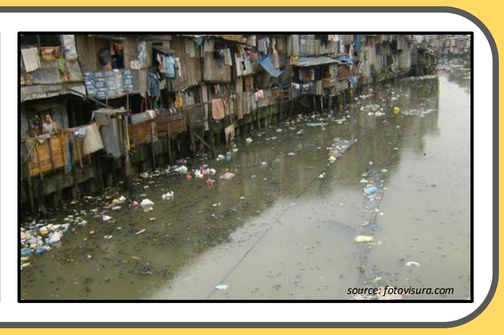
Assessing Health Risks of the Tanning Industry in Hazaribagh, Dhaka, Bangladesh – Conceptual Modeling of Priority Exposure Pathways

Tanning in Bangladesh

- 90% of Bangla's tanneries are in Hazaribagh District, a 4 km^2 area
- Estimated 150 – 250 tanneries
- 8,000 – 12,000 employed in tanneries
- $663 million USD exported in 2012
- 1.5 mil cows slaughtered annually; Italy, China, Spain and US are the major importers of Bangla leather
- 75 MT of solid waste and 21,600 m^3 of liquid waste/day
- Untreated effluent discharges into open canals which flow to Buriganga River

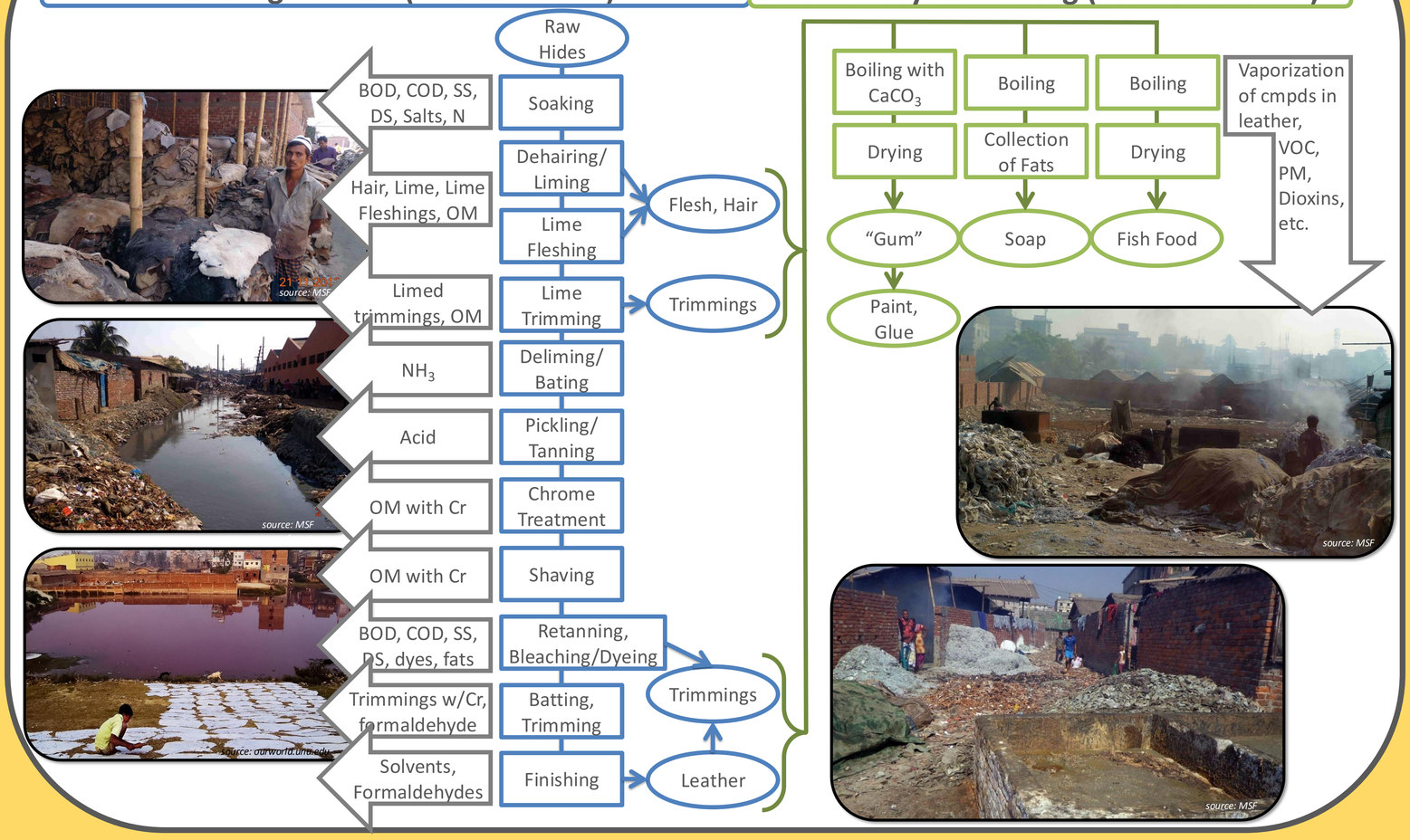
Objectives

1. Identify major exposure pathways, contaminants of concern, environmental receptors, exposure routes, and susceptible populations. Utilize literature review and observations/interviews from the site visit
2. Develop a conceptual model from this information
3. Select the most susceptible populations based on health risk, receptors, COC, risk cofactors, potential health effects, and data gaps



source: MSF

Formal and Informal Tanning Processes



Results

- Higher risks for children; higher risks associated with the informal waste recovery/processing operations.
- Slum housing conditions at work sites exacerbate risks.
- Major data gaps in air quality information, documentation of health effects.

Select conceptual model results: three most susceptible populations

Susceptible Population	Critical COCs	Exposure Routes	Exposure Media Concentrations	Relevant Enviro. Standard	Potential Target Organ Toxicities
Child Informal Workers (Waste Recovery)	Chromium	Dermal absorption; PM inhalation; incidental ingestion	Water: Cr(III): 28,000 mg/kg Cr(VI): 1 mg/kg	Cr(III): 2 mg/L	Skin, kidneys, lungs, mucous membranes, immune system, reproductive toxicity
	Sulfates	Dermal absorption; incidental ingestion	27,902 mg/L	1 mg/L	Skin, mucous membranes
	Water pH	Dermal absorption	Water: pH: 4.9		Increased dermal absorption of other chemicals
	Chromium	Incidental ingestion of soils/dusts; inhalation of contaminated dusts	Soil: Cr: 33,500 mg/kg		Kidneys, lungs, mucous membranes, immune system, reproductive toxicity
	Nitrates	Dermal absorption; incidental ingestion	Nitrate: 168 mg/L		Hemoglobin
Child residents near waste recovery operations	PM	Inhalation; incidental ingestion of contaminated soils/dusts	Unknown	Bangladesh, PM_{10}, 24 hour: 150 µg/m^3 $PM_{2.5}$, 24 hour: 65 µg/m^3	Respiratory toxicity, carcinogenic effects; Multiple target organ effects, dependent upon cmpds adhered to PM
	VOCs	Inhalation	Unknown	Dependent upon specific compound	Reproductive system, lungs; Multiple target organ effects, dependent upon specific compound
	Dioxins	Inhalation; incidental ingestion of contaminated soils/dusts	Unknown	ATSDR Chronic MRL: 1 pg/kg/day Acute MRL: 200 pg/kg/day	Reproductive system, carcinogenic, skin, liver, peripheral nervous system, lungs, bone marrow, brain
Child residents near Buriganga River	Chromium	Ingestion	Cr(III): 28,000 mg/kg Cr(VI): 1 mg/kg	Cr(III): 2 mg/L	Nephrotoxicity
	SO_4^-	Ingestion	27,902 mg/L	1 mg/L	Mucous membranes, gastrointestinal

Conclusions

- All wastes are processed in both the formal and informal tanning sectors.
- Severe exposures and health risks are well documented in the literature and by human rights groups. However, efforts to reform the formal sector have been delayed for more than a decade.
- Residential exposures are roughly equivalent to occupational exposures.
- The most susceptible populations are among children of families engaged in informal scavenging and the waste processing sectors. This group will not benefit from reform of the formal sector.

BOD = Biological Oxygen Demand	*Cr = Chromium*	*N = Nitrogen*	*SO_4^- = Sulfate*
$CaCO_3$ = Calcium Carbonate	*DS = Dissolved Solids*	*NH_3 = Ammonia*	*SS = Suspended Solids*
COC = Contaminant of Concern	*MRL = Minimal Risk Level*	*OM = Organic Matter*	*VOC = Volatile Organic Compounds*
COD = Chemical Oxygen Demand	*MT = Metric Ton*	*PM = Particulate Matter*	*km = kilometer, m = meter*

Acknowledgements: *The authors wish to thank Medécins Sans Frontières and Dhaka Community Hospital Trust*

Margrit von Braun, PhD**,** Collegium Ramazzini, TIFO
Ian von Lindern, PhD**,** TIFO
Casey Bartrem, TIFO, PhD Candidate, University of Idaho

TerraGraphics International Foundation, Inc.
Assistance to communities to reduce environmental exposures
www.TerragraphicsInternational.org