needed, as EMS doesn't work for itself.

Life Cycle Assessment (LCA) may be used for analysing a system in a life-cycle perspective on energy and mass flows.

Environmental Impact Assessment (EIA) is used on the Management level, where outputs are Environmental Performances. Environmental Labelling is the output on the activity level.

Cleaner production is a function of scope and results, time and work. It works as a staircase of concepts for industry.

Ms Josefin Wangel from the Royal Institute of Technology, Sweden, had a presentation with the title “Environmental Strategies for Social Change”. She discussed e.g. social LCA – Socio-ecological impact assessment of clean development management, which includes integrated planning and institutional capacity building.

Dr S. Gangopadhyay from CRRRI, India, had a presentation with the title “Sustainable Urban Transport”, containing issues within the traffic and transportation planning area.

Dr T. S. Panwar from the Energy Environment Policy Division at TERI had a presentation with the title “Air Quality Issues and Initiatives”. He mentioned that buses are just 1% of the total vehicular fleet in India, and undergrounds have been constructed in some Indian cities.

Stricter emission norms are now being introduced, as Euro II and Euro III. The fuel qualities are continuously improved. The sulphur and lead contents are reduced, and the benzene content is regulated.

Activities at TERI in this area are:

- Spatial environmental planning and management
- Human exposure and health studies
- State of environment reporting
- Source apportionment studies
- Quantification of the share of pollution
- Scenarios and management plans

Dr Panwar mentioned that aerosols have to be considered due to increased use of fossil fuels and biofuels. Biomass use at cooking is a problem, due to air pollution.

Prof Ramanathan from Jawaharlal Nehru University, School of Environmental Sciences, in New Delhi had a presentation with the title "Water and Sustainability". The available water amount per capita in India was 500 litres per day in year 2000. In year 2020, the corresponding amount of water per capita is estimated to be 400 litres per day. Prof Ramanathan pointed out that the risk of water famine in India will increase in the future.

Dr R. C. Trivedi from CPCB, India, had a presentation with the title "Wastewater Management in India". He discussed that in India, the amount of generated wastewater from industry is lower than the amount of generated wastewater from domestic sources. However, the amount of generated BOD from industry is higher than the amount of generated BOD from domestic sources.

There is a gap between treated un-treated sewage. The amounts are increasing for both treated un-treated sewage.

Solid fine particles in wastewater from e.g. distilleries are a problem.

Dr Suneel Pandey from TERI had a presentation with the title "Municipal Solid Waste – Status and Issues". Today, the generated amount of municipal solid waste (MSW) is 0.4 – 0.5 kg per day and person in the cities. 30 – 55% is compostable, 5 – 15% is recyclable and 40 – 55% is inert construction and demolition waste.

The aim of an on-going MNRE waste energy project is to identify responsibilities of municipalities.

The aim of an UN Development program is to point out objectives of pilot studies in Kasur and in Delhi. Both wastewater and MSW are here considered. Performance measurement indicators will be developed.

The pilot studies concern both financing, technical and management issues. Examples of technical issues are proportion of waste, average quantity of waste, management and average staff deployed.

Dr Pandey suggested some topics for Indo-Swedish co-laboration:

- Reuse of treated wastewater
- Utilization of industrial waste, e.g. sludges and PCB.
- Various waste treatment, including energy issues (e.g. biofuels)
- MSW

### Summary of the workshop

Prof Ramon Wyss, KTH, started the summary saying that an INSTEC organisation in India would be preferred as a partner against the Swedish INSTEC organisation.

Chain of Commerce in Pune has shown interest in taking the lead of a Synbios city – project on Pune. Co-laboration between the universities can be fruitful in the long term. Prof Wyss looks forward increased activity. First, key projects have to be identified. Secondly, the organisations for developing project proposals and performing the projects have to be institutionalized.

Prof Christer Bengs, SLU, said that we have to figure out which problems we have. He meant that land management is a crucial issue. It is not possible to build for reducing the problems.

Dr T. S. Panwar, TERI, said that TERI is interested in students' exchange and co-laboration in research. Interesting topics are biotechnology and refining.

Mr Shirish Garud, TERI, said that bioenergy and solar energy are two main issues. He suggested co-laboration on sustainable development of cities, where one city can be chosen in Sweden, while another city is chosen in India. He looks forward to future co-laboration on this topic.

Prof Ramanathan, JNU, said that there is a lack of data regarding the remoting areas (e.g. Himalaya). The groundwater level is well monitored. However, more research and data is required for studying the relationship between climate change and the groundwater level.



Carl-Gustaf Svensson from the Embassy of Sweden in New Delhi mentioned that it is possible to apply for funds from the Environmental facility. Pilot plants funds are available from Sida. Credits are available for implementing. However, it has to be co-financed from both Sweden and India.

### **Indo-Swedish Workshop on Sustainable Urban Development**

4th April 2008 : Casurina Hall, IHC Complex, Lodi Road, New Delhi

#### **Rapporteur Summary**

<b>9:00-9:40</b>	<b>Inaugural session</b>
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The inaugural session of the workshop commenced with welcome remarks by Dr. Leena Srivastava (Executive Director, TERI). She discussed about the trends of growth and development of Indian cities, urbanization issues and related problems. She emphasized on the need to establish suitable paths for sustainable urban development. She also stressed on the need for capacity building and exchange of knowledge between Sweden and India.

Her remarks were followed by inaugural address by Dr. Stefan Jonsson (Counselor, Office of Science and Technology (ITPS), Embassy of Sweden) who focused on the historical relationship between India and Sweden in trade and economics and expressed his desire to strengthen relationships amongst two countries in the field of research and development. He invited Indian organizations to extensively collaborate with Sweden.

This was then followed by presentation by Prof. Ramon Wyss (Head, Swedish Delegation), which detailed out the facts about the Indo – Swedish Cooperation on Technical Research and Education (INSTEC). He stated that the Presidents of the signing Universities agreed to form a network (INSTEC), with the purpose to develop and strengthen relations between scientific communities in India and Sweden. Prof. Wyss also stressed on the importance of the concept of Sustainable Cities.

During his special address, Mr R Sethuraman (Advisor (PHEE), MoUD) pointed out the major urban environment challenges in India. He explained how increasing urban population and rapid urbanization is leading to water scarcity, and deteriorating water. He also highlighted areas where Indo- Swedish cooperation can be extended, which include training and technology transformation for mapping of the urban utilities centre using GIS, technical tie-up in tunnel boring, ground probing radars, pipe jacking tools etc, and innovative and low cost technology options. He also emphasized on the need for cooperation in the fields of wastewater treatment, preservation of urban surface water bodies, and flood management.

<b>10:00-11:00</b>	<b>Role of Green Infrastructure in sustainable urban development (Panel Discussion)</b>
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The session 'Role of Green Infrastructure in sustainable urban development' started with a presentation by Prof. Christer Bengs (SLU) on "the concept of Sustainable Cities". Prof. Bengs discussed the interaction of environmental, economic, and social aspects, across the city, regional and global scales. A case study of the Urban Audit project of the European Union (1997-2005) covering 258 large and medium sized cities was presented to highlight the case of knowledge production related to policy making. It was concluded that Sustainable Cities is a very complex concept and it is necessary to understand the interplay at various scales: the city, region and urban systems.

This was followed by the presentation by Mr. Gaurav Shorey and Dr Hina Zia (TERI) on " Green design initiatives in urban infrastructure-TERI's role". The presentation highlighted the role of TERI to promote sustainable living. Prime challenges posed by rapid increase in urbanization were highlighted alongwith estimates of future energy and resources demands. Two case studies, first on 'Eco housing in Pune', and second on 'Environmental Building Regulations and Guidelines for Hyderabad' were presented. The presentation highlighted a number of showcase projects at buildings level (like TERI-RETREAT, CII, ITC, IIT, etc.), taken up by TERI to promote sustainable/green buildings. Mr. Shorey emphasized that TERI has also been instrumental in giving the nation, its first environmental rating system, popularly known as GRIHA, which is a tool to facilitate design, construction, and operation of a green building and measure its 'greenness'.

Next presentation of the session was on 'The Challenge of Sustainable Urban Development in India' by Ms Shikha Gandhi (TERI). The key challenges to promote sustainable urbanization in the country were discussed by her. She informed the audience that to meet these challenges, economic reforms for urban management and financing were introduced in India, in 1991. Subsequently, a number of reform missions were started and/or strengthened like Jawaharlal Nehru National Urban Renewal Mission (JNNURM), Urban Infrastructure Development Scheme for Small and Medium Towns (UIDSSMT); Integrated Housing and Slum Development Programme (IHSDP). JNNURM was discussed in detail and its constraints were brought to notice. Ms. Gandhi also highlighted TERI's intervention in this direction through a project, 'Provision of Sustainable Infrastructure services in India'. The presentation concluded with a remark on the need to strengthen the legal framework, institutional set up, and governance of Indian cities and also to cover all the urban issues in a holistic manner rather than sector-based approach.

<b>11:10-12:30</b>	<b>Energy Management for urban sustainable development (Panel Discussion)</b>
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In the second session, Prof Rajni Hatti-Kaul (Dept. of Biotechnology, Lunds University) drew attention of the audience on issues related to biotechnology and sustainable urban development. She expressed deep concerns about the future of petroleum reserves of the world, and emphasized on transformation of the technology from OIL- Refinery to BIO- refinery. Prof. Kaul explained the ideal biomass refinery concept and their products like fuel, solvents, plastic fine chemicals and oil using food grains. She discussed industrial biotechnology applications to resolve the problems related to energy and environment, and also explained the concept of "GREEN CHEM". She explained how surface coating (which traditionally have toxic chemicals) can be changed to green coating; lubricants can be replaced by bio-lubricant (fatty acid / oil); and surfactants can be replaced by bio-surfactants. In her presentation, Prof. Kaul also referred to the technologies for production of bio-diesel, bio-plastic and bio-gas.

The next presenter Dr A. K. Singhal (Director, UICA group MNRE) in his presentation on 'Solar Energy for Urban Areas (Govt. policies and programmes)', explained the importance of solar energy utilization in the urban environment. He pointed out the vast potential for solar energy applications in urban regions of India. Dr. Singhal showcased three important solar energy technologies for urban areas, which include solar thermal air, water heating, & steam generation technologies, solar photovoltaic technology for electricity generation, and passive & low energy architecture for energy efficient green buildings. He discussed the existing status of urban and industrial waste management in India and stressed on the potential of power generation from the waste.

Dr. Shirish Garud (TERI) explained the role of renewable energy in urban sector. He discussed the urban energy issues and renewable energy solutions for urban environment in India. He also highlighted TERI's activities in renewable energy, and scope for Indo-Swedish cooperation. He touched upon the TERI's research activities in the field of renewable energy divided into different categories - resource assessments, technology developments, policy assessments and project evaluations. Under resource assessments, solar & wind resource assessment, biomass resource assessment and land use & land cover assessment, were discussed. Under technology development, he talked about the various technologies developed by TERI like Gasifiers, TEAM process, Solar ICT, Solar lantern. Dr. Garud also discussed the thrust areas under which Indo-Swedish projects can be developed. Suggested thrust areas of collaboration include biomass utilization, RDF fuel production technologies, hydrogen and fuel cell vehicles, solar thermal district heating and cooling plants for new urban areas, and technology development in bio-methanation.

The last presentation of the session was delivered by Dr. Meenakshi Munshi (Joint Director, Department of Biotechnology). She focused mainly on bio-technological interventions for improved bio- fuel production. Dr. Munshi discussed the present energy usage patterns in India and stated that the present scenario of energy consumption is forcing biotechnological development to explore alternate renewable energy sources in India. She explained the government plans for the promotion of bio-diesel, algal system for production of hydrocorban, bio-ethanol, energy bioscience centre & capacity building. She emphasized the fact that after the GREEN and WHITE revolutions, the next one will be the BROWN revolution focusing on bio-fuels.

<b>13:30-15:20</b>	<b>Management of eco-systems and environment (Panel Discussion)</b>
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In the session 'Management of eco-systems and environment', Dr. Nilson (Industrial Ecology , KTH) presented 'Environmental management and environmental system analysis', with an overview on industrial ecology. He talked about the industrial environmental management and cleaner production issues. He stated the objectives of environmental management system and emphasized on monitoring

and continual improvement. He talked about cleaner production, which aims at pollution reduction at source by recycling, substitution of raw material etc. He also explained the concept of industrial ecology and its application at city level and emphasized that an industry is not in isolation of its surroundings. The next speaker, Ms. Josefin Wangel (MSc., KTH) explained that a system consists of nodes and linkages. In the case of an urban area, the nodes symbolize as infrastructure and the linkages as the different types of resources and services provided or used by the infrastructure. Optimizing the urban system to minimize the environmental impact is essential to achieve sustainable urban development. She insisted that this could be achieved by using tools for life cycle analysis, environmental impact assessment and by choosing eco-technologies. She emphasized on integrated planning and also recommended that in order to make the processes of change viable for longer terms, the socio-cultural context must not be neglected. She also suggested few examples of possible areas of Indo-Swedish collaboration, which include social LCA, socio-ecological impact assessment of CDM, and integrated planning and institutional capacity building.

Dr. S. Gangopadhyay (Central Road Research Institute, New Delhi) highlighted the key issues in sustainable transportation and the nature and extent of transport problems. He showed the rapid vehicular growth in India and discussed about the imbalance between supply (road network) and demand (vehicular growth). He showed his concern over the wastage of fuels, and stated that fuel worth Rs. 994.5 crores is being wasted annually due to idling of vehicles at 600 signalized intersections in Delhi. He also talked about the air pollution levels in Indian cities which often exceed NAAQS and WHO standards. Dr. Gangopadhyay highlighted the very high rate of accidents in India and stated that India has only 1% of the world's vehicle population but 6% of the world's traffic accidents. For ensuring sustainable transport a few solutions such as discouraging the usage of personalized modes, converting trips longer than 3 kilometers into public transport trips, and encouraging the non-motorized modes. He also showed the benefits of non-motorised transport (NMT). Presenting a 10-year plan for transport, he suggested a balanced approach for investment in different transport modes.

Dr. T.S. Panwar (TERI) described the air quality status in Indian cities. It was evident that SO<sub>2</sub> levels were meeting the standard at most of the places, and NO<sub>x</sub> levels were close to the standard at many places, though still under limits. However, RSPM and SPM levels were violating the standards at most of the places. He discussed about the interventions taken to tackle the air pollution problem which include :- stricter emission norms (Bharat Stage I, Euro II, & III), fuel quality improvements, Judicial intervention- action plans for cities, shifting of industries, fuel shift to CNG/LPG, introduction/ongoing work for Metro, and environmental awareness campaigns. He also addressed the existing gaps and constraints for better air quality management. He showed his concerns about the fact that besides the metro cities, air pollution problems are being faced by smaller cities also. Finally, he presented the various initiatives taken by TERI, which include spatial environmental planning and management, human exposure and health studies, state of environment reporting, source apportionment study, urban clean fuels project, national plan of action for coastal pollution, industrial eco-rating/ industrial ecology (ind. estates), industrial waste treatment studies, mining sector studies, and life cycle assessment. Apart from local air pollution, Dr. Panwar also presented TERI's work in addressing global environmental challenges, which include policy analysis, climate change mitigation strategies, capacity building, outreach, impacts assessment, vulnerability mapping and identification of adaptation strategies, GHG Inventorisation and analysis, CDM (clean development mechanism), and climate modeling activities (regional climate models).

The next speaker Dr. Ramanathan from JNU initiated his presentation (Water Quality issues in Sustainable Urban Development) by showing decline in mean annual water availability in India. He presented the pesticides levels in various Indian rivers and the presence of heavy metals in wastewater generated from Delhi. He discussed the presence of toxic metals in the solid component of liquid waste. Dr. Ramanathan also talked about the problem of declining ground water levels in India, during the period 1960-2002. He suggested some strategies for better water management, such as controlled withdrawal of ground water, dual water supply system, and rain-roof water harvesting, etc. The CPCB representative Dr. R.C. Trivedi initiated his presentation (Wastewater Management in India) by talking about the rapid increase in urban population in India. He presented the decadal growth of sewage generation and treatment capacity in Delhi (MLD) and also the experiences from Ganga Action Plan. He emphasized on industrial pollution load, which gets disposed in the rivers. Dr. Trivedi mentioned about the industrial effluents having high organic and inorganic loads from distilleries, pharmaceuticals, pesticides, rayon, dye and dye intermediates etc. He expressed concerns over the presence of small-scale industries in the residential areas. Dr. Trivedi talked of the major challenges faced during implementation and also discussed about the major guiding principles for wastewater management. Finally, he presented the benefits of reuse of wastewater and suggested an Action Plan for waste water management in the cities.

Dr. Suneel Pandey (TERI) presented the scenarios of municipal solid wastes (MSW) – generation, collection and disposal in Indian cities. He informed the audience that high moisture content and low calorific value of organic fraction of Indian MSW makes it more amenable to biochemical conversion and bio-methanation route of ‘waste-to-energy’. Dr. Pandey talked about the waste processing issues and stated that 6000 TPD of MSW can be processed into compost. Talking about the recent initiatives to combat the problem of waste management, he mentioned about the MSW Rules 2000 (MoEF), MNRE-waste energy projects, MoUD- financing schemes for solid waste management projects especially under JNNURM, MoA- composting projects, DST- refuse pelletization projects, initiatives by municipalities in improving the services, involvement of public/private partnerships, initiatives by NGOs and CBOs at decentralized level and the role of informal sector in waste recycling. Presenting the initiatives taken by TERI, Dr. Pandey also discussed TERI’s USERS project which focussed on the development of performance measurement indicators and benchmarks for the solid waste management.

<b>16:50-17:50</b>	<b>Summary and way forward</b>
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In the final session, speakers summarized the key messages. Prof. Wyss appreciated the participation of various Indian organizations and referred to it as a starting point for further collaboration. He asked the participants to raise the issues discussed in the workshop within their organizations and come back with the ideas of joint cooperation. He termed the Universities as the key assets for relationship building and cooperation between the two nations. He also emphasized on identification of major challenges in urban sustainable development. Finally, he suggested a comparative study based on system approach such as (Pune & Stockholm – 20 years from now).

Prof. Bengs emphasized on production of knowledge, which is understandable and accessible to other people. He also called for more interactions and collaborations for social, economic, and cultural sustainability.

Dr. Panwar requested the participants to discuss relevant issues within their organizations and select few themes on which further collaborations could be made. He mentioned about numerous environmental problems in India and need for their prioritization. He stressed upon theme based collaboration with different organizations as per their expertise. Finally, he emphasized on the requirements of training and capacity building between INSTEC and Indian organizations to improve their capabilities.

Dr. Garud stressed upon the prioritization of issues and expressed TERI’s interest in furthering collaboration in the fields of bio-tech, bio-energy, solar energy, and sustainable buildings. He also suggested a collaborative project on sustainable cities, in which two cities (one each in India and Sweden) could be compared and studied on sustainability parameters. Finally, he also agreed on extension of knowledge sharing programs.

Finally, Counselor (Swedish Embassy) congratulated the organizers for holding the workshop and creating a platform for future joint projects in the fields of energy and environment. He also informed the audience about the availability of various funding opportunities for implementation of joint Indo-Swedish projects.

**Reception at the residence of Carl-Gustaf Svensson at the Embassy.**

**Visit to the Nordic Centre in New Delhi**

**Visit to Trivandrum**



### Programme

The visit of the following scientists of the Swedish Delegation:

Prof. Ramon Alexander Wyss, Royal Institute of Technology, Sweden

Dr. Goran Baurne, Royal Institute of Technology, Sweden

Prof. Lars-Christer Lundin, Uppasala University Prof. Bjorn Karlsson Lund University

Prof Lars Oberg, Umea University

Prof. Baboo M. Nair Lund University

Axriyal : Sunday 6th April 2008 1.50 pm, Jet Airways -(Dr. R. Prakashkumar, Principal Scientific Officer will receive the team at the airport and drop at the Hotel at Thiruvananthapuram).

Evening: Discussion with University team - Dr. Achuth Sanakar Nair may be contacted to co-ordinate.

### DAY 1: 7th April, 2008

10.00 am - Visit to the Kerala State Council for Science, Technology & Environment (KSCSTE).

KSCSTE is an autonomous body of the Government of Kerala dealing with the policy matters related to the Science & Technology of the State. The KSCSTE being the head quarters of the Science & Technology activities in the state, has its own R&D centres such as Centre for Earth Science Studies (CESS), Tropical Botanical Garden & Research Institute (TBGRI), National Transportation Planning and Research Centre (NATPAC), Kerala Forest Research Institute (KFRI), Centre Water Resource Development & Management (CWRDM, Rajiv Gandhi Centre for Biotechnology (RGCB).

11.00 am - 12.00 pm: Meeting with the Director

The activities spearheaded by the KSCSTE are grouped into S&T Promotion programmes, Ecology & Environment programme, S&T Popularization programmes.

The R&D issues to be addressed in the State are implemented through centre such as Centre for Earth Science on earth system sciences, Tropical Botanic Garden & Research Institute on Conservation and sustainable utilization of tropical biodiversity, Rajiv Gandhi Centre for Biotechnology on biotechnology with special reface to health biotechnology, Kerala Forest Research Institute on Forest research including forest biodiversity, Centre for Water Resources Development and Management on hydrology and National Transport Planning and Research Centre on transportation planning and research.

12.30 pm - 1.30 pm - Discussion

The Directors of all these Centres will discuss on the R&D programmes and new initiatives for possible collaboration with the INSTEC.

1.30 PM – Lunch

2.00 PM - 3.00 pm: Presentation by INSTEC on possible Collaboration (This involve a detailed presentation by the delegation to find out areas of interest for mutual co - operation)

3.00 PM - 4.30 pm: Visit to Sri Chitra Tirunal Centre for Medical Sciences and Technology (SCTIMST). (Dr R Prakashkumar, Principal Scientific Officer will accompany the delegates to the Sri Chitra Tirunal Centre for Medical Sciences and Technology. Sri Chitra Tirunal Centre for Medical Sciences and Technology is an autonomous Centre of National importance under Government of India. R&D programmes related to health in general and neurobiology and cellular and molecular cardiology, pathology, biochemistry and molecular biology in partitalar are focused here.)

5.00 pm: Meeting the Hon'ble Chief Minister, Kerala State (Hon'ble Chief Minister, Government of Kerala, Shri VS Achuthanandan is the President of the KSCSTE. Dr EP Yesodharan, Executive Vice President, KSCSTE will lead the delegation to the Hon'ble Chief Minister. The delegation could interact with the CM and his staff on many matters of Science and Technology and discuss on the possible options of co-operation.)

Return to the hotel.

## **DAY 2: 8th April, 2008**

09.30 AM: Visit to Sastra Bhavan (Delegates will be picked from the hotel)

10.00 AM: Visit to Rajiv Gandhi Centre for Biotechnology (RGCB),(Dr. R. Prakashkumar, Principal Scientific Officer will accompany the delegates to Rajiv Gandhi Centre for Biotechnology. RGCB is an autonomous research centre under the KSCSTE. The Centre was established in 1994 and undertakes advanced research in Biotechnology, Molecular biology, Bio informatics, Infectious diseases, Referral services etc.

11.15 AM: Visit to Centre for Earth Science Studies (CESS)  
( Dr. R. Prakashkumar, Principal Scientific Officer will accompany the delegates to Centre for Earth Science Studies. Centre for Earth Science Studies is an autonomous research centre of the KSCSTE. CESS was established in 1978 to carry out extensive studies and research in the field of Earth Sciences. The major studies involve seismology, coastal regulation zone, research analysis using GIS, pollution monitoring, Environment Impact Assessment, Heavy metal concentration studies etc.)

1.00 PM: Lunch

1.30 pm: Discussion at Sastra Bhavan

3.00 PM - 4.00 PM: Discussion and possible finalization of fields of collaboration.  
(This include a detailed discussion on identifying the area and disciplines in which the delegates, INSTEC as well as other scientific bodies in Sweden could interact with KSCSTE and its R&D Centres.)

5.00 PM - Press briefing (tentative)

(It is expected that a good out come will be generated out of this visit. If so the KSCSTE will an-ange a meet the press programme, with proper approvals.)

The delegates will be returning to hotel and then to air port.

## **Kerala - seminar, study tour and meeting with the chief minister**

A Report by Baboo M. Nair, Lund, 20th April 2008.

On 6th of April six of us proceeded to Kerala to meet the representatives of the KSCSTE- Kerala State council for Science Technology and Environment ([www.kscste.org](http://www.kscste.org)) and the directors of its individual institutions. The main aim of the visit was to have meetings with the president, the executive vice president of the Kerala State council for Science Technology and Environment as well as the directors



of the different centres of research and development to discuss future cooperation within “Sustainable Development and Environmental Technology ”



Professors Lars Öberg, of Umeå University, Lars-Christer Lundin of Uppsala University, Göran Baurne of Royal Institute of Technology, Stockholm, and Björn Karlsson LTH, Lund University at the back, with Prof Ramon Wyss of Royal Institute of Technology, Stockholm and Prof Baboo M. Nair of LTH, Lund University in the front.

We arrived at 12.30 PM and we were received at the Thiruvananthapuram airport by Dr. Prakashkumar for further transport to Mascot Hotel located at the centre of the city with a view over the skyline of the city including the state legislative assembly building. On 7th April we were picked up from the hotel for a scientific session at the conference hall of the KSCSTE at Sasthra Bhavan, Pattom. The day started with a warm floral welcome by the ladies of the council following the age old tradition of Kerala "Ethirellpu" which was deeply appreciated by all the Swedish visitors even though there was no "kottum kuravayum".

The executive vice president of the KSCSTE Dr. EP Yesodharan welcomed the Swedish delegates and expressed his wish to have a fruitful discussion during the visit and valuable cooperation in the future presenting the genesis and mission of the KSCSTE which has the chief minister of the state as its president.

The KSCSTE- Kerala State Council for Science, Technology and Environment was constituted in November 2002 as an autonomous body to encourage and promote Science and Technology related activities in the Kerala State by restructuring the erstwhile State Committee for Science, Technology and Environment (STEC) established in 1972 in concurrence with the Science Policy of Government of India.

The apex body of KSCSTE is the State Council with Chief Minister of Kerala as the President. The chief executive officer of the Council is Executive Vice President (EVP).

The Main functions of the State Council are to:

- Plan, formulate and implement Science and Technology Promotion and other related research and development programmes.
- Provide overall guidance to the programmes and the developments of R&D centres of the Council.
- Withdraw and disburse the grant-in-aid funds from the Government and sponsoring agencies to R&D Centres and other grant-in-aid institutions.

KSCSTE also have initiatives in popularising education in science in the schools and institutions of higher learning in the state.

KSCSTE has its own R&D centres and the presentations of the technical session were done by the directors of the respective institutions. There are six R&D centres under the umbrella of the Council



which does research work in specific identified domains. Presentations of the activities of the centres were done under the chairmanship of Prof. Ramon Wyss.

In his presentation Dr. M. Baba, director of the The Centre for Earth Science Studies ([www.cessind.org](http://www.cessind.org)) talked about the genesis, vision, mission and activities of the centre which was started as a Centre of Excellence in Earth Sciences instituted by the Government of Kerala in 1978. It is an Autonomous Research Centre and it promote and establish modern scientific and technological research and development studies in earth sciences. CESS pursues multidisciplinary approach in problems related to land, sea and atmosphere, does Research & Development activities in basic and applied fields, conducts user training, academic programs, consultancy and popularisation of Science.

Dr. MD Nandeswar, Director of The Centre for Water Resources Development and Management (CWRDM) located at Kozhikode presented various the activities of his institution. CWRDM has a Research Council and a Research Committee consisting of all scientists of the Centre which assist in monitoring the progress of research works and in carrying out preliminary screening of the project proposals. There are 37 scientists belonging to multifarious disciplines like civil engineering, hydrology, hydrogeology, environmental sciences, agriculture, biological and chemical sciences, social sciences etc carrying out research on 'WATER' in CWRDM. The technical staff and project staff provide support to the scientific teams. The scientific activities of the Centre are organized into seven scientific divisions, five units/central facilities and five regional centres.

Dr. R. Gnanaharan presented the activities of The Kerala Forest Research Institute (KFRI) which was established to undertake research in areas like forestry, biodiversity etc., that are vital to the development of the Kerala State. The Institute has well equipped laboratories to carry out modern research in tropical forestry to cater to the needs of various stakeholders. Some of the major facilities are:

Herbarium: Represented by more than 25,000 specimens of the flora of Kerala, recognized by International Association of Plant Taxonomists with the acronym KFRI.

Medicinal Plants Garden: Live reference collection of about 350 medicinal plant species of the forests of Kerala.

Wood Treatment Plant: Pilot-scale facility to assess treatability and treatment schedules of different timbers.

Biotechnology and Tissue Culture Facility: Sophisticated facility for molecular characterization and micro-propagation of forest plants.

Nursery and Field Trial Facilities: Attached to Subcentre, Nilambur and Field Research Centre, Velupadam, for laboratory experiments and nursery, species and plantation trials.

Teak Museum: The only one of its kind in the world with exhibits on history, research and development of Teak.

Bambusetum: Live-collection of over 65 native and exotic bamboo species of the world.

Germplasm: Live-collection of 30 species of indigenous and exotic canes.

National Transportation Planning and Research Centre ([www.natpac.org](http://www.natpac.org)) was established in 1976 as a Division of Kerala State Electronics Development Corporation (KELTRON), a Public Sector Enterprise under the Government of Kerala. In 1982, it was reconstituted as an R&D institution under the Department of Science, Technology and Environment, Government of Kerala. In November 2002, Kerala State Council for Science, Technology and Environment (KSCSTE) was formed, with the objective of adopting a concerted and integrated approach to the research and development activities in Kerala. In February 2003, NATPAC was amalgamated to the new Council and accordingly is functioning as an R&D unit under KSCSTE which is fully funded and supported by the Government of Kerala. The Centre is undertaking research and consultancy works in the fields of traffic engineering and transportation planning, highway engineering, public transport system, inland water transport, tourism planning, rural roads, environmental impact assessment and transport energy.

Rajiv Gandhi Center for Biotechnology (<http://www.rgcb.res.in>) was established exclusively for pursuing research in Biotechnology. RGCB's new, 1,10,000 square feet laboratory complex. In addition, the center has an excellent 350 seat convention center, guest house for visiting faculty and on-campus student accommodation. Rajiv Gandhi Center for Biotechnology is the only institution of its kind within the country, exclusively devoted to Biotechnology, focusing precisely on translational research. All RGCB research programs are created with the underlying concept seeking to promote better health care and improved productivity of spices and medicinal plants. The institute has 6 highly focused research departments working on medical

biotechnology and plant genetic engineering (Molecular Medicine, Molecular Endocrinology & Reproduction, Molecular Microbiology, Cancer Biology, Neurobiology and Plant Molecular Biology). The institute has major interdisciplinary consortium research programs on vaccine development, bioinformatics and bioprospecting for clinically bioactive compounds.

Dr. S. Ganeshan Director of the institute talked about the Tropical Botanic Garden and Research Institute ([www.tbgr.in](http://www.tbgr.in)) which was established with the vision of Conservation and sustainable utilization of the plant biodiversity of India, particularly of Kerala for the well being of her people". Examples on the mandate of the institute are:

To conserve, preserve and sustainably utilise the plant wealth of Kerala.

To introduce, cultivate and culture plants of India/other countries with comparable climatic condition for the economic benefit of Kerala and India.

To carry out botanical, horticultural and chemical research for plant improvement and utilization.

To organize germplasm collections of economic plants of interest to the state in the case of those species for which separate centers are not already in existence.

To establish tissue culture facility with special reference to the improvement of seeds/fruits/flowers and quick and easy propagation.

Thus TBGRI functions for inventory, conservation and sustainable utilization of the plant wealth through appropriate R & D efforts for the welfare of the state and the country at large.

After the lunch presentations were done by the members of the INSTEC deligation under the chairmanship of Dr. EP Yesodharan.

Prof Ramon Wyss of KTH Stockholm talked about the INSTEC, how it was formed and how it would like to work and what it want to achieve. He said INSTEC at present is a consortium of nine universities of Sweden and it would like to expand to contain all universities and probably even industries and NGOs. One of the objectives of INSTEC is to initiate a centre for advanced research in environmental science and engineering in India to carry out collaborative research programmes between India and Sweden.

Prof. Lars Christer Lundin of Uppsala University talked about a model system for water management, which was very interesting for the participants from the Centre for Water Resources Development and Management located at Kozhikode in Kerala. Dr. Kamalakshan kokkal of KSCSTE have already established a research link with him.

Prof Björn Karlsson of Lund University talked about various methods of using solar energy for heating and cooling of the built environment. One research link proposal on solar energy for cooling is being processed between Dr. Ajit Prabhu of KSCSTE and Prof Björn Karlsson of LTH, Lund University.

Prof. Göran Baurne of the Royal Institute of Technology was familiar with Kerala state and he had worked with Kerala and Tamil Nadu in connection with projects on water management in the 80-ties ( 9 years). He presented the activities of the Department of Land and Water Resources Engineering at KTH, Stockholm

Prof. Lars Öberg from Umeå University talked about his Department of Environmental Chemistry, its research projects and the masters degree programme in environmental science and chemistry which he is in charge of. A collaboration between Dr. Prakashkumar of the KSCSTE and Prof. Lars Öberg has been also initiated

In the afternoon we were taken to Sri Chitra Thirunal Institute for Medical Sciences and Technology (<http://www.sctimst.in>) for a study tour. This is an institute of national importance established by an Act of the Indian Parliament. It is an autonomous institute under the administrative control of the Department of Science and Technology, Government of India. The Institute signifies the convergence of medical sciences and technology and its mission is to enable the indigenous growth of biomedical technology, besides demonstrating high standards of patient care in medical specialties and evolving postgraduate training programs in advanced medical specialties, biomedical engineering and technology, as well as in public health. The Institute has the status of a University and offers postdoctoral, doctoral and postgraduate courses in medical specialties, public health, nursing, basic sciences and health care technology. BMT Wing has been instrumental in establishing a medical device industry base in India by successfully developing and commercializing technologies of a number of devices and implants. Some of the commercialised technologies include the production of blood bag, blood oxygenator, hydrocephalus shunt, artificial heart valve, concentric needle electrode etc.

## Meeting with the honourable chief minister of the Kerala state



KSCSTE-Kerala State Council for Science Technology and Environment with its Chairman Chief minister of the state Sri V:S. Achudanandan and the Vice Chairman Dr. Yesodharan received us and we had a hearty discussion about cooperation in research and education in environmental science and engineering.

The out-come of the visit.

In the concluding session we made a review of the visit, presentations study visits and other activities in general, some time was allotted for making a presentation of some concrete proposals from the scientists of Kerala to the visiting delegates to take home to Sweden for further action.

KSCSTE is an Indian counter-part endowed not only with required political power but also clear understanding of the acute necessity to attack serious problems of environmental pollution and management of waste, water, land, energy and bio-mass by carrying out advanced research and higher education.

Kerala government is planning to establish an institute for carrying out advanced research in environmental science and engineering and the chief minister extended an invitation to Swedish counter part to take a 50% stake. A letter of intent is to be drafted by the vice president of KSCSTE to be sent to Dr Ramon Wyss of INSTEC for further action in Sweden.

Concrete research link projects evolved at the meetings

1. Dr. Ajit Prabhu of the KSCSTE and Prof. Karlsson of LTH, Lund University have already identified "solar energy for cooling as a theme for a research link project between their respective institutions.
2. Dr. Kamalakshan Kokkal of KSCSTE and Prof. Lars Christer Lundin of Uppsala university also have established contact with each other in producing a research link project on water management
3. Dr, Harikumar of The Centre for Water Resources Development and Management, is al ready involved in a collaborative project with KTH, Stockholm.
4. Dr. Prakashkumar of KSCSTE and Lars Öberg of Umeå University on environmental science and chemistry.

Future plans

1. Organisation of an international seminar and workshop on sustainable development at the end of this year probably/possible in connection with the arrival of the VOLVO ocean race

2. To further develop the details of the proposal on cooperation in establishing an international institute for advanced research and education in environmental science and engineering.
3. A visit by officers of KSCSTE (president, vice president and the principal scientific officer) to Sweden for processing the proposals
4. Visit of Dr. V. Shobha, professor of environmental science, Kerala University, Trivandrum to visit Lund University
5. Preparation of a concept note on the centre for advanced research in environmental science and engineering

### **Proposals for future cooperation received from Kerala organisations**

KERALA STATE COUNCIL FOR SCIENCE, TECHNOLOGY AND ENVIRONMENT

Thiruvananthapuram – Kerala

#### CONCEPT NOTE ON ESTABLISHMENT OF CENTRE FOR ADVANCED RESEARCH IN ENVIRONMENTAL SCIENCES AND ENGINEERING (CARESE)

#### IN COLLABORATION WITH

#### SWEDISH INSTITUTIONS / SWEDISH GOVERNMENT

1. The Kerala State Council for Science, Technology and Environment (KSCSTE), the premier agency of the State co-coordinating and funding research and development in science, technology and environment proposes to establish a centre for advanced research in environmental science and engineering devoted to multi disciplinary research and development. This centre may be named Centre for Advanced Research in Environmental Sciences and Engineering (CARESE).

2. With the establishment of this Centre, KSCSTE will be empowered to carry out research and development activities aimed at providing scientific, technological and management solutions of the highest quality for sustaining human endeavor with respect to the quality of environmental resources and sustainable development in the state.

3. The Centre for Advanced Research in Environmental Sciences will have the following core Research and Development Divisions.

1. Air pollution Control (APC)
2. Environmental Biotechnology & Genomics (EBG)
3. Environmental Planning and Management (EPM)
4. Environmental Systems Design and Modelling (ESDM)
5. Geo-Environmental Management (GEM)
6. Solid Waste and Hazardous Waste Management (SHWM)
7. Water & Wastewater Technology (WWT)
8. Environment friendly energy options

4. The following service / support units will provide the necessary logistic support to the core research divisions.

1. Analytical instrumentation
2. Information and Communication Technology
3. Training and continuing education
4. Library & Documentation
5. R&D planning and Business Development
6. Engineering Services
7. Stores and Purchase
8. Transport, Security and Guest House

5. The management structure of the proposed research centre will consist of the following :

- (a) Research Council
- (b) Management Committee
- (c) Director
- (d) Registrar
- (e) Such other authorities and officers as may be appointed by competent authorities.

6. The year wise break up of scientific and other staff required in the research centre will be as follows:

	Year 1	Year 2	Year 3	Year 4
Scientific / Technical Staff	20	40	60	80
Administrative & Support Staff	5	10	15	20
<b>Total</b>	<b>25</b>	<b>50</b>	<b>75</b>	<b>100</b>

7. The Centre will have to rely on state government support in the first three years to fund its operations. Hence, if the Swedish Government / institutions are interested in this venture, 50% of the capital expenditure may be met by them. Consequently, they will have a role in the management. The support of the major industries in the state may be sought for developing the infrastructure of the Centre. It should be possible to generate at least 30 percent finance for research from year six onwards.

8. Organisations such as United Nations Environment Programme (UNEP), Ministry of Environment and Forests, Govt of India, Department of Science and Technology, Govt of India, Department of Scientific and Industrial Research, Govt of India, Central Pollution Control Board, State Pollution Control Board etc may be part funding in establishing the research centre or providing project grants.

9. The Centre would be established on 5 hectares of land and provide approximately 8000 sq.m of laboratory space for various functions.

10. The total investment required for setting up the Centre for Advanced Research in Environmental Science and Engineering is estimated as Rs. 5000/- lakhs. (US \$ 12 million). The project is proposed to be completed in 3 years.

11. Expected benefits to the participating institutions (in this case Government of Sweden / Swedish institutions)

- 11.1 Mutual exchange of scientists / academicians / researchers between two countries
- 11.2 Swedish institutes can get research projects done in the proposed laboratory as joint venture between India and Swedish scientists
- 11.3 Swedish industry / research establishment can get research projects done on contract basis at lower cost
- 11.4 Sweden can contribute towards establishment of an institute of international standards in the developing world and this would be a proud symbol of Swedish collaboration in a fast emerging economy like India.
- 11.5 Development of new technology on environment protection and waste management, which will be useful for India, Sweden and the world at large.
- 11.6 The proposed research project in the field of climate change, will be of mutual interest and global significance.
- 11.7 Research on alternate source of energy with special relevance to India and Sweden.

### **Concept Paper on Environmental monitoring Programme for the State**

- X Water Quality Monitoring Programme for the State
- X Soil Quality Monitoring Programme for the State

The prime objectives of the programme

- Ø Generation of primary water quality data of all river basins.
- Ø Effective storage, analysis and retrieval system for spatial and temporal databases on water and Soil quality .
- Ø Spatial analysis on depicting the source-pollutant relationship,

- Ø Graphical presentations, visual impacts and spatial distribution of graphical outputs on water and soil quality changes, pollution load and relationship with sources and
- Ø Management of river basins and other water bodies by generating classification on best designated use on the basis of water quality criteria and also based on water quality indices

Management of agricultural practices based on Soil quality

Water quality monitoring

X The programme will cover the entire 44 River basins of the State Surface water & ground water will be monitored in each basin area

Soil Monitoring programme

X Soil monitoring programme to be launched in one Gramapanchayth each in 56 blocks of the State.

Budget

X Water Quality programme - Rs. 20 million per year

### **Concept Note regarding Study on Climate changes in Kerala**

Introduction

The global climate change occurs due to natural and anthropogenic activities. The natural changes which are cyclic and resulted in glaciation followed by inter glaciation periods. It is also worth to be remember that uncontrolled anthropogenic activities are largely influencing the climate factors contributing the climate changes. In either case proper mitigation efforts should be resorted in order to compact and reduce the impact of climate changes on our land and water mass, sea level rise and habitat destructions. This global phenomena may have pronounced effect on Kerala as it has a extensive coast of 590 Kms. About 26% of the total population of Kerala out of the 30 million people is residing in the coastal area which is 10% of the total land area. Further, Kerala has a unique coastal wetland ecosystem in which two are Ramsar sites and two wetlands of national importance. The area like Kuttanad in Kerala which is the lowest region of India with 500 Km<sup>2</sup> of extend lies below sea level. This elevation ranges from 0.6 m about to 2.2m below sea level. According to the IPCC scientific report, 'Climate Change 2007: Impacts, Adaptation and Vulnerability', "Coasts are projected to be exposed to increasing risks, including coastal erosion, due to climate change and sea-level rise. The effect will be exacerbated by increasing human-induced pressures on coastal areas. Sea-level rise and human development are together contributing to losses of coastal wetlands and mangroves and increasing damage from coastal flooding in many areas."

With the above background, Kerala State Council for Science, Technology and Environment (KSCSTE) proposes to undertake a project on Study on Impact of Climate Changes in Kerala with the possible funding from Government of Sweden.

Objectives

The proposed study will focus on the following factors : X Observation and collection of local data on climate change X Climate change and its impacts in Kerala

X Paleoclimate - Understanding the causes of such past climate changes is an essential part of developing and validating models of future climate change

The impact of climate change in the following may also be studied : X Land and water (landslider, flood, drought etc)

X Emerging infections (Vector Borne)

X Wetlands & Mangroves

X Changing cropping pattern and agricultural practices X Coastal Ecosystems

X Coral reefs of Lakshadweep sea

X Eustatic water levels

Methodology

The climate changes will be studied using the available data with IMD, R&D Centres and universities.

The monitoring systems will be implemented with the following factors under consideration

X Carbon monitoring Towers ("tall tower" network will be used to measure carbon emissions.)

X Methane emissions in wetlands

X Carbon absorption potential of plantation corps

+ Rubber

- + Coconut
- + Tea
- + Coffee
- + Cardamom etc

The following components are included for monitoring: X Changes in weather phenomena

x Rainfall pattern/distribution/period

X Local impact like sea level rise (risk analysis) X Change in agricultural pattern

X Changes in habitation of animals

X Carbon sequestration capacity of plantation crops

The important Plantation Crops of Kerala with the total percentage of land area in the state is given below

4'ai: utta M Total percentage o an ' with respect to State

Coconut

Rubber

Coffee

Tea

Cotton

Arecanut Cardamom Total 23.10%

12.72% 2.17%

0.90% 0.069%

0.069%

0.011%

39.02%

Project period

The project is initially proposed for a period of three years with a provision to extend it based on requirement.

Budget

The budget for three years period is worked out to be 60 million (details are being worked out).

### **Concept Paper Study on impact of Climate Change in Kerala**

Kerala

X Kerala has a sea coast of 587 km.

X 26% of the total population is residing in the coastal area which is 10% of the total land area.

X Kerala has a unique coastal wetland ecosystem in which two are Ramsar sites and two Wetlands of National importance.

X Kuttanadu in Kerala, India is the lowest region of India, with 500 Km<sup>2</sup> of the region below sea level. Its elevation ranges from 0.6 m above to 2.2 metres below sea level

The study will focus on

X Observation and collection of local data on climate change

X Climate change and its impacts in Kerala

X Paleoclimate - Understanding the causes of such past climate changes is an essential part of developing and validating models of future climate change.

Impact on

X Land and water (landslides, flood, drought etc)

X Emerging infections (Vector Borne)

X Wetlands & Mangroves

X Changing cropping pattern and agricultural practices

X Coastal Ecosystems

X Coral reefs of Lakshadweep sea

Monitoring system

X Carbon monitoring Towers ("tall tower" network will be used to measure carbon emissions.)

X Methane emissions in wetlands

X Carbon absorption potential of plantation corps

+ Rubber + Coconut



- + Tea
- + Coffee
- + Cardamom etc

Components for monitoring

X Changes in weather phenomena

X Rainfall pattern/distribution/period X Local impact like sea level rise (risk analysis) X Change in agricultural pattern

X Changes in habitation of animals

X Carbon sequestration capacity of plantation crops

Plantation crops OF Kerala

Species	Crop area hectares	Total percentage of land with respect to State
	8,97,83,300	23.10%
	4,94,40,000	12.32%
	8464400	2.17%
	3504300	0.90%
Cotton	265500	0.069%

Cardamom 41332

Total 39.02%

Budget for 5 years programme

Rs. 75 million (Details are being worked out)

### **Sastraposhini- A Scheme for Boosting Science Education in Kerala Schools**

The educational achievement of Kerala in terms of literacy including female literacy, dramatic increase in number of schools and college etc., is well known and much studied. What is less well recognised is the alarming decline in the standard of education at all levels, especially science education. This has had many serious consequences - drop in the enrolment for science courses; inability of science graduates from Kerala to compete for admissions or jobs at the national level; poor record in terms of patents and research and development work for industry etc. The problem has been aggravated in recent years by the hype on IT, BT, management etc., which, while exceedingly important, cannot replace science education of high quality at the school and college levels. Indeed a knowledge society, which spawns IT, BT etc can be built only on the foundations of a work force educated in science. As any reform process must begin at the grass roots, the 'Sastraposhini' scheme aims to strengthen science education at the school levels in Kerala.

In the present proposal, it is intended to implement the scheme of strengthening of the laboratories in all the govt. high schools of the state of Kerala. It may be noted that the concept, methodology, monitoring and outcome were standardized in three phases with the guidance of a set of senior teachers. The Council has already established model science laboratories in over 100 selected schools in the state and the response is highly rewarding.

Objectives

- To stimulate interest in science at the school level (8<sup>th</sup> -10<sup>th</sup> standard) by the performance of experiments in physics, chemistry and biology by students.
- To organise training programmes for teachers for demonstrating scientific experiments.
- To foster innovations in science teaching, especially laboratory experiments in schools.

Budget

Total expenditure for implementation for 1 school is as follows:

Sl. No.	ITEM	For 1 school (amount in Rs.)
1	Teachers training	15000.00
2	Refurbishing of laboratory	100000.00
3	Procurement of laboratory items	3,25,000.00
4	Operational expenses	10000.00
5	Man power- At KSCSTE HQ	10000.00
	<b>TOTAL</b>	<b>4,60,000.00</b>

The State of Kerala has over 2500 government high schools. If the science education in the entire government high schools of the state can be strengthened, it will be a valuable contribution to the science as well as future generation.

The total budget estimated for implementing the programme in the 2500 schools is 1150 millions.

### **Centre for DNA Barcoding of Lifeforms**

Modern biological taxonomy began in the 18 century with the Linnean system of binomial nomenclature and higher classification. Since that time, taxonomists have been describing species on the basis of their morphology, ecology and behavior. Molecular biomarkers have become invaluable tools in taxonomic research and in systematic and evolutionary biology. DNA sequence analysis of a short standardized diagnostic gene region enabling to specimen identification has been referred as DNA barcoding. Just like UPC barcodes used to identify manufactured goods, the DNA sequences within each species are unique. A run of 15 nucleotides, with 4 options at each position, creates the possibility of 1 billion codes, a hundred-fold excess over the estimated number of animal species. A public library of sequences linked to named specimens, plus faster and cheaper sequencing, will make this new barcode key increasingly practical and useful.

Why do we need a molecular taxonomy tool?

An increasingly accepted view is that traditional taxonomic practices are insufficient on their own, to cope with the knowledge on the systematics of organisms, much required for biodiversity studies in continents. Approximately 1.7 million species have been described and named under the Linnaean system, though the total number of species on earth remains unknown and estimates vary widely, ranging from 10 million to more than 100 million (<http://www.barcodinglife.com/>). The task of recognizing new species has certain urgency; the diversity of our biosphere so large that the methodical cataloguing of new species by traditional methods is being outpaced by losses from human impacts. In the face of such mounting losses to biodiversity, the need to catalogue and describe life is greater than ever.

Embracing the molecular biology tool to identify species can turn taxonomists into 'a high tech community'. The ability to identify the source and origin of an unknown specimen benefits not only conservationists, but also a tremendous tool for a ecologists as well. The use of barcoding will readily allow the identification of small biological fragments or sterile material, eggs and larvae of marine species and forensic materials which previously would have been extraordinarily difficult or impossible to identify. The importance of establishing such a facility in the tropical belt of the country has much application and value in the context of emerging patent issues and IPR values. Proposed Budget for establishing and running the programme is 40 millions

### **Biotechnology Resource Centre (BRC)**

The core technique of biotechnology is elegant in its simplicity and allows researchers to isolate, copy, and rearrange this genetic blueprint at the molecular level to manipulate the quantity, structure, and function of the biomolecules. Discoveries concerning the molecular bases of cellular processes will have a wide range of applications and allow biotechnologists to develop new products, processes, and therapies of commercial interest. However these techniques need sophisticated instrumentation. A core facility with advanced instruments like automated DNA sequencer, Gene Chip microarray system, RT-PCR, MALDI-TOF/TOF, Confocal Microscope, SEM, 2-Dimensional Electrophoresis system etc are needed to provide services to R&D centers, University departments, biotech enterprises etc in the state. The Kerala Biotechnology Commission and KSCSTE intend to create a Core Biotech Instrumentation facility in the state.

The mission of the proposed Bio-Resource Centre is to be a centre for excellence in Biotechnology Resource in the state of Kerala, which provides the state of art equipments and expertise to accelerate and support research as well as HRD process. The proposed Bio-Resource Centre will have well equipped laboratories and provide services and training in the areas of Microbial-biotechnology, Molecular biology, Proteomics and Animal Tissue Culture. The facilities can be used for a multitude of research applications, services, training and pilot scale product scale up and validation. Bio-Resource Centre will facilitate in establishing closed formal linkages/collaborations with local universities and research institutions for collaborative research programmes in biotechnology and also to provide instrumental support to small and medium level biotech entrepreneurs.

Proposed Budget for establishing and running the programme is 300millions Our Track record STIC- Sophisticated Test and Instrumentation Centre, is a similar kind of Institution established by KSCSTE. The objective of this institution is to assist the Industries, R&D organizations and Higher Education Centers by providing highly sophisticated testing and calibration facilities, material analysis facility, R&D support and consultancy services. The Calibration Laboratories of STIC are accredited by National Accreditation Board for Testing and Calibration Laboratories (NABL).

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### **INTEC Partners**

The following universities have joined the network:

Lund University (LU), [www.lu.se](http://www.lu.se)

Blekinge Institute of Technology (BTH), [www.bth.se](http://www.bth.se)

Linköping University (LIU), [www.liu.se](http://www.liu.se)

Stockholm University (SU), [www.su.se](http://www.su.se)

Royal Institute of Technology (KTH), [www.kth.se](http://www.kth.se)

Swedish University of Agricultural Sciences (SLU), [www.slu.se](http://www.slu.se)

Uppsala University (UU), [www.uu.se](http://www.uu.se)

Umeå University (UMU), [www.umu.se](http://www.umu.se)

Luleå University of Technology (LTU), [www.ltu.se](http://www.ltu.se)

IVL Swedish Environmental Research Institute, [www.ivl.se](http://www.ivl.se)

has also become a member of the network. Our aim is not only to include universities and institutes but also industry and government as well as non-government organisations.

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