Environmental Decay and the Illegal Market in E-waste from an European Perspective: Current Problems and Future Directions

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BACKGROUND: ILLEGAL TRAFFICKING OF WASTE (1)

- **WASTE MOVEMENT FROM DEVELOPED TO DEVELOPING STATES (DRIVERS)**
  - Increase in costs for environmentally sound management of waste in developed states
  - World economic globalization
  - National regulatory and market asymmetries

- **LEGISLATIVE FRAMEWORK IN THE EU (EC Regulation No. 1013/2006)**
  - Implementation of the Basel Convention (1989)
  - Ban on export of waste to non-OECD countries *

BACKGROUND: ILLEGAL TRAFFICKING OF E-WASTE (2)

- **E-WASTE**
  - Waste generated from electrical and electronic equipments

- **LEGISLATIVE FRAMEWORK IN THE EU (EC Regulation No. 1013/2006)**
  - Ban on export of e-waste to non-OECD countries *
  - Export of second-hand electrical and electronic equipments (allowed)

BACKGROUND: ILLEGAL TRAFFICKING OF E-WASTE (3)

- **ILLEGAL EXPORT OF E-WASTE (METHODS)**
  - Labelled as second-hand material
  - Hidden or mixed with recyclible non-hazardous waste
- **ILLEGAL EXPORT OF E-WASTE (DRIVERS)**
  - Increased manufacturing and consumption of electrical and electronic equipments
  - High demand for raw materials
  - Lax environmental regulation and cheap labor force in industrializing countries
  - Inexpensive handling, recycling and disposal of e-waste in industrializing countries

Waste Trafficking to South-East China

(Source: Milan Public Prosecutor´s Office, 2010)

Electric and electronic equipments are mainly sent to Africa, China or India where the demand for raw materials is high, environmental regulations are lax, and handling, recycling and disposal of e-waste is very profitable (Schmidt, 2006; Babu, 2007: 311; Interpol, 2009: 358; Sepúlveda et al., 2010; Shinkuma, 2009).

ILLEGAL "BACKYARD RECYCLING" ACTIVITIES

Countries such as China and Nigeria have developed a thriving business of illegal "backyard recycling" facilities where workers employ primitive tools and methods to recover commercial materials and components from e-waste. "[T]he processes and techniques used…during the recycling activities are often primitive and lack pollution control measures" (Wong et. al., 2007: 435). E-waste is recycled in uncontrolled environments and the residual components are burned or discarded in open fields causing further release of toxic substances into the air, soil and water (Umesi & Onyia, 2008).

LINKAGES BETWEEN BIODIVERSITY AND LOSS AND E-WASTE TRAFFICKING

"CONTAMINATION ARISEN FROM PRIMITIVE RECYCLING AND PROCESSING OF ELECTRONIC AND WASTES…IS AN EMERGING GLOBAL ENVIRONMENTAL ISSUE, AS THESE WASTES HAVE BECOME ONE OF THE FASTEST GROWING WASTE TYPES IN SOME PARTS OF THE WORLD " (WONG ET. AL., 2007: 434).

THE EFFECT OF THE ILLEGAL TRAFFICKING IN E-WASTE

- **E-WASTE POLLUTION**
  - **Hazardous substances in e-waste: heavy metals and chemical compounds**
  - **Release of toxins during primitive recycling of e-waste**

POLLUTANTS (Source: E-Waste Guide, 2010; Puckett et al., 2002)	RELATED USE IN ELECTRONIC AND ELECTRIC APPLIANCES
TBBA (tetrabromo-bisphenol-A) PBB (polybrominated biphenyls) PBDE (polybrominated diphenyl ethers)	Fire retardants for plastics (thermoplastic components, cable insulation)
PVC (polyvinyl chloride)	Cable insulation
Arsenic	Small quantities in the form of gallium arsenide within light emitting diodes
Barium	Fluorescent lamps, Getters in Cathode Ray Tube (CRTs)
Cadmium	Rechargeable NiCd-batteries, fluorescent layer (CRT screens), printer inks and toners, photocopying-machines (printer drums)
Chromium VI	Data tapes, floppy-disks
Lead	CRT screens, batteries, printed wiring boards, cathode tubes for monitors
Mercury	Fluorescent lamps that provide backlighting in LCDs, in some alkaline batteries and mercury wetted switches
Antimony	In (CRTs) in old monitors, in printed circuit boards and as a fire retardant in electronic cable coatings

WASTE POLLUTION AND BIODIVERSITY LOSS

- **LEAD**
  - Damages to the nervous and reproductive system of humans and wildlife and to the structure of chloroplasts (Rebechini & Hanzely, 1974; Bridgen et al. 2005: 26)
- **MERCURY**
  - Neurological disorders in human beings and reproductive problems in biota (Mukherjee et al., 2004: 158; Hylander et al., 2006)
- **CHROMIUM VI**
  - Morphological alterations in several aquatic and terrestrial species (Prakash, 2004: 323)
- **DIOXINS**
  - "Reproductive and developmental problems in animals" and threats "the biodiversity of fragile and vulnerable ecosystems such as the deep-sea" (Rotllant et al. ,2006: 1895)
- **FIRE RETARDANTS**
  - Disorders in the development of organs and the functioning of the hormonal system in wildlife (Colborn et al., 1993; Legler & Brouwer, 2003; Fossi et al., 2006)

PROPERTIES OF POLLUTANTS

- **BIOACCUMULATIVE**
  - "Bioaccumulation (or bioconcentration) is the uptake of organic compounds by biota from either water or food" (Smith et al. , 1988: 92)
- **HIGHLY PERSISTENT IN THE ENVIRONMENT**
  - Not degraded into natural environment
- **ENDOCRINE DISRUPTERS**
  - Interference with the metabolic functions of wildlife and humans and cause of neurological and reproductive problems (Oetken, 2004; Legler & Brouwer, 2003: 879)

E-WASTE POLLUTION AT THE ILLEGAL RECYCLING FACILITIES

- **LEAD IN THE WATER SAMPLES (Lijiang River, China)**
  - Concentrations of lead were 2,400 times higher than the levels of pollutants allowed by the World Health Organization (WHO) Drinking Water Guidelines (BAN, 2002: 22; Hicks, 2005: 461)
- **LEAD AND CADMIUM IN RICE CROPS (Taizhou, Zhejiang Province, China)**
  - Lead and cadmium in rice samples exceeded the tolerable daily intakes according to the FAO food safety levels (Fu et al., 2008)
- **AIR POLLUTION (Guiyu ,China)**
  - Concentrations of pentabromodiphenyl ether (PDE-47) were “even about 2 times higher than that in the dismantling hall of…[a] recycling electrical plant of Sweden” (Chen et al. , 2009: 1053)

THE EU LEGISLATION ON E-WASTE
NEW EVENUES OF BIODIVERSITY PROTECTION?

THE EU LEGISLATION ON E-WASTE

- **EU DIRECTIVE ON WASTE ELECTRICAL AND ELECTRONIC EQUIPMENT (WEEE)**
  - REDUCTION OF LANDFILLING AND PROMOTION OF RECYCLING
  - EXTENDED PRODUCER RESPONISIBILITY
  - PRODUCT DESIGN TO FACILITATE RECICLYING

- **EU DIRECTIVE ON THE RESTRICTION OF THE USE OF CERTAIN HAZARDOUS SUBSTANCES IN ELECTRICAL AND ELECTRONIC EQUIPMENT (RoHS)**
  - PHASE OUT OF TOXIC SUBSTANCES FROM ELECTRICAL AND ELECTRONIC EQUIPMENTS

WEEE DIRECTIVE: LIMITS

- **NO FINANCIAL INCENTIVES FOR PRODUCERS TO GO BEYOND THE MINIMAL LEGAL OBLIGATIONS OF COLLECTION TARGETS**
  - Risk that producers would opt for the cheapest treatment solutions
- **NO REWARDS FOR BETTER ENVIRONMENTAL PERFORMANCE**
  - High burdens imposed to EEE producers
- **NO OBLIGATIONS TO CHOOSE AUTHORIZE COLLECTORS**
  - Risk that producers will choose unauthorized companies for collection

RoHS DIRECTIVE: LIMITS

- **LIMITED SCOPE OF APPLICATION**
  - Eight categories of electrical and electronic appliances regulated by the WEEE Directive
- **EXEMPTION FROM SUBSTITUTION REQUIREMENTS**
  - For some type s of electroical equipment (e.g. Fluorescent lamps)
  - For some types of toxic substances (See table below)

POLLUTANTS NOT BANNED BY THE ROHS DIRECTIVE (Gross et al., 2008)	RELETED EFFECTS ON ANIMALS AND PLANTS (Gross et al., 2008)
Tetrabromobisphenol-A (TBBP-A)	Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment
Medium-chained chlorinated paraffins (MCCP) (Alkanes, C14-17, Chloro)	Very dangerous for the aquatic environment and endocrine disrupter (Cat. No. 1)*
Hexabromocyclododecane (HBCDD)	Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment
Short-chained chlorinated paraffins (SCCPs)	Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment and endocrine disrupter (Cat. No. 1)*
Phthalates: Bis (2-ethylhexyl) phthalate (DEHP), Butyl benzyl phthalate, (BBP) Dibutylphthalate (DBP)	Endocrine disrupters (Cat. No. 1)*
Phthalates, II: Butyl benzyl phhalate (BBP)	Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment and endocrine disrupter (Cat. No. 1)*.
Phthalates, III: Dibutylphthalate (DBP)	Very toxic to aquatic organisms and endocrine disrupter (Cat. No. 1)*
Nonylphenol and nonylphenol ethoxylates	Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment

A WAY FORWARD ?

A REVISION OF THE WEEE AND THE ROHS DIRECTIVES COULD REPRESENT A SIGNIFICAN STEP IN PROTECTING THE ENVIRONMENT IN ALL PARTS OF THE WORLD