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Post -Tsunami Programme

Demonstrating ESTs for Building waste Reduction in Indonesia

The DEBRI Project

Guidelines for Collection of data on debris resulting from the 2004 Indian Ocean Tsunami in Banda Aceh, Indonesia

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International Solid Waste Association

LINGKUNGAN HIDUP
Ministry of Environment, Government of Indonesia

UNEP
United Nations Environment Programme

These guidelines have been developed in order to lead activities related to firstly, collecting all existing information on Tsunami-generated waste, including the organizational and operational processes to clear it[1]; secondly, creating baseline data that will help in developing a waste management mechanism to handle day-to-day construction and demolition waste, but quickly up-scaled to handle debris during a disaster.

The manual will be used by a consultant to be hired under the project, who will work closely with the DEBRI Staff Members in Indonesia and Indonesian Ministry of Environment, along with local government agencies/units in Banda Aceh itself, to collect data as outlined below.

The manual is part of Activity 1 of the DEBRI Project (Baseline Data Creation). The information resulting from this manual will be used as a basis for (a) development of a Waste Management Mechanism and for (b) technology identification and selection that will be procured under the project. The intended output of this manual is a report containing the issues outlined here.

Information from environmental assessments and discussions of UNEP, UN-OCHA, UNDAC and other organizations, carried out in the aftermath of the tsunami disaster, was used to prepare this manual.

1. Introduction: Disaster Waste

As highlighted by the Indian Ocean Tsunami that struck Indonesia on 26 December 2004, natural and man-made disasters can generate enormous volumes of debris, including soil and sediments, building rubble (brick, concrete and timber), vegetation (leaves, branches and trees), personal effects, hazardous materials (oil drums, asbestos and batteries), mixed-up domestic and clinical wastes and, all too often, human and animal remains.

This waste represents in many cases, a risk to human health from biological sources (flies, rodents, rotting carcasses), chemical sources (asbestos, oils, solvents) and physical sources (cuts, abrasions, collapse). The waste also impedes pedestrian and vehicle access and blocks services (drains, sewers).

Disaster wastes need to be handled in an environmentally friendly manner including proper handling of scrap metals (copper, steel, aluminium), timber (for reconstruction and heating/cooking), demolition waste from buildings/structures (for re-use, re-working as an aggregate or infilling/protection material) and uncontaminated soil/sediment (for restoration or in-filling). Disaster waste materials place an additional burden on a nation or community already struggling to cope from the disaster.

[1] Much of this information is already available with various local government agencies and international NGOs working in Banda Aceh.

The amount and type of debris generated from a disaster varies from situation to situation, including the following:

1. **Natural Disasters**

- *Tsunami*: widespread deposition of wastes on relatively narrow coastal fringe, potentially pan-oceanic (including sub-sea deposition)
- *Earthquake*: localized generation of building material waste (and sediment from landslides) from seismic activity
- *Flood*: generally localized generation of soil, sediment and building material waste
- *Hurricane:* high-velocity winds and storm surge generally impact region of first landfall with high volumes of building material and vegetation waste being generated
- *Forest Fires:* although low volumes of waste are generated, includes building material waste; de-vegetated slopes are more vulnerable to mud-slides/landslides

2. **Man-Made Disasters**

- *Industrial Accidents:* generally localized, waste types dependent on chemical release (or combustion by-product)
- *Dam Breach:* similar to flood above
- *Conflict*: bomb-damaged buildings (domestic and industrial) potentially impacted by depleted uranium (DU) and unexploded ordinance (UXO)

Debris in Banda Aceh

It has been estimated 4.7 million tonnes of recyclable demolition wastes will result from the planned recovery and reconstruction works in the Aceh Province. These demolition wastes include brick and concrete blocks that have been deposited around the buildings destroyed and damaged by the tsunami and wastes that will be generated immediately prior to reconstruction works. These demolition wastes include those derived from damaged buildings (domestic housing and commercial buildings) and infrastructure including roads and bridges.

The recycling of these wastes will have many benefits, including reduction of environmental risks, support and accelerate reconstruction works, sustainable employment generation, and demonstration and awareness-raising in waste recycling.

The nature and scale of disaster waste problem is also dependent on the event's intensity and duration, topography (coastal fringe, reclaimed land, highland), human settlements (sparse or densely populated area) and human activities (industry, farming, fishing). The ability to respond to the disaster waste problem will be dependent on the residual status of the communities infrastructure (roads, landfills), equipment (wagons, compacter, collectors) manpower (trained operatives, waste planners) and funding.

2. Types of disaster waste and its implications

Vegetative debris is the largest portion of the debris produced during a disaster. These includes wastes such as trees, stumps, brush, and leaf litter that can easily be collected, stockpiled, land filled, used for firewood, as compost or as mulch.

The materials that remained after the recent Indian Ocean tsunami included aggregates, wood, metals, gypsum, plastics, bricks, tiles, and asbestos roofing. The materials from the construction and demolition (C&D) class of debris can generally be recycled. However, materials containing asbestos need careful handling.

Two of the main classes of non-vegetative waste are aggregates, and construction and demolition debris. Aggregate debris, such as asphalt pavement and concrete, results from the destruction of roadways and other constructed land covers. These materials, if separated can be stockpiled and rescued after reprocessing them to the specifications used for road base aggregate or solid fill material.

The second class, C&D debris, is also a large component of disaster debris. This debris is the result of the destruction of homes, commercial and non-commercial buildings, and other structures. Most of the non-vegetative waste can also be reused or recycled. Any non-vegetative waste that cannot be reused or recycled should be carefully disposed in a properly managed dumpsite to avoid groundwater pollution and other problems.

Based on site-specific conditions of geology and hydrogeology, a debris disposal site could be strategically located above the groundwater table and over a layer of densely pack soil, such as clay, that would act as a barrier to leachate entering the groundwater supply.

Some debris components have specific storage and disposal requirements. For example, debris that consists of decomposing organic matter, chemicals, and fuels such as petrol, kerosene, and diesel could contaminate the groundwater for years to come unless a suitable location and dump site design is selected for disposal or burial.

Thus, as illustrated above, different types of disaster wastes need to be handled in different environmentally-sound ways. The key to a systematic approach to handling disaster debris is proper data/information on the quality and quantity of wastes, and information on the organizational/operational processes that are needed to properly manage them.

3. Data Requirements

In order to develop a comprehensive baseline database on C&D debris and other related issues (including the development of a debris waste management mechanism), and collect date for the next set of activities of the DEBRI project, the following information will be necessary:

a. Waste Assessment:
This is a brief section on assessments of the waste situation in Banda Aceh, in the aftermath of the Tsunami disaster (2004-2006):

- **Tsunami-generated C&D Wastes**:
  - Debris categories identified, for example bricks, concrete, wood, stone, plastics, metals, tiles etc. *List and briefly describe the various kinds of debris.*
  - Estimates of waste quantities resulting from the tsunami。 *For each waste category, indicate quantities of waste generated in a table.*
- **Normal C&D Wastes:**
  - Normal daily waste arisings. *List out the waste quantities and source to project future demand on waste management mechanism*
  - The quality of the wastes. *For each category of waste, briefly describe the quality, for example, are they mixed or clean/sorted*
  - Waste sources. *Indicate the sources – both the location where they are generated (geographical), and activities that generate them (functional)*

- Identify directly reusable and/or recyclable waste materials. *For each category, indicate the potential for recycling and mention any ongoing formal or informal recycling/reuse activities.*

- **Other types of Wastes:**
  - Brief description of the qualities and quantities of daily municipal solid wastes

Box 1: Estimating the volume of C&D debris generated during a disaster

- Use census data to list out pre-disaster number of buildings based on the building material used*:
  - Single-storied wooden houses
  - Single storied brick-and concrete houses
  - Single storied commercial establishments
  - Multi-storied commercial establishments
- Estimate the average floor area in [sq.m.] of each of the above types by sampling about 30 houses and establishments.
- Multiply the floor area with the following ratio (estimates by Indonesian Architect Y. Hardjono):
  - Traditional wooden house: 10-15 kgs of C&D debris per square meter of floor area.

    NOTE: Of this, approximately 70% is wood, 15% is roof tiles or sheeting, and the remaining is other/mixed materials, including concrete foundations.
  - Modern brick and concrete house: 20-25 kgs of C&D debris per square meter of floor area.

    NOTE: Of this, approximately 65% is brick/concrete, 15% is wood, 10% is roof tiles or sheeting, and the remaining other/mixed materials, including concrete foundations.
- Make note of type and volume of building materials used (this information should be confirmed by interviewing a local architect or civil engineer):

Type of structure	Building material type	Debris characteristics		
		Weight [kg/sq.m.]	Percentage volume	Percentage weight

* *If this data is not available from the Census, then SPOT5 or other aerial maps can be used for the purpose. For example comparison of pre and post tsunami on vegetation loss (from infra-red / chlorophyll) and texture/pattern changes (e-cognition) provide estimates of displaced soil and sediment quantities and building debris quantities and present location.*

b. Recycling and Disposal Options:
This section provides short explanation on the different techniques and management options for debris and wastes in Banda Aceh, in the aftermath of the tsunami disaster

(2004-2006). The section describes and explains the following topics:

- Description of pre-Tsunami waste disposal methods. *A description of the various methods used to dispose waste before the tsunami disaster. This can include information on equipment (trucks, heavy equipment etc.) Information on human and financial resources, can also be included.*
- Description of current post-Tsunami disposal practice. *A description of the various methods currently being used to dispose waste. This can include initiatives started by international organizations and NGOs, as well as informal sector.*
- Identification and assessment of current and potential national / local recycling markets, including export. *Include descriptions of recyclable waste types, potential volumes, prices/costs of scrap materials. Where possible, include activities and role of informal sector recyclers.*
- Current status of dump site / landfill. *List out the location, distances, capacity, and environmental impacts, if any.*
- Lifespan of present (and pre-tsunami planned) dumpsites and landfills. *This information will be necessary for assessment of possible void space available for future disaster wastes.*
- Identification of transfer sites and temporary waste storage sites. *Such sites have been and can be used for sorting and processing of waste materials (including recycling) and intermediate storage/treatment of wastes.*
- Exiting medium / long term strategy for sustainable waste management in region/province. *This description will have to be linked to relevant sections of the (new) national waste management strategies*

c. Institutional Structure:
This section provides an overview of the various institutional responsibilities currently in place in Banda Aceh. The section describes and explains the following topics:

- Current national waste management legislation and regulations, highlighting environmental protection legislations, reuse/recycling structures and waste categorizations. *Particular reference needs to be made to the new national waste management legislation that will come into force in 2007.*
- Legal waste ownership structure and liabilities. *This information is critical to ensure that a market can be effectively developed for recyclable/reusable wastes*
- Geographic and functional jurisdictions of legal legislations and governmental agencies/departments at the city, province and national levels. *This information will contain descriptions of the legal/legislative mandate and corresponding waste management activities at the three levels.*
- National and regional reconstruction and rehabilitation plans, with particular reference to waste issues. *Information from BRR and other local/provincial agencies can be included here.*
- Roles and responsibilities of local government agencies in waste management (Banda Aceh Municipality, BAPEDALDA, Cleansing Dept. etc.) before and after Tsunami for waste management
- Capacities of local provincial and central governments to cope with waste management. *Information on human, technological and financial capacities should be listed. Opinions of officials may also be quoted. This includes the potential training that they may need in the future.*
- Details of disaster waste management plans in place and initiated, if any, after the tsunami disaster

d. Local/regional Capacity Assessment:
This section provides a brief assessment of the available and needed capacities for

effective handling of debris and waste. It describes and explains the following topics:

- Currently available waste management and recycling capacity including personnel and equipment/machinery
- Current level of waste management knowledge and expertise, including approved codes of practice and national/regional guidelines, for example for asbestos handling or healthcare wastes
- Integrate pre-tsunami waste management contractors/operators and planned developments
- Identify areas for enhancement and additional assets, including technical knowledge and guidance

e. Social Fabric:
This section illustrates the social fabric of Banda Aceh that will affect the waste management mechanism's structure and implementation. The section describes and explains the following topics:

- Social setting, i.e. social groupings in affected areas (ethnicity, gender, etc.)
- Implications of regional and local religious beliefs on possible waste management practices
- Role of reuse and recycling of debris in communities (acceptance level)
- Economic activities, i.e. tourism, industry, residential
- Mobilisation and inclusion of community-based organisations
- Psycho-socio impact from disasters – including the earthquake and the tsunami.

4. Report Structure

The structure of the DEBRI Data Report needs to cover the following aspects.

Part 1: QUANTIFICATION AND CLASSIFICATION OF DEBRIS:

Data on construction and demolition waste in Banda Aceh, Indonesia as a result of the 2004 Indian Ocean Tsunami

Debris types	Details	Remarks
Indicate each of the different types of C&D debris generated: • Concrete • Brick • Wood • Roof tiles • Metal • Plastics •	For each debris type, indicate: • Characteristics o Size – *approximate size of the debris.* o Total volume generated *(cu.m.)* o Total weight generated *(tons)* o State – *whether the debris was mixed with other types, reusable or recyclable etc.* • Sources of debris – *what kinds of building structures generated the debris*	• Indicate source of information • Focus on Kota Banda Aceh, with some generic info as introduction from NAS as a whole

Part 2: CURRENT STATUS OF DEBRIS:

Data on current status of clearance of C&D waste

Debris types	Details	Remarks
Indicate each of the different types of debris as above	For each debris type, indicate: • Approx. volume cleared, and volume remaining to be cleared (this can include buildings to be demolished and foundations to be cleared) • Location of debris wastes disposed, including temporary locations • Actual process of clearance and equipment technologies used for clearance (indicate organizations involved, if relevant) • Potential future use of debris/wastes	• Also consult engineers and other professionals (to be jointly identified by DEBRI Partner organizations) in Banda Aceh to estimate potential quality and quantity of C&D wastes that may be generated in the future (from everyday activities and/or a future disaster)

Part 3: COMPLETED/ONGOING WASTE PROJECTS:

Information on waste initiatives already carried out by international and national organizations in Banda Aceh

Data type	Details	Remarks
Names of organization	• Projects launched (including current status, ongoing or completed) • Types and volumes of debris cleared • Description of clearance system used • Technologies and techniques used	• Indicate, where available, lessons learnt and problems encountered

Part 4: REVIEW OF PREVAILING WASTE MANAGEMENT SYSTEMS:

Description of debris waste management analysis, as indicated in Section 3 above, covering:

a. Waste Assessment
b. Recycling and Disposal Options
c. Institutional Structure
d. Local/regional Capacity Assessment
e. Social Fabric
f. Rapid Risk Assessment
g. Emergency Measures

ANNEX

Descriptions of some common construction and demolition wastes

CONSTRUCTION AND DEMOLITION WASTES

1. **Concrete** means a hard material made from sand, gravel, aggregate, cement mix, and water. Examples include pieces of building foundations, concrete paving, and cinder blocks.

2. **Asphalt Paving** means a black or brown, tar-like material mixed with aggregate used as a paving material.

3. **Asphalt Roofing** means composite shingles and other roofing material made with asphalt. Examples include asphalt shingles and attached roofing tar and tar paper.

4. **Lumber** means processed wood for building, manufacturing, landscaping, packaging, and processed wood from demolition. Examples include dimensional lumber, lumber cutoffs, engineered wood such as plywood and particleboard, wood scraps, pallets, wood fencing, wood shake roofing, and wood siding.

5. **Gypsum Board** means interior wall covering made of a sheet of gypsum sandwiched between paper layers. Examples include used or unused, broken or whole sheets of sheetrock, drywall, gypsum board, plasterboard, gypboard, gyproc, and wallboard.

6. **Rock, Soil and Fines** means rock pieces of any size and soil, dirt, and other matter. Examples include rock, stones, and sand, clay, soil, and other fines. This type also includes non-hazardous contaminated soil.

7. **Remainder/Composite Construction & Demolition** means construction and demolition material that cannot be put in any other type or subtype. This type may include items from different types combined, which would be very hard to separate. Examples include brick, ceramics, tiles, toilets, sinks, dried paint not attached to other materials, and fiberglass insulation. This type may also include demolition debris that is a mixture of items such as plate glass, wood, tiles, gypsum board, and aluminum scrap.

HOUSEHOLD HAZARDOUS WASTE

8. **Paint** means containers with paint in them. Examples include latex paint, oil based paint, and tubes of pigment or fine art paint. This type does not include dried paint, empty paint cans, or empty aerosol containers.

9. **Vehicle and Equipment Fluids** means containers with fluids used in vehicles or engines, except used oil. Examples include used antifreeze and brake fluid. This type does not include empty vehicle and equipment fluid containers.

10. **Used Oil** means the same as defined in Health and Safety Code section 25250.1(a). Examples include spent lubricating oil such as crankcase and transmission oil, gear oil, and hydraulic oil.

11. **Batteries** means any type of battery including both dry cell and lead acid. Examples include car, flashlight, small appliance, watch, and hearing aid batteries.

12. **Remainder/Composite Household Hazardous** means household hazardous material that cannot be put in any other type or subtype. This type also includes household hazardous material that is mixed. Examples include household hazardous waste which if improperly

put in the solid waste stream may present handling problems or other hazards, such as pesticides, caustic cleaners, and fluorescent light bulbs.

SPECIAL WASTE

13. **Ash** means a residue from the combustion of any solid or liquid material. Examples include ash from structure fires, fireplaces, incinerators, biomass facilities, waste-to-energy facilities, and barbecues.

14. **Sewage Solids** means residual solids and semi-solids from the treatment of domestic waste water or sewage. Examples include biosolids, sludge, grit, screenings, and septage. This category does not include sewage or waste water discharged from the sewage treatment process.

15. **Industrial Sludge** means sludge from factories, manufacturing facilities, and refineries. Examples include paper pulp sludge, and water treatment filter cake sludge.

16. **Treated Medical Waste** means medical waste that has been processed in order to change its physical, chemical, or biological character or composition, or to remove or reduce its harmful properties or characteristics, as defined in section 25123.5 of the California Health and Safety Code.

17. **Bulky Items** means large hard-to-handle items that are not defined separately, including furniture, mattresses, and other large items. Examples include all sizes and types of furniture, mattresses, box springs, and base components.

18. **Tires** means vehicle tires. Examples include tires from trucks, automobiles, motorcycles, heavy equipment, and bicycles.

19. **Remainder/Composite Special Waste** means special waste that cannot be put in any other type. Examples include asbestos-containing materials, such as certain types of pipe insulation and floor tiles, auto fluff, auto-bodies, trucks, trailers, truck cabs, untreated medical waste/pills/hypodermic needles, and artificial fireplace logs.

MIXED RESIDUE

20. **Mixed Residue** means material that cannot be put in any other type or subtype in the other types. This category includes mixed residue that cannot be further sorted. Examples include clumping kitty litter and residual material from a materials recovery facility or other sorting process that cannot be put in any of the previous remainder/composite types.