Challenges and Opportunities in Agro-waste Management: An Asian Perspective

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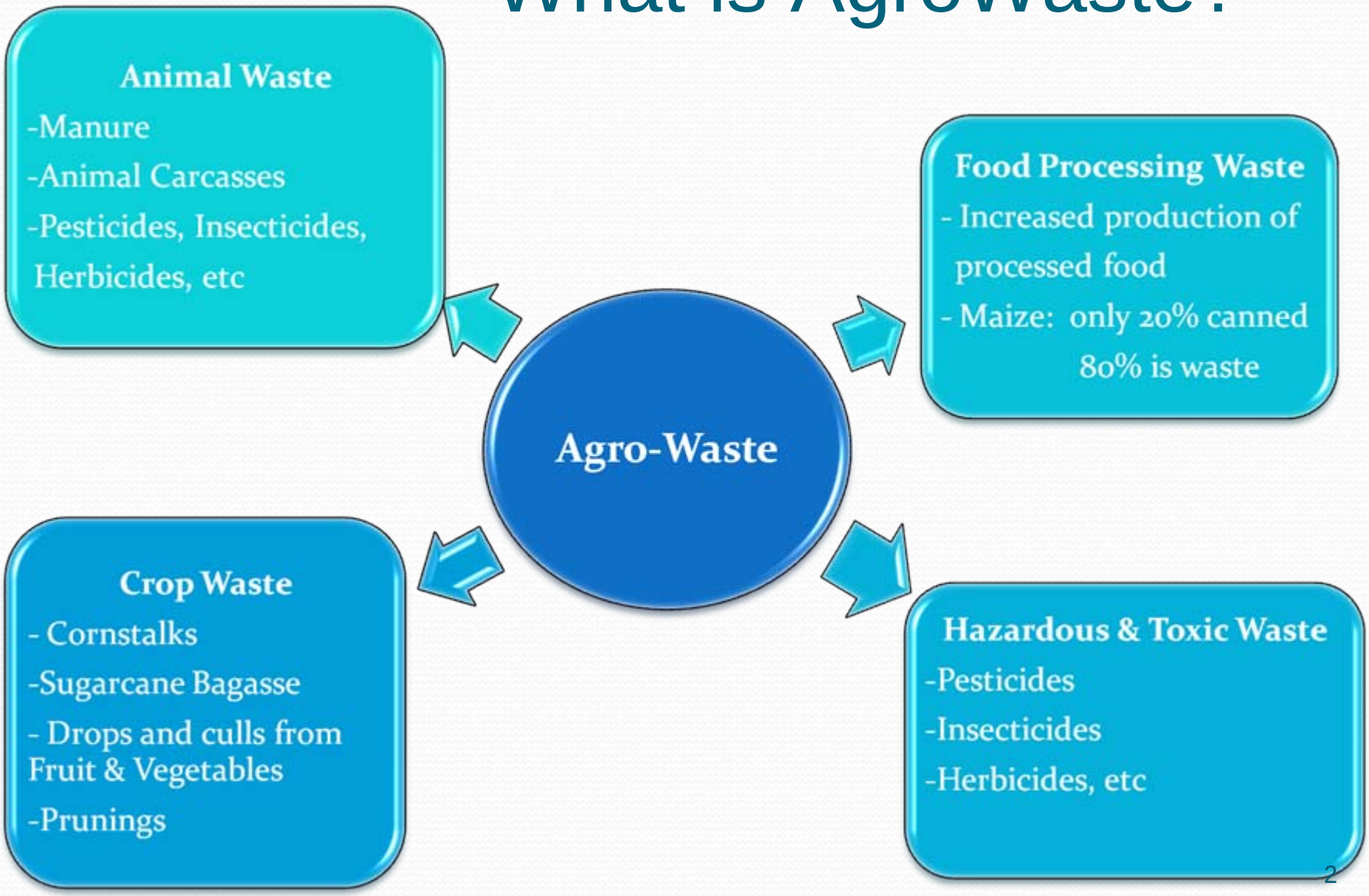
What is AgroWaste?



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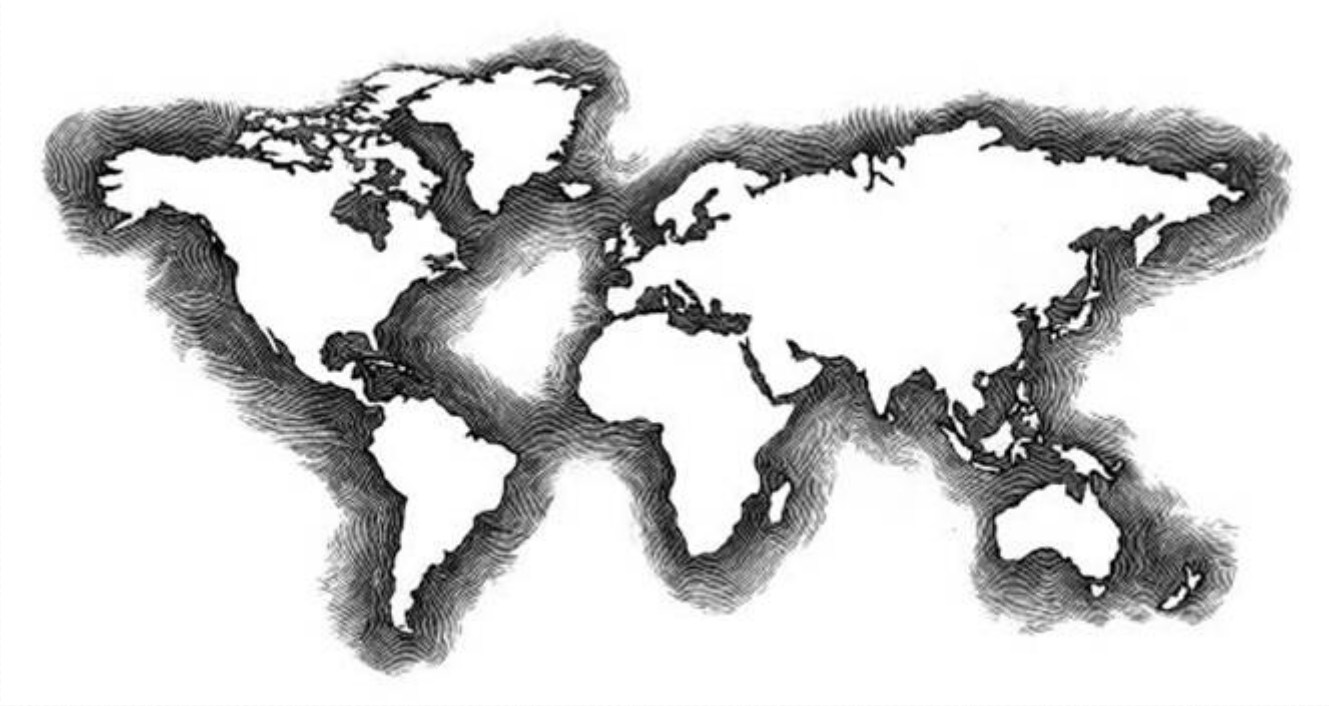
Agricultural Waste Generation



•Globally, 998 million tonnes of Agricultural Waste is produced in a year.

• In Malaysia, 1.2 million tonnes of agricultural waste is disposed into landfills annually.

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AgroWaste Generation in Asia

Country	Agricultural Waste Generation (kg/cap/day)	Projected Agricultural Waste Generation in 2025(kg/cap/day)
Brunei	0.099	0.143
Cambodia	0.078	0.165
Indonesia	0.114	0.150
Laos	0.083	0.135
Malaysia	0.122	0.210
Myanmar	0.068	0.128
Philippines	0.078	0.120
Singapore	0.165	0.165
Thailand	0.096	0.225
Vietnam	0.092	0.150

- An estimated 15% of total waste generation consists of AgroWaste (Hsing et. al. 2001).

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AgroWaste Generation in Asia (cont'd)

Country	Agricultural Waste Generation Rate (kg/cap/day)	Projected Agricultural Waste Generation in 2025 (kg/cap/day)
Nepal	0.060	0.09
Bangladesh	0.04	0.09
Mongolia	-	0.09
China	0.12	0.135
Sri Lanka	0.03-0.14	0.150
Republic of Korea	0.15	0.210
Japan	0.17	0.195

- An estimated 15% of total waste generation consists of AgroWaste

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AgroWaste Utilization

AgroWaste	Utilization
Rice Husk Ash & Charcoal	•Additive in cement mixes •Water glass manufacture •Active carbon
Rice Husk	•Electricity production
Banana Peel & Sugarcane fibers	•Paper making pulp
Oil Palm Empty Fruit Bunch (EFB)	• Mulching, Organic Fertilizer
Oil Palm stems, Rubber wood	•Particleboards • Softwood furniture
Onion skin, Groundnut husk	•Heavy metal removal
Husk, Bagasse	•Mushroom cultivation
Bagasse, Banana Fruit Reject	•Ethanol production •Animal feed

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AgroWaste Utilization (cont'd)

AgroWaste	Utilization
Husk, Straw, Cow Dung	• Biogas production • Electricity generation
Sunflower stalk Corn Stalk Bagasse Fibers	• Reinforcement for thermoplastics
Animal waste (dung)	• Compost •Fertilizer




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Greenhouse Gas Emissions from Agricultural Sector

- Global mitigation potential is 5,500-6,000 megatons of CO_2e / year by 2030
- Carbon sequestration - nearly 90% of this potential
- Potential to reduce methane (CH_4) emission from rice fields by China and India by 26%
- Up to 50% of emissions (1,100-3,000mt CO_2-eq/yr) can be mitigated by 2030 through soil carbon sequestration
- Potential to reduce emissions by 277 Mt CO_2-eq/year at carbon price of $20 per ton, equivalent to benefit of $5.5 billion a year

Source: Asian Development Bank, 2009

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Biomass as an Alternative

- **Shifting of paradigm towards BIOMASS**
  - **Renewable energy**
  - **Sustainable**
  - **Environmentally friendly**
  - **Abundant**
  - **Untapped energy**
- **Uncertainties of BIOMASS**
  - **Technological proven ?**
  - **Economically feasible ?**
  - **Constant supply ? (quality and quantity)**
  - **Availability & distribution ? (worldwide)**

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Biomass utilization

- Thermal conversion - power/electricity generation
- Biological conversion – CH_4 generation
- Biological Conversion - Organic acids generation
  - acetic, propionic and butyric acids
- Biological Conversion – Bioplastics
  - organic acids into poly-hydroxyalkanoates
- Biological Conversion - Bio-compost
  - Good properties such as pH 6-8, C/N 20 and comply to USEPA standards

3R's AgroWaste Opportunities

- Heat Production *agricultural residues burnt as fuel

  -92% as thermal output (EIA 2008)

  - 12.9 and 14.6 million btu/tonne of agricultural residues
- Production of Cellulosic Ethanol as a Biofuel
- Biogas production as a substitute for cooking gas instead of fuel wood (in rural villages) and to meet urban demands for cooking biogas

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3R's AgroWaste Opportunities (cont'd)

- Compost production in efforts of sustainable farming – organic fertilizers substituting chemical fertilizers
- Electricity Generation
- NCFR – Non Conventional Feed Resources

  - cattle/livestock is fed straw, spent grains, and other agricultural waste
- AIBP- Agro Industrial By Product

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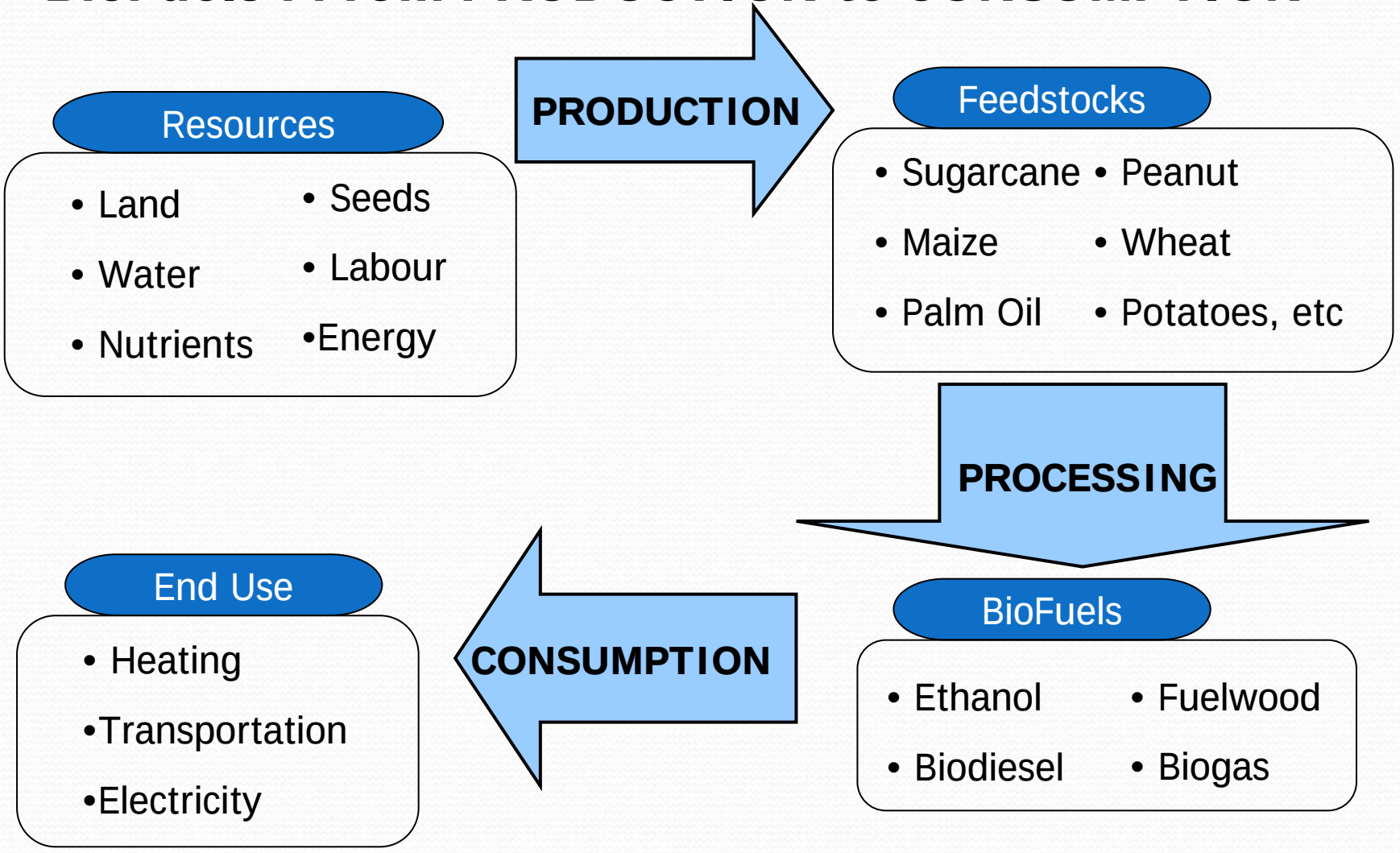
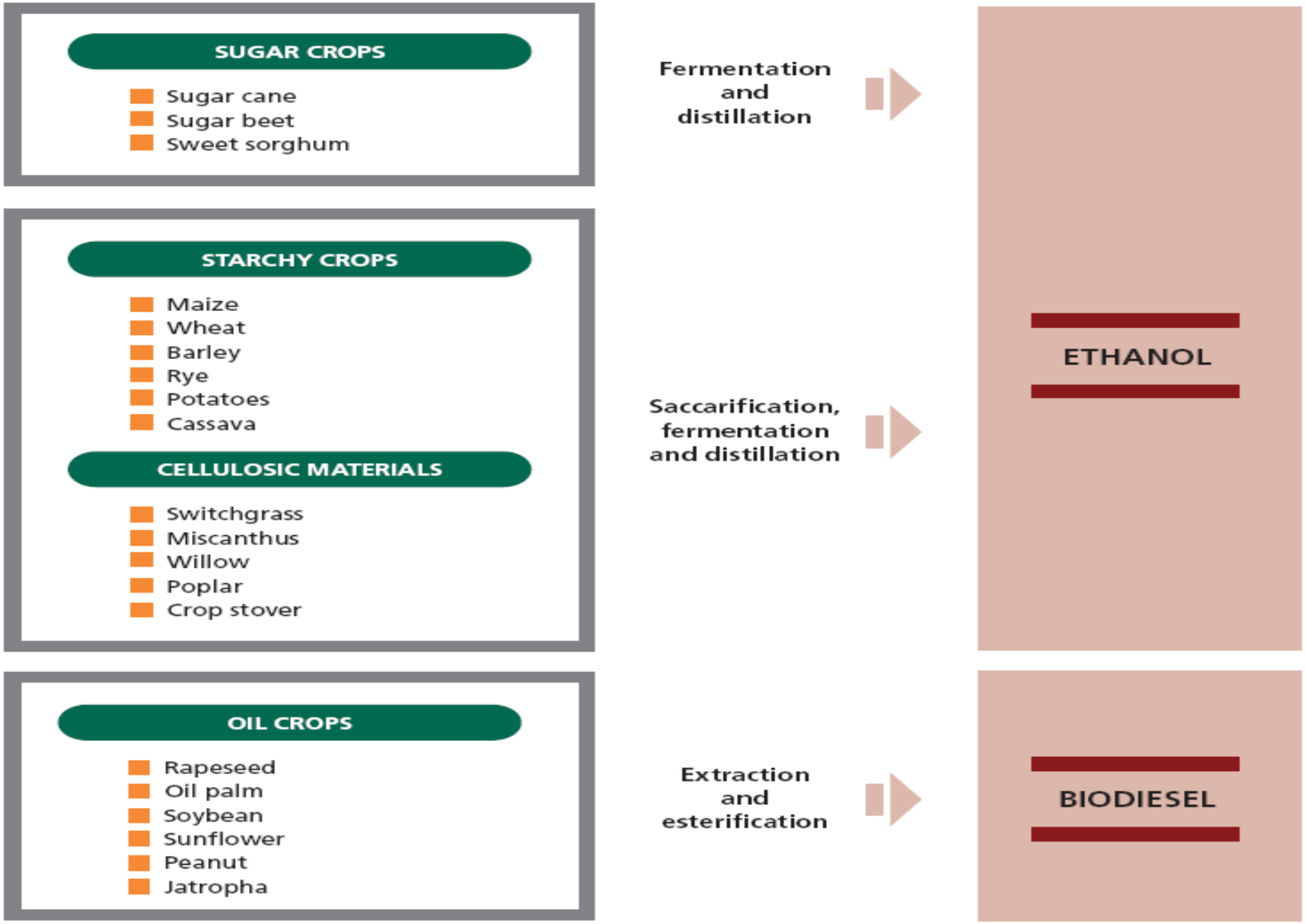
BioFuels : From PRODUCTION to CONSUMPTION



Conversion of agricultural feedstocks into liquid biofuels



Source: FAO.

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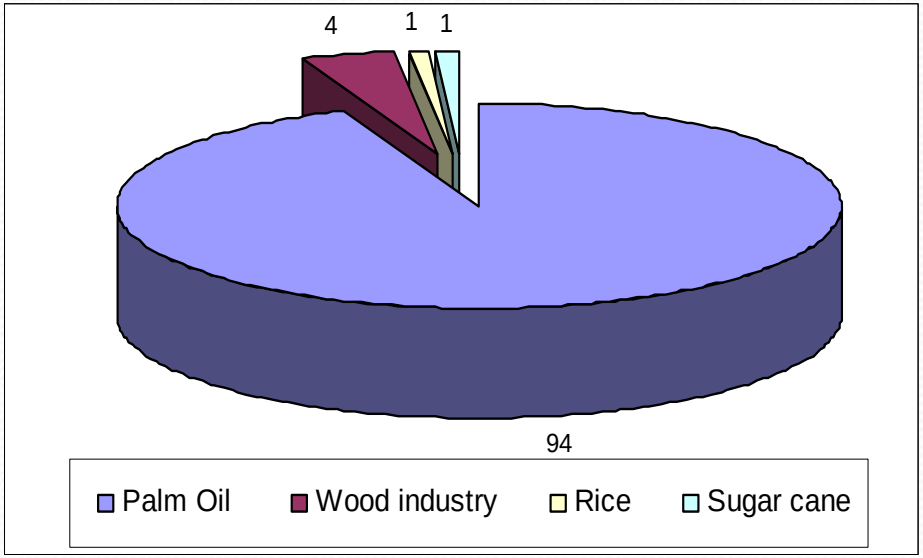
Biomass resources from Agricultural residues

- **Most abundant in Malaysia (> 70 million tonnes annually)**
- **Production of biomass throughout the year**
  - **high sunlight intensity/time and high rainfall**
- **Main contributor of biomass – palm oil industry (in 2003)**
  - 14 mil tonnes EFB
  - Palm oil mill effluent
  - 5 mil tonnes mesocarp fiber
  - 8 mil tonnes palm kernel shells
  - Palm kernel cake (residue)
- **Ligno-cellulosic materials**



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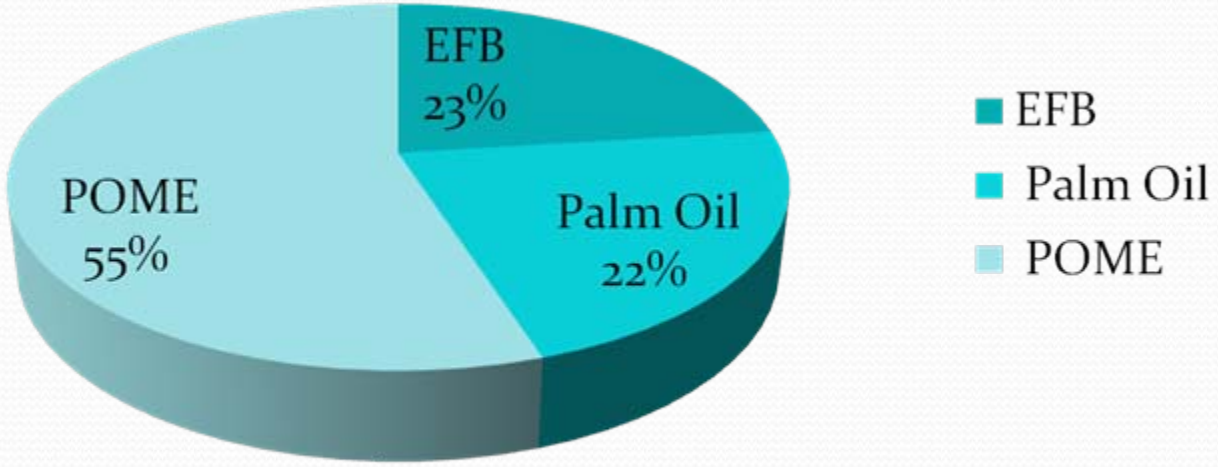
Palm Oil Industry: A Case Study

- Malaysia is the largest producer of Palm Oil
- 18 million tonnes of CPO was produced in 2008.
- 18-22% Palm Oil
- 23 % is solid waste : Empty Fruit Bunches, EFB



Palm Oil Production and Waste Generation

Oil Palm

Palm Oil Full Fruit Bunch (FFB)

Application of empty fruit bunch (EFB) as covering material

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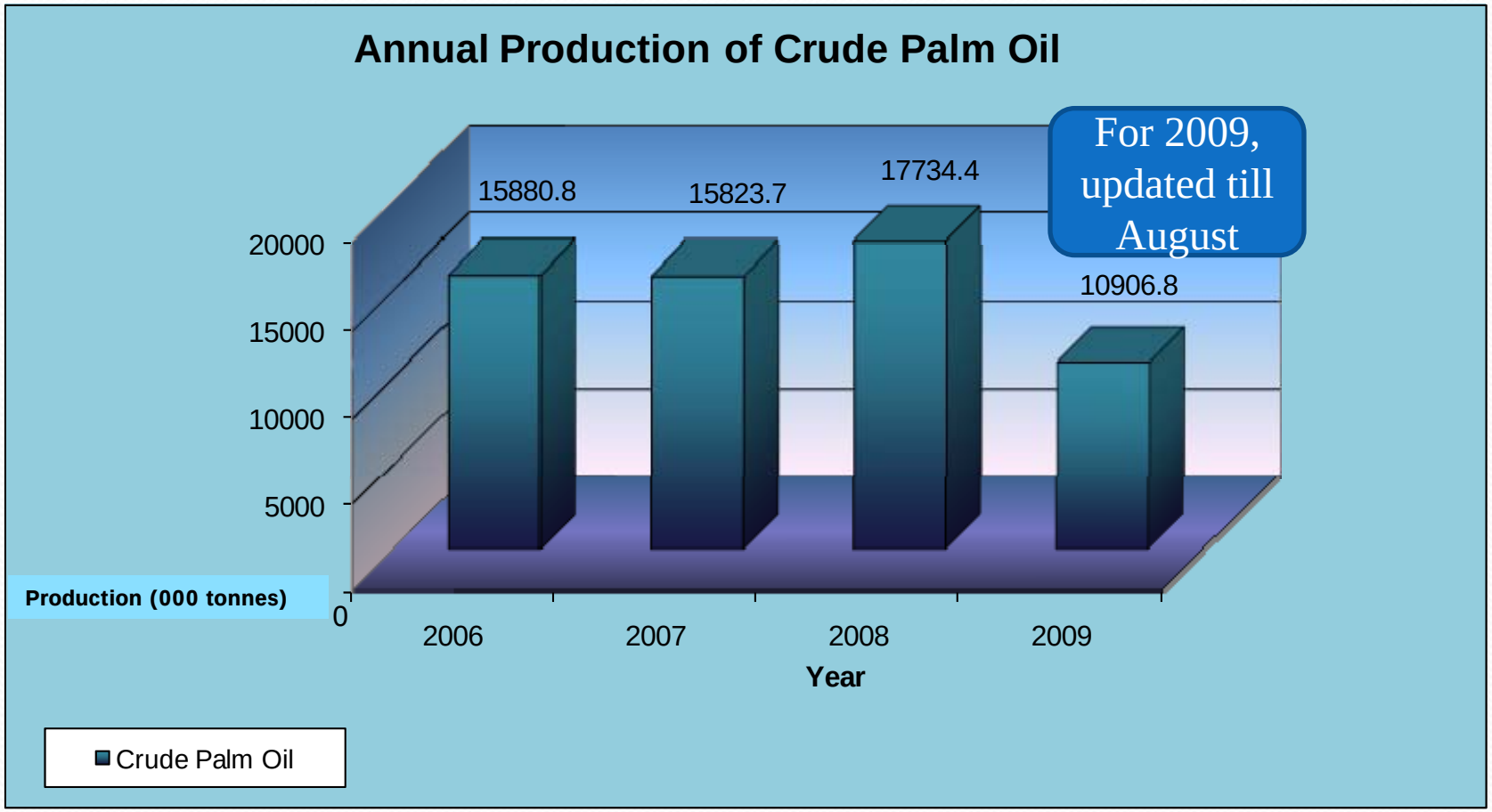
Annual Production of Crude Oil



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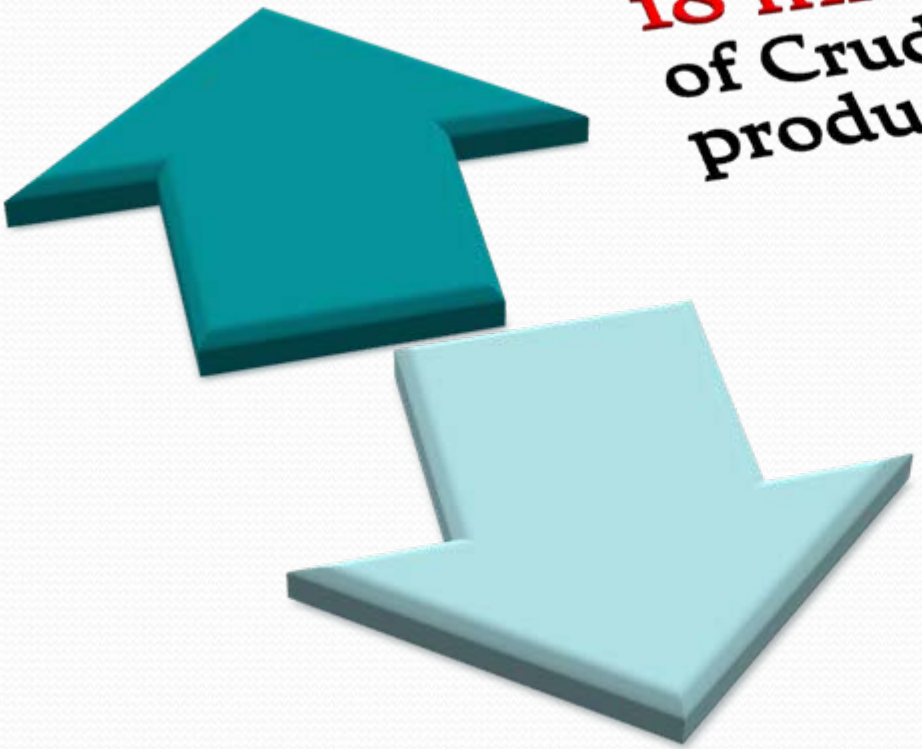
Where does all the waste go?



18 million tonnes of Crude Palm Oil produced

2008

63 million tonnes of EFB & POME (waste)produced

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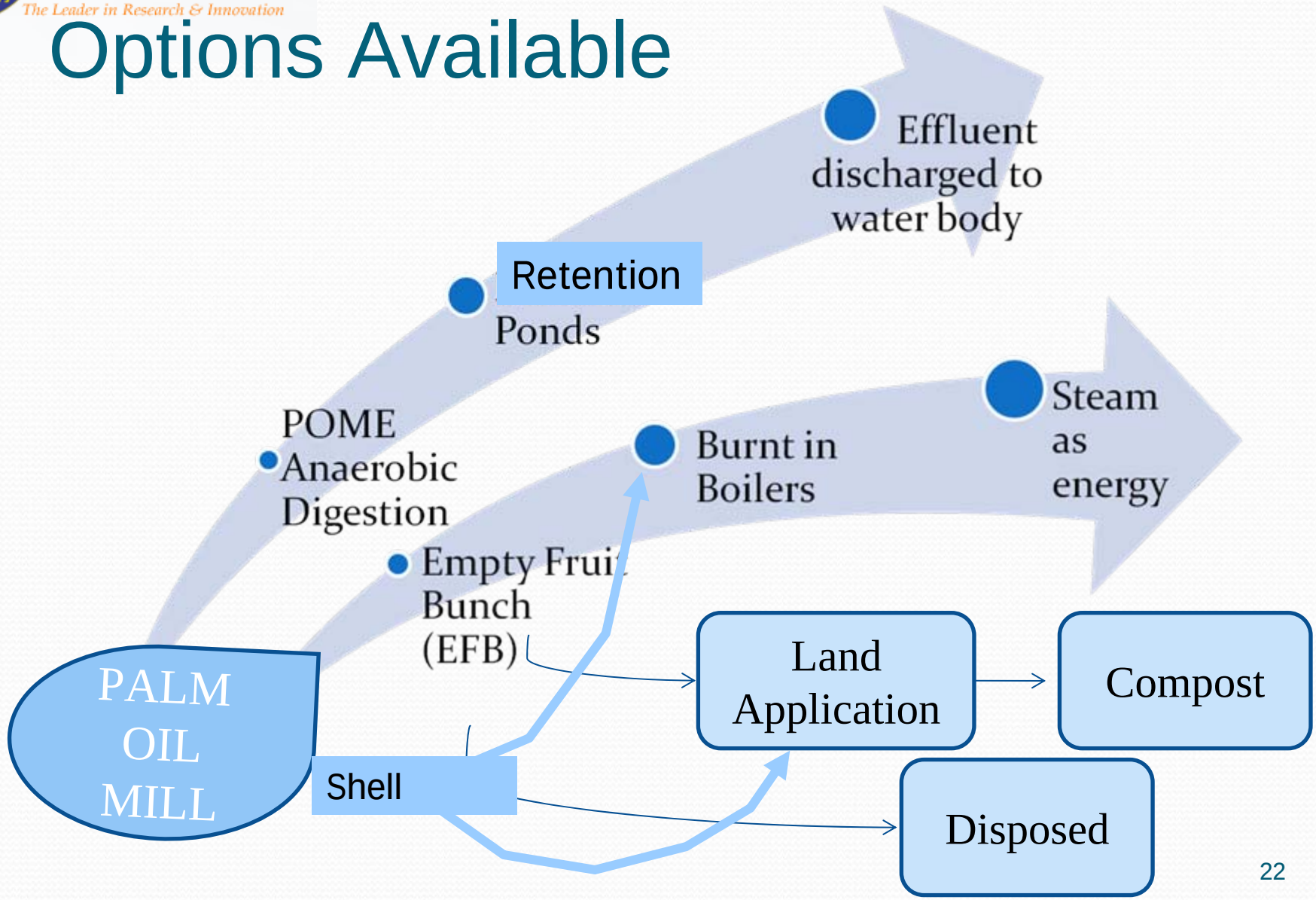
Options Available



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Palm oil Industry: Towards Zero Emission

Concentration of biomass

Oil Extraction

Empty Fruit Bunch

Palm Oil Mill Effluent

Compost

Cellulose

Sugars (Polylactate)

Bioplastics Bio-acids (PHA)

Bio-acids

Methane

Biofuel

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Summary

- With technology advancement and research findings, agricultural waste is no longer an environmental issue but a resource for energy production.
- 'Waste-to-Wealth' perception of Agricultural Waste
- A tremendous potential in improving the general state of sanitation, positive environmental actions to reduce GHG emissions.
- Significantly improve the crop yield, soil fertility
- Reduces the global dependence on chemical fertilizers, fossil fuel, etc.

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