Health and Environmental Impacts of Chemical Production, Use and Trade

Margaret Molefe
DEA: Hazardous Chemicals Management
1) Production, Uses & Trade Chemicals
2) Inorganic Fertilizers
3) Pesticides
   a) Rodenticides, Highly Hazardous Pesticides & Illegal/street pesticides
4) Pharmaceuticals: Veterinary drugs & Human Medicines
5) Ozone depleting substances & PCB’s
Chemicals of Concern

Chemical ‘coverage’
- Other chemicals of concern
- Specific Chlorinated Compounds

Rotterdam Convention:
- Prior informed consent

SAICM:
- Strategic Approach To Chemicals Management

Basel Convention:
- Control Of Transboundary Movements Of Hazardous Wastes And Their Disposal

Stockholm Convention:
- Persistent Organic Pollutants

Chemical ‘life cycle’
- Production
- Trade
- Use
- Waste & disposal

www.environment.gov.za | Call Centre: (086)111 2468
Chemical industry is a crucial component of economic development.

Diagram:

- **Raw materials** (e.g., minerals, water, air, gas, oil, coal)

- **Chemical processing/refining**
  - **Bulk inorganics and organics** (e.g., ammonia, gases, acids, salts, Petrochemicals, Benzene, Ethylene, Propylene, Xylene, Toluene, Butadiene, Methane, Butylene)

- **Chemical processing**
  - Fertilizers, industrial chemicals, plastics, propylene oxide, resins, elastomers, fibers, dyestuffs

- **Speciality chemicals**
  - Rubber and plastic goods, paints, adhesives, performance chemicals

- **Consumer chemicals**
  - Detergents, soap, bleaches, fragrances, hair care, etc

- **Life science**
  - Pharmaceuticals, agrochemicals, biotechnology

- **Other industries**
  - Metals, glass, automobile, paper, textiles, etc

Figure 1: The General structure of the chemical industry. Source: OECD 2001
Over 600 million tonnes of chemicals produced. More than 140,000 chemicals not evaluated.

SELF REGULATED BY INDUSTRY
Global per capita production & consumption of chemicals and total demand for chemicals has increased drastically.

1) Increased Communicable (HIV/AIDS, STIs, TB, etc) & Non-Communicable diseases (Hypertension, Diabetes, depression/stress, morbidity from accidents)

2) Synthetic Chemicals
   - Inorganic Fertilizer – alleviation of food security
   - Pesticides
   - Human and veterinary medicines

3) Rapid Urbanization AND Greater demand for Transportation fuel & energy sources, petrochemicals & speciality chemical products
Serious Incidents occurring with chemicals

1) Poisoning from industrial and agricultural chemicals are top 5 leading cause of deaths:
   - 1 million deaths
   - 14 million Disability Adjusted Life Years.

2) Scope of unintended industrial accidents involving chemicals continues to grow rapidly
Major Public Health Challenges ...

- Microorganisms becoming extremely resistant to available existing antibiotics, especially Gram-Negative rods (e.g. E.coli, Salmonella, Klebsiella spp, Acinetobacter spp)
- The availability of new antibiotics becoming extremely dry (incentives for pharmaceutical companies to develop and manufacture new antibiotics limited)
- New antibiotics ONLY available for treating Gram-Positive infections (NO NEW Gram-Negative in next 15-20yrs)
Rate of antibiotics resistance

- South Africa faces a quadruple burden of diseases with **HIV/AIDS**, **other infectious diseases** and **communicable diseases**. Highest number of HIV infected people in the world (2009) – 5.6 of its 50 million infected.

<table>
<thead>
<tr>
<th>Year</th>
<th>Antibiotic Resistance Type</th>
<th>Antimicrobial Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>Methicillin resistant Staphylococcus aureus (MRSA)</td>
<td>all tertiary hospitals</td>
</tr>
<tr>
<td>2012</td>
<td>Vancomycin resistant enterococci (VRE)</td>
<td>sensitive to Vancomycin</td>
</tr>
<tr>
<td>2011</td>
<td>Extended spectrum beta-lactamase (ESBL) producing Gram Negative bacteria</td>
<td>Cephalosporins &amp; penicillin</td>
</tr>
<tr>
<td></td>
<td>Carbapenemase producing Enterobacteriaceae (CPE)</td>
<td>Colistin</td>
</tr>
<tr>
<td></td>
<td>Klebsiella pneumonia resistance to all available antibiotics</td>
<td></td>
</tr>
</tbody>
</table>
Environmental Impact of Inorganic Fertilizers

A dead African buffalo (Syncerus caffer) found in a reservoir with a dense bloom.
Health Impact of Inorganic Fertilizers

Fertilizer from industry to running to water

Kidney diseases

Lung cancer

www.environment.gov.za | Call Centre: (086)111 2468
Pesticides use and trade

Steady increase of pesticide imports ...

... but also increased pesticide use per unit agricultural production
Environmental Impact

Pesticide Environmental Effects

Death of fish, aquatic species (here the total toxic load for fish)

Leaching, persistence and bio-accumulative
Anticoagulant Rodenticides –
Environmental impact
Where do you dispose dead rats?
Causes of Rodents

Poor sanitation
Informal settlements & overcrowded building
Illegal dumping of food, wood piles and debris
### Diseases transmitted by rats

1. **Foot and Mouth Disease** - Causing losses to livestock farming and export of red meat.

2. **Salmonella** - Carrier of bacteria leading to Salmonells

3. **Tuberculosis** - Carrier of TB bacteria

4. **E.Coli** - Carrier of bacteria and passed through feaces
Diseases transmitted by rats

4. Leptospirosis - Death of prisoners at Pollsmor Prison, Babies-Alexandra & Diepsloot

5. Wounds and deformation of body
Illegal street pesticides
1) Human and Veterinary pharmaceuticals and their metabolites are detected in soil, foodstuffs and water sources:

2) Environmental and human health impact:
   - Endocrine disruption impact
   - Increased resistance for commensal and pathogenic bacteria

3) Rivers reservoirs for antibiotic resistance:

---

**Food safety**
- E. coli
- Salmonella
- Campylobacter
- Enterococci

---

**Water Safety**
- E. coli
- Salmonella spp
- Mycobacterium tuberculosis
- Staphylococcus aureus
- Streptococcus pneumoniae
- Streptococcus pyogenes
- Vibrio cholerae
Veterinary pharmaceuticals can enter the environment via different pathways:

- **Intensive Livestock treatment (i.e feedlots, dairy, Intensively Reared Animals)**
- **Storage of manure & slurry**
- **Manure and Slurry spreading**
- **Treatment of companion animals**
- **Inappropriate disposal of used containers and**
- **SOIL**
- **Contaminated water sprayed on vegetables**
- **RECEIVING WATER**
- **DRINKING WATER**
- **Aquaculture**
- **Manufacturing process**
Analgesics & Nonsteroidal anti-inflammatory Agents

<table>
<thead>
<tr>
<th>Drug</th>
<th>highest level detected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diclofenac</td>
<td>Highest levels detected in cattle</td>
</tr>
<tr>
<td></td>
<td>Toxic to vulture population</td>
</tr>
<tr>
<td>Phenylbutazone</td>
<td>Highest level detected</td>
</tr>
<tr>
<td>Ibuprofen</td>
<td>mostly detected in water ways and municipal effluent</td>
</tr>
<tr>
<td>Propyphenazone</td>
<td></td>
</tr>
<tr>
<td>Indonethacin</td>
<td></td>
</tr>
<tr>
<td>Phenazone</td>
<td></td>
</tr>
<tr>
<td>Acetylsalicylic acid</td>
<td></td>
</tr>
<tr>
<td>Ketoprofen</td>
<td></td>
</tr>
</tbody>
</table>

Inhibits prostaglandin production.
<table>
<thead>
<tr>
<th>In-feed Antibiotic Spectrum</th>
<th>PREMIXES</th>
<th>Broiler Production: Compounding</th>
<th>Aquaculture Production</th>
<th>Beef &amp; Swine Production: Feedlot</th>
</tr>
</thead>
<tbody>
<tr>
<td>5. Sulphonamides</td>
<td>5. Streptogramins</td>
<td>5. Florfenicol</td>
<td>5. Emamectin</td>
<td></td>
</tr>
<tr>
<td>8. Phosphoric acid</td>
<td>8. Lincomycin</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# Growth Stimulating Hormones

## Natural Hormones

<table>
<thead>
<tr>
<th>Group</th>
<th>Chemical</th>
<th>Detection Level</th>
<th>Human Health &amp; Environmental Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estradiol benzoate</td>
<td>Diethylstilbestrol</td>
<td>0.02-2.57 ng/l</td>
<td>Cancer of uterus, poor sperm quality, testicular disruption</td>
</tr>
<tr>
<td>Estradiol estradiol</td>
<td>Estradiol benzoate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>altrenogest</td>
<td>Ethinyl estradiol</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Melatonin</td>
<td>Progesterone</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Methyltestosterone</td>
<td>Melatonin</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Beta-Agonists

<table>
<thead>
<tr>
<th></th>
<th>Zilpaterol</th>
<th>42 sites (of 46) levels ranging from 69 to 23 703 ng/l</th>
</tr>
</thead>
<tbody>
<tr>
<td>Melengesterol acetate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>alpha-Zearalanol</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beta- Trenbolone</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Levels above set maximum residue limits

## Antibiotic Promotants

<table>
<thead>
<tr>
<th>Promotants</th>
<th>Monensin</th>
<th>Avilamycin</th>
<th>Salinomycin</th>
<th>Flavophospholipol</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Antibiotics, bacteria and resistance gene found in dust from feedlots. Environmental Health Perspective, February 2015
<table>
<thead>
<tr>
<th>Bacteria</th>
<th>Multi-Resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>E. coli</td>
<td>Tetracycline (95%), Ampicillin, Chloramphenicol, Erythromycin, Cotrimoxazole, Rifampicin (94.7%)</td>
</tr>
<tr>
<td>Salmonella spp</td>
<td>Tetracycline (95%), Ampicillin, Chloramphenicol, Ceftriaxone, Ciprofloxacin, streptomycin, Sulphonamides, Nalidixic acid, Fluoroquinolones</td>
</tr>
<tr>
<td>Enterococcs spp</td>
<td>Tetracycline (95%), Fluoroquinolones, Enrofloxacin, Amoxicillin, Ceftriaxone, Aminoglycosides, Avoparcin (related to Vancomycin, Sulphonamide &amp; Trimethoprim - Sulfa combination)</td>
</tr>
<tr>
<td>Staphylococcus spp</td>
<td>Tetracycline, Streptomycin, Methicillin, Gentamicin,</td>
</tr>
<tr>
<td>Streptococcus spp</td>
<td>Tetracycline, Macrolides, Lincosamide, Erythromycin, Streptogramins, Penicillins, Chloramphenicol Methicillin, Gentamicin,</td>
</tr>
</tbody>
</table>
Triclosan:

<table>
<thead>
<tr>
<th>Widespread uses</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Antibacterial soaps</td>
<td>Toys</td>
<td>Medical</td>
<td>Cosmetics</td>
</tr>
<tr>
<td>Toothpaste (gingivitis)</td>
<td>Clothes</td>
<td>devices</td>
<td>&amp; toiletries</td>
</tr>
<tr>
<td>Mouth wash</td>
<td>Mattresses</td>
<td>(antimicrobial</td>
<td>(face wash,</td>
</tr>
<tr>
<td>Hand sanitizers</td>
<td></td>
<td>sutures)</td>
<td>mascara,</td>
</tr>
<tr>
<td>Soap &amp; dish-washing</td>
<td>Kitchen</td>
<td></td>
<td>etc)</td>
</tr>
<tr>
<td>detergent</td>
<td>utensils</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In most cases antibacterial soap is not necessary for safe, effective hand hygiene.
Health and Environmental Impact

Triclosan

Persistent Environmental Pollutant
Carcinogenic Impurities
Acute/Chronic Toxicity
Carcinogenic Transformation Products
Cross-resistance to Antibiotics
Endocrine Disruption

Bioaccumulation
Allergen
Laboratory Chemicals
Human Health

<table>
<thead>
<tr>
<th>Ozone depleting substances (ODS)</th>
<th>Death of 20 people in maize shipment from Nigeria</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCB</td>
<td>Developmental Neurological Reproductive</td>
</tr>
</tbody>
</table>
CONCLUSION

• Strengthen Information sharing, Awareness and Training of chemicals
• Training of Environmental Crime Specialist (trafficking of chemicals, smuggling, etc)
• Tools for environmental Inspectors to detect toxic chemicals
THANK YOU

Margaret Molefe
Director: Hazardous Chemicals Management
Department of Environmental Affairs

smolefe@environment.gov.za