Overview of Presentation:

- Life Cycle Approaches in India
- Status of LCA in India
- Some LCA Case Studies in India
- Events/ Networking/ ISLCA
- LC Approach to Household Waste Management
- Results and Discussion
- Conclusions
### Life Cycle Approaches in India

- **1991 (MoEF)**: Introduction of Eco-mark (as old as SETAC code of practice)
- **1996 & 2002 (World Bank)**: Training Programmes for the Senior Officers (including Chairmen and MS) of CPCB and SPCBs (highest technical bodies in India).
- **1997**: Establishment of ISLCA for networking and knowledge sharing on LCA; (see www.neef.in for details)
- **1997-2006**: Some abridged LCA case studies mostly by academia, Govt, Companies
- **1998-2006**: Guiding students, consultants and others on LCA
- **1999-2006**: Representing on the Editorial Board, Int. J. of LCA, Germany
- **2002**: International Conference: on “EcoBalance and LCA in India” - largest LCA event in the country so far by MoEF, AIST and IDBI: The main objective of conference was to promote the LCA concept and capacity building in India; also supported by the UNEP and APO
- **2002-2006**: Representing on ILCP of UNEP
- **2003-2005**: Participation of Govt. officers, Academia, in several events abroad.
- **2006**: UNEP-MoEF-Air-India Roundtable on Sustainable Consumption and Production

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### Eco-Mark in India

- LC Approach formally initiated by introduction of ‘Eco-mark’ Scheme by GoI in 1991, to increase consumer awareness for easy identification of Eco-friendly products.
- It is issued to products, which have little or no adverse impact on the environment or health of consumers.
- It covers sixteen categories of products such as soaps, detergents, paper, food items etc.

**Eco-mark Logo: An earthen pot:**

- Signifies Eco-friendly products as an Earthen pot uses a renewable resource like earth;
- Does not produce hazardous waste and consumes little energy in making;
- Represents both strength and fragility (Which is also characterizes our Eco-system)
Eco-Mark in India

- Evaluation based on two main criteria that follows a “cradle-to-grave” approach.
  - Product General Requirements (PGRs) - compliance with the pollution control acts, creating environmental awareness among consumers in addition to safety, quality and performance of the products.
  - Product Specific Requirements (PSRs)- cover the production process including the source of raw materials, use of natural resources, likely impact on environment, conservation of energy during production, disposal, utilisation of waste and recycled materials, suitability for recycling and packaging and biodegradability.

- The overall response to the Eco-Mark programme has been quite limited and manufacturers are hesitant to apply for the Eco-Mark label due to several reasons (costs involved, numerous regulatory requirements, etc.)

- The label is voluntary and awarded by BIS, MoEF and CPCB

- Very Low Public Awareness only 18% among literates and 3% in general public total (Survey by IGIDR and IITB)

National Environmental Policy 2006

- NEP- 2006 is the latest policy document of GoI but it does not mention anything about LCA.
- It does mention about Ecolabeling which differs from the EMS in that they address the preferences of environmentally conscious consumers, rather than ensuring adherence to national environmental standards.
- They may involve review of the entire product cycle, and since they are concerned primarily with consumer preferences, may relate to external or ad-hoc, rather than national environmental standards.

Actions to be taken by the GoI

- Formulate “Good Practice Guidelines” for ecolabels to enhance their scientific basis, transparency, and requirements of participation.
- Promote the mutual recognition of Indian and foreign ecolabels, which adhere to the Good Practice Guidelines, to ensure that Indian exporters enhance their market access at lower costs.
- Promote “good practices” norms in all relevant sectors to conserve natural resources and reduce adverse environmental impacts, covering siting, choice of materials, use of appropriate energy efficiency and renewable energy options, and addressing solid wastes generation, effluents and sewage handling, gaseous emissions, and noise.
LCA Case Studies in India

In terms of methodological development and application of LCA, India is still far behind in comparison to developed countries.

Only a few case studies on limited LCA have been carried out so far by Academic and Research Organizations

- Paper Sector Study (Academic and R&D)
- Steel Sector Study (Industry and Govt.)
- Coal Sector Study (Academic and Industry)
- Cement Sector Study (Academic and R&D, Govt.)
- Coir Sector Study (Academic and R&D)
- Dairy Sector Study (Academic and R&D)

LCA related Projects

- 1992-94 (UNCED): Consumption Patterns, Demographic Pressures, Resource Use and Environmental Stress
- 1994-05 (UNCTAD): Trade and Environment Linkage: A Case Study of India
- 1996-98 (UN-ESCAP): Models for Sustainable Development
- 1998-2000 (UNDP): Consumption Pattern by Income Groups and Environmental Implications for India
LCA related Publications


2006: Limited Life Cycle Assessment of Coir Processing

Study of HWM using LC Approach

- Conducted in Mumbai using abridged LCA by IITB
- Objective was to estimate Socio-economic and Environmental impact during each life cycle stage of Household Waste (HW)
- Household Waste Management cycle was divided into four main stages within the household
  - Generation
  - Storage/Handling
  - Re Use/ Recycle
  - Final Disposal (collection from home by garbage collectors)
- Included extensive field survey of 100 households (Nearly 500 people)
- Shows that simple abridged LCA methods can be used for various products/processes which may help in delivering the complex LCA models
Why LC Approach to HWM

Life cycle approach, is holistic, all-encompassing thus well suited for HWM

» Social aspects consist of source reduction at the micro level i.e. household level using the “5Rs principle” - Refuse, Reduce, Recover, Reuse and Recycle.

» Economic aspects involve waste recycling and trade (barter) of waste.

» Environmental aspects consist of eco-efficient disposal of waste.

» Political, Legal and Administrative aspects consist of formulation and implementation of environmentally effective, economically efficient and socially acceptable ways (macro level) covering the first three aspects of HWM.

Thus, individuals are not only made aware of but also have the responsibility of the amount of HW generated.

Details of Study

- Location: Mumbai - the Financial Capital and largest populated city of India.
- Sampling: 100 households selected randomly based on socio-economic parameters and investigated using cradle-to-grave approach.
- Functional Unit = Household; Cradle = Generation of Household waste; Grave = Final Disposal (collection from home by garbage collectors)

» The Main objectives:
  • To estimate Socio-economic and Environmental impact during each life cycle stage of household waste.
  • Understand amount and types of waste generated by households, methods of handling/storing, re-use, recycle upto its final disposal i.e. collection by garbage collectors
  • To develop a conceptual and methodological framework for integration of social issues into environmental LCA relevant to India.
  • To help create a greater awareness at the local/national levels to conduct day-to-day activities in an environmentally responsible way.
Biodegradable (wet) waste = kitchen and garden waste.
Recyclable (dry) waste = paper, plastics, glass, steel tins and cans, clothing, shoes, etc.
Hazardous/Toxic waste = adhesives, medicines, disposable hypodermic needles, fuels, oil-based paint, batteries etc.
Debris / Renovation waste = from household renovation

- In India, at the household level, waste is generally not segregated as dry and wet garbage and only mixed waste is collected.
- HW - major part of MSW, which also includes commercial wastes generated in municipal or notified areas in either solid or semi-solid form excluding industrial hazardous wastes but including treated bio-medical wastes (MoEF, 2000, Notification)
- Generation of MSW from 4378 cities in India is estimated as 100,000 TPD of which only 7% is treated to generate compost and power; the remaining consists of 20% recyclable, 35% compostable and about 35-40% inert waste.
- Among these cities, Mumbai, generates highest amount of MSW at 7500 TPD

**Composition of Household Waste**

**Functional unit = Household**

- Generation
- Storage/Handling
- Utilization
- Final Disposal

Where is the waste produced?
Mixed or Segregated?
Reuse/Recycle/Traded (barter)?
Collection by garbage collectors
**Socio-Economic Parameters**

- Size of Household
- Size of Family
- Age
- Gender
- Education
- Household Income
- Household Expenditure
- Household Savings
- Health Status/Immunity

**Brief Methodology**

- **Primary Data**: face-to-face interviews of 100 households (about 500 persons)
- **Secondary Data and information**: from literature has been used to generate past and present scenarios of waste generated due to household activities.
- **Household activity SWM** within the household focusing on Generation, Handling (whether segregated into dry and wet or mixed garbage), Re Use/Recycle (Trade of waste) Method of garbage disposal, Level of awareness.
- **Socio-Economic Parameters**: Age, Gender, Education level (School, College, University), Employment, Size of family, Income level of household per month classified into 4 groups as follows: (in INR where, 1 INR = 45USD approx)
  - Very Low Income Group (VLIG) less than INR 7,500/-
  - Low Income Group (LIG) from INR 7,501/- to 10,000/-
  - Middle Income Group (MIG) from INR 10,001 to 15,000/-
  - Higher Income Group (HIG) more than INR 15,001/-
- **Household Expenditure, Savings and Assets per month in INR**
Average family size
- 6 persons in VLIG and LIG households
- 4 persons in MIG and HIG households

Literacy level
- b/w illiterate and matriculate levels in VLIG and LIG
- b/w matriculate and undergraduate levels in MIG and HIG

Income levels
- In some VLIG and LIG families were as low as INR 9000 per annum and on higher side upto INR 96000 per annum.
- In sharp contrast, the higher income levels in HIG households were as high as INR 2400000 per annum.
- This highlights the gross disparity in income levels across various strata of the society in the country.

Buying behavior
- In general, higher correlations were observed between income and education levels and environmental awareness \( (r = 0.8 \text{ and } 0.9, \text{ respectively}) \)
  - VLIG (in particular) and LIG households determined primarily by personal needs and there was hardly any decision taken by them based on environmental choices.
  - MIG and HIG households, higher income and education levels more conducive to make sustainable consumption decisions, yet lack motivation, put onus of proper waste management on municipal authorities.

Mixed Waste collection strategy
- Irrespective of income/education levels, most households not conscious of the great danger to environment and health of mixing waste (lose of useful secondary resource; health impacts on informal waste pickers).

Food habits
- 64.1% Non-vegetarian (National Average)
- 92% of 4 Southern States (recent survey by NIN, under WB assisted project)
Preliminary Conclusion

- Data analysis using a life cycle approach reveals that at each stage of HWM, the households (functional unit) were more concerned about meeting their personal needs than caring for the societal benefits in terms of health and environment.
- Although they are quite sensitive to HW at generation, handling (collection and storage) and utilization (reuse, recycle and trade of waste) stages, they are not much concerned about its final disposal and subsequent impacts.
- In all stages of HWM, the socio-economic status of households plays a significant role and also influences other aspects such as households’ buying behavior, perception and attitude towards environmental issues.
- Lack of source segregation of HW at household level as well as MSW at city level not only results in loss of useful secondary resource but also poses a danger to health and environment.

Preliminary Conclusion

- HWM in Mumbai needs increased attention of concerned stakeholders including households, municipal authorities and decision makers.
- Greater awareness at the local and community levels will educate individuals to adopt eco-friendly approaches to their activities, including better management of the HW.
- It is recommended that enforcement of technical and policy measures are needed for improving the conditions in terms of HW management in particular and the environmental conditions of the household sector, in general.
- Promotion of environmental awareness at all levels is necessary; Local political leaders could play an important role in motivating the people and authorities to work in tandem to take care of HW through its efficient management.
HWM Matrix

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<thead>
<tr>
<th>Level of decision making</th>
<th>Waste Management Aspects</th>
</tr>
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<tr>
<td></td>
<td>Social</td>
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<tr>
<td>National</td>
<td>✓</td>
</tr>
</tbody>
</table>

Conceptual Framework for Promotion of LCA in India

- Selection of National Level Organization
- Formation of National Core Group (All Stake holders)
  - Research and Academics
  - Government, Industry Representative NGO's
  - Others (Individuals, Consultants)
- Regional Networks (N, W, S, E, etc.)
- Identification of Key Issues and Problems
  - Resources Constraints (Human, Financial, Technical)
  - Lack of Awareness, Policies, Methodology
- Promotion of LCA
  - Networking, Collaborations
  - Researchers, Capacity Building, etc.
- Output
- Review/Feedback
Thank you