RESPONSE TO THE GREEN ECONOMY IMPERATIVE FOR AFRICA IN THE 21ST CENTURY

A PLENARY SESSION

by

Prof. Hilary I. Inyang, NNOM

US Ambassador's Distinguished Scholar to Ethiopia with a base at Bahir Dar University, Bahir Dar, Ethiopia.

h.inyang26@gmail.com

at

the

GLOBAL AFRICA DIASPORA SYMPOSIUM (GADS)

hosted

by

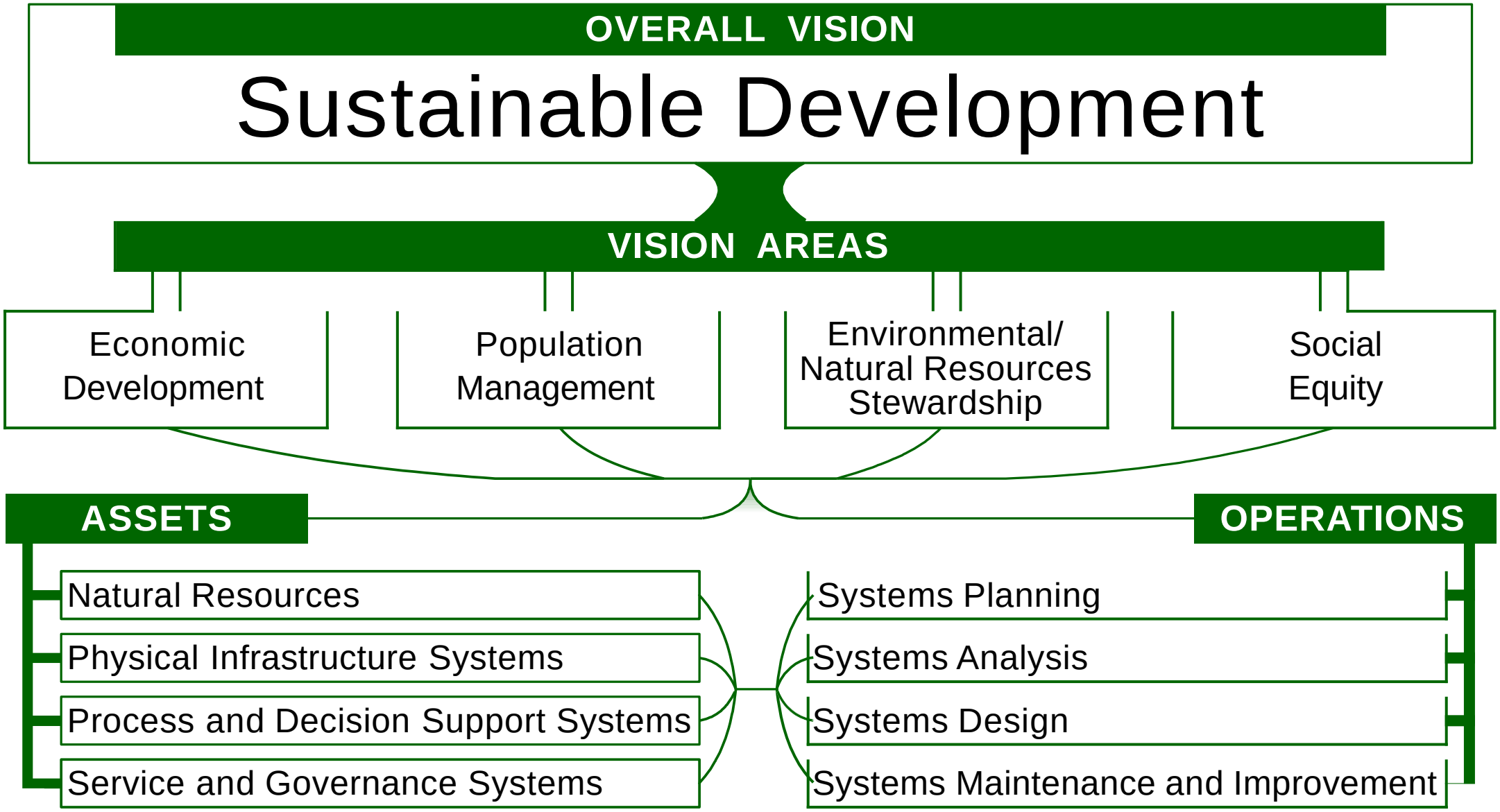
The Nigerians in Diaspora Commission (NiDCOM)

The Federal Republic of Nigeria,
Abuja, Nigeria.

DATE: APRIL 27-28, 2023

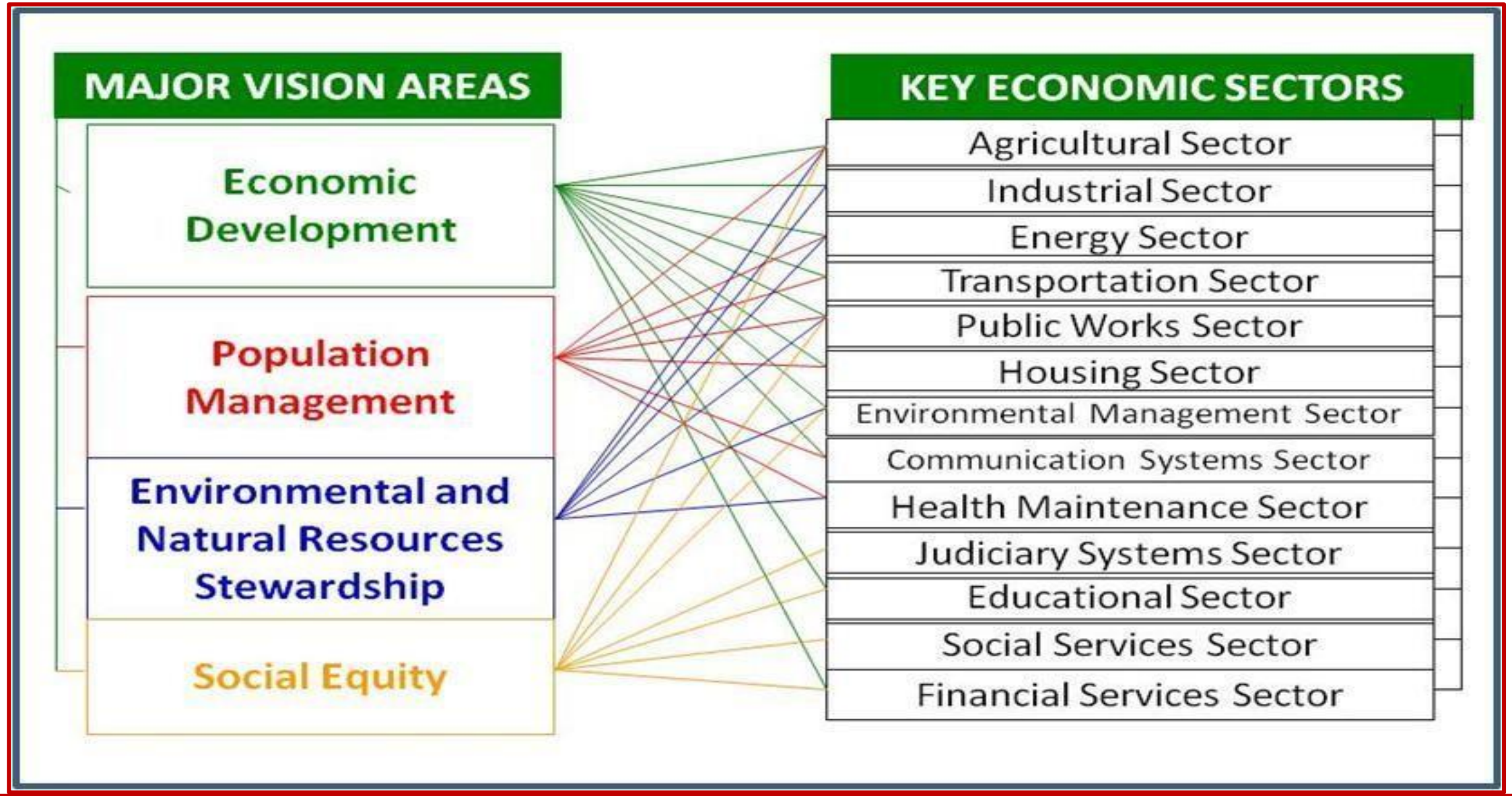
THE SUSTAINABLE DEVELOPMENT CONTEXT

(Inyang, 2016)

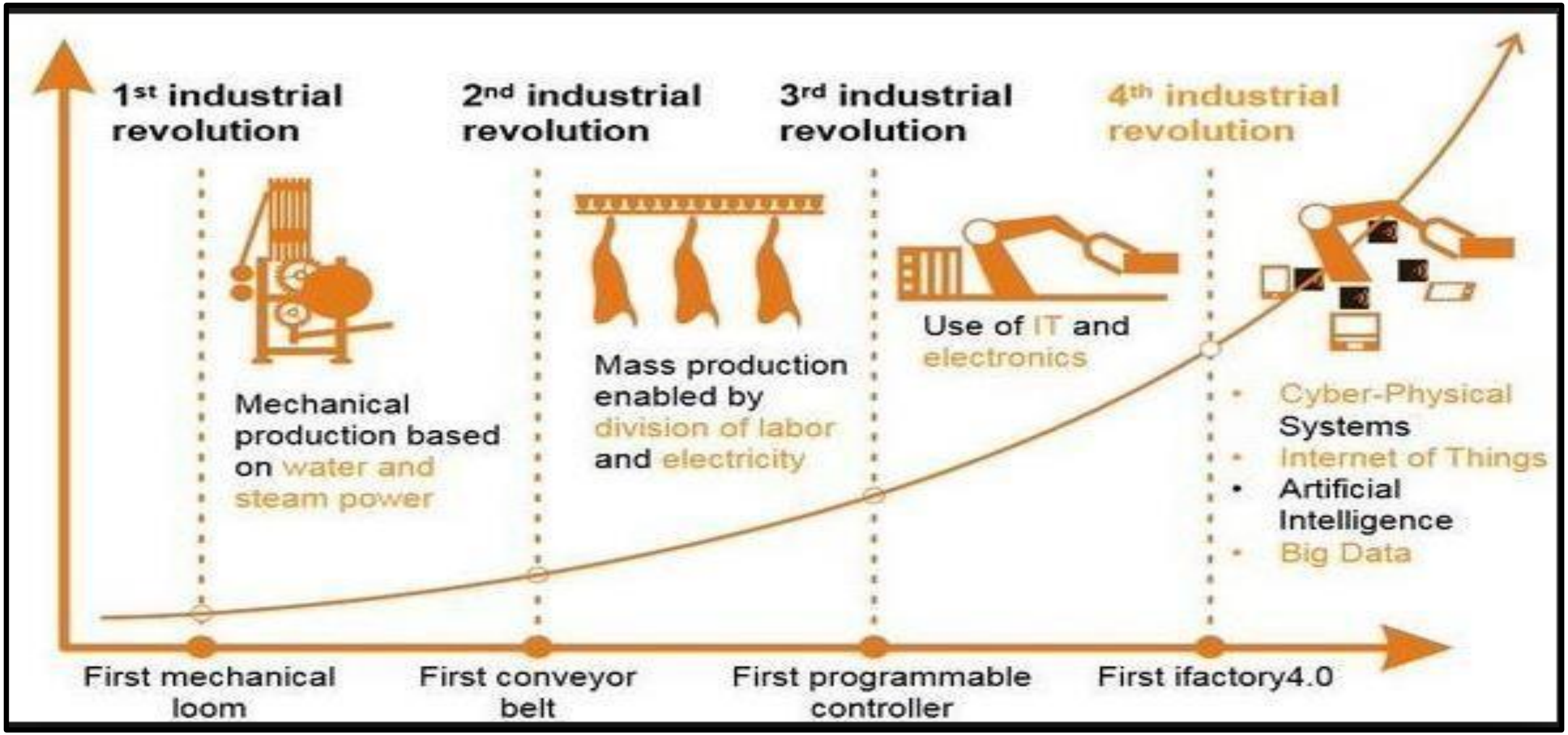


GREEN ECONOMY AND SUSTAINABLE DEVELOPMENT NEED TO PERCOLATE THROUGH ALL SOCIOECONOMIC SECTORS

(Inyang, 2016)



GREEN ECONOMY IS TARGETED BY MOST COUNTRIES EVEN AS THE 4TH INDUSTRIAL REVOLUTION UNFOLDS

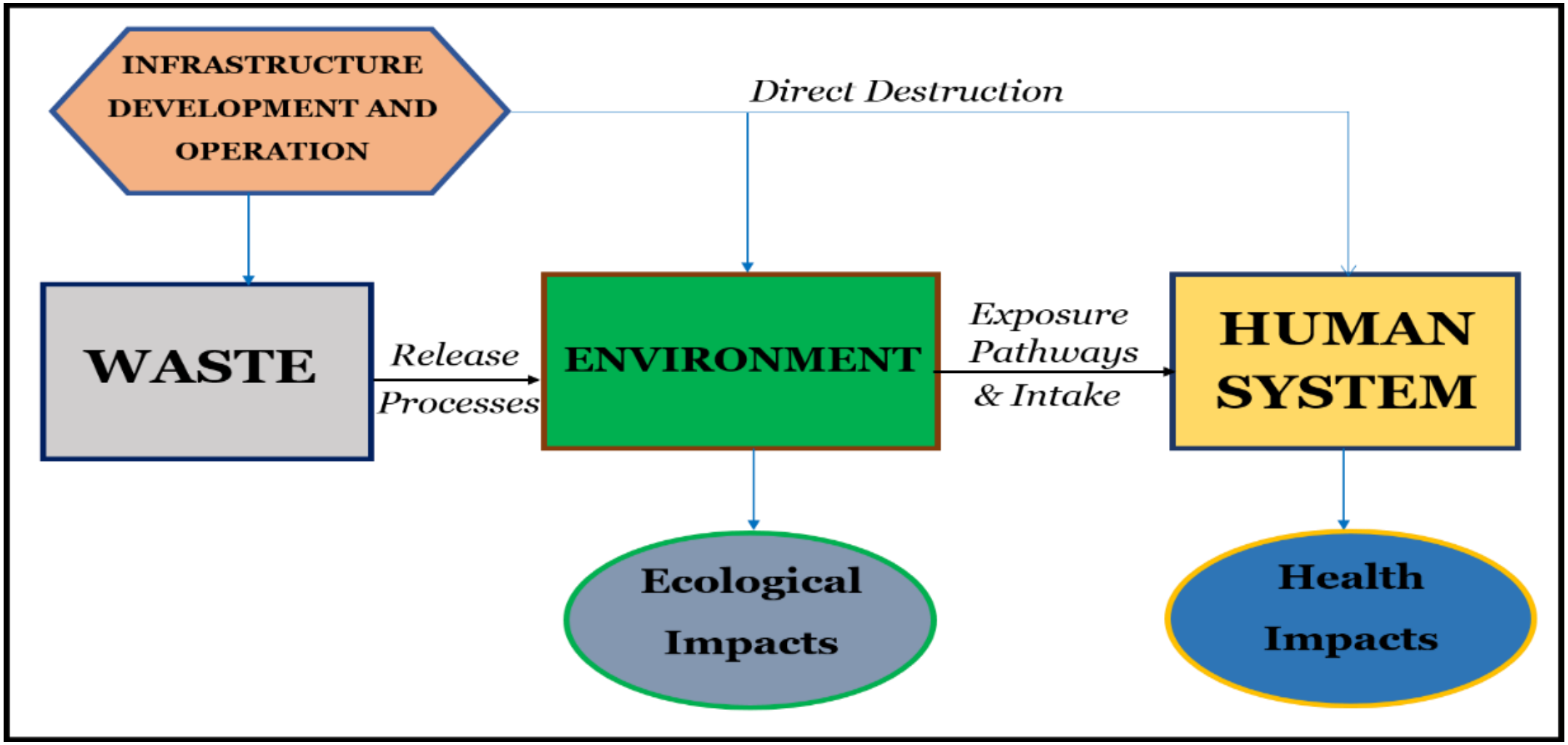


SOURCE: ottomotors.com/blog/industry-4-0-connected-factory

SECTION A

INTRODUCTION: DEFINING GREEN ECONOMY AND ITS SIGNIFICANCE

THE RELATIONSHIP BETWEEN INFRASTRUCTURE DEVELOPMENT/OPERATION AND THEIR IMPACTS ON THE ENVIRONMENT AND HUMAN HEALTH



DEFINING GREEN ECONOMY

KEY POINTS TO NOTE

- **UNEP'S DEFINITION OF GREEN ECONOMY**

"An economy that results in improved well-being and social equity, while significantly reducing environmental risks and ecological scarcities"

- **CHARACTERISTICS OF GREEN ECONOMIES**
  - Low-carbon development
  - Enhanced efficiency
  - Social equity/inclusiveness

SECTORS IDENTIFIED BY UNEP (2011) AS KEY TO GREENING THE ECONOMY

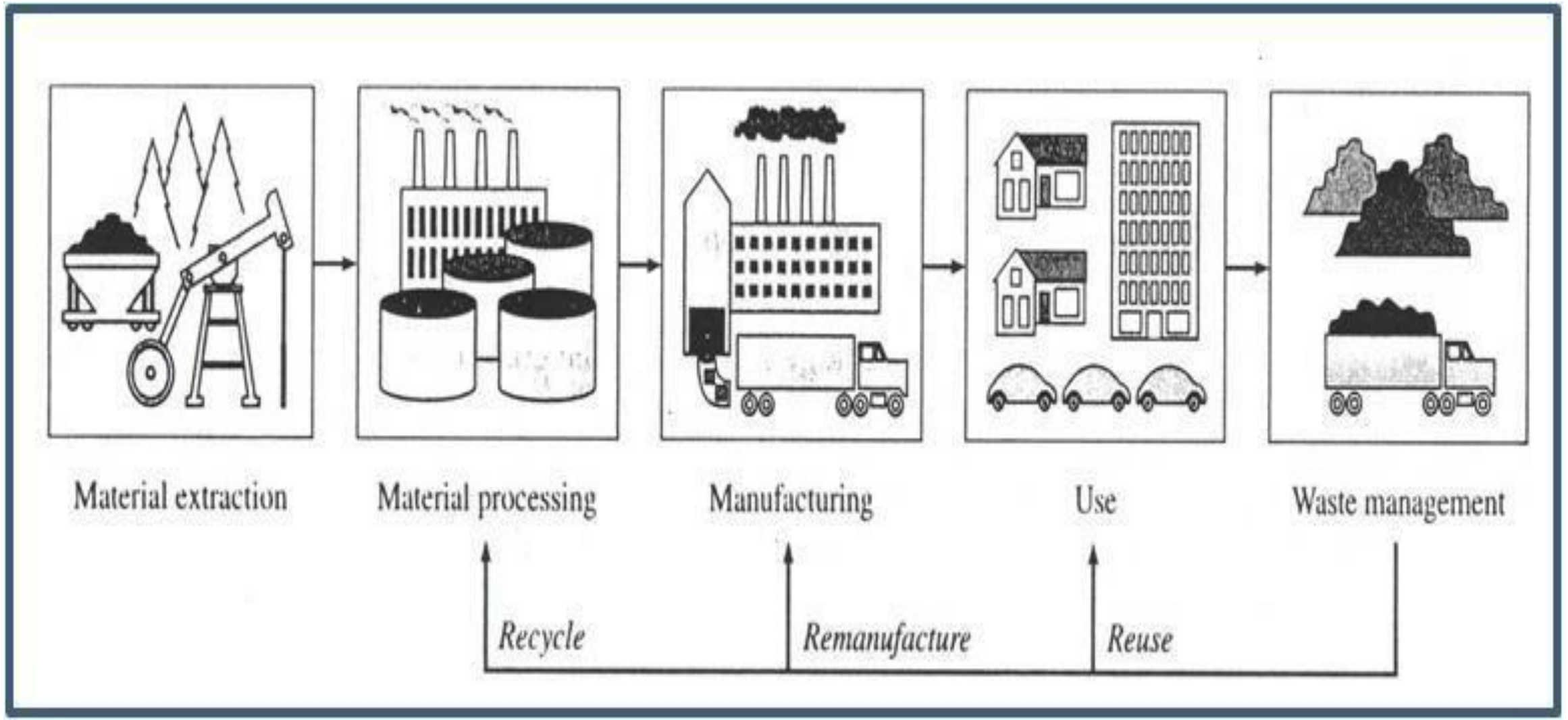
SECTORS OF GREEN ECONOMY TO ADDRESS	
• AGRICULTURAL PRACTICES AND FORESTRY • BUILDING MATERIALS • ENERGY SUPPLY • FISHERIES	• ENERGY EFFICIENCY IN INDUSTRY • TOURISM • WASTE MANAGEMENT • WATER SYSTEMS

- 80% of Africa's employment derives from agriculture, mineral exploitation, fishing and forestry (UNESEC, 2011)

SIGNIFICANCE OF GREEN ECONOMY INTERVENTIONS IN AFRICA

- On July 15, 2021, the African Union Commission (AUC) launched a 5-year Continental Green Recovery Action Plan 2021-2027.
- The African Development Bank (AfDB) (Undated) estimates that with proper capacity building, the private sector can exploit 75% of about US $3 trillion investment opportunities that climate change will generate in Africa by 2030.
- The World Meteorological Organization (2021) as reported in Africa Report (2021), estimates that African countries are spending 2-9% of their GDP on climate change adaptation and mitigation.

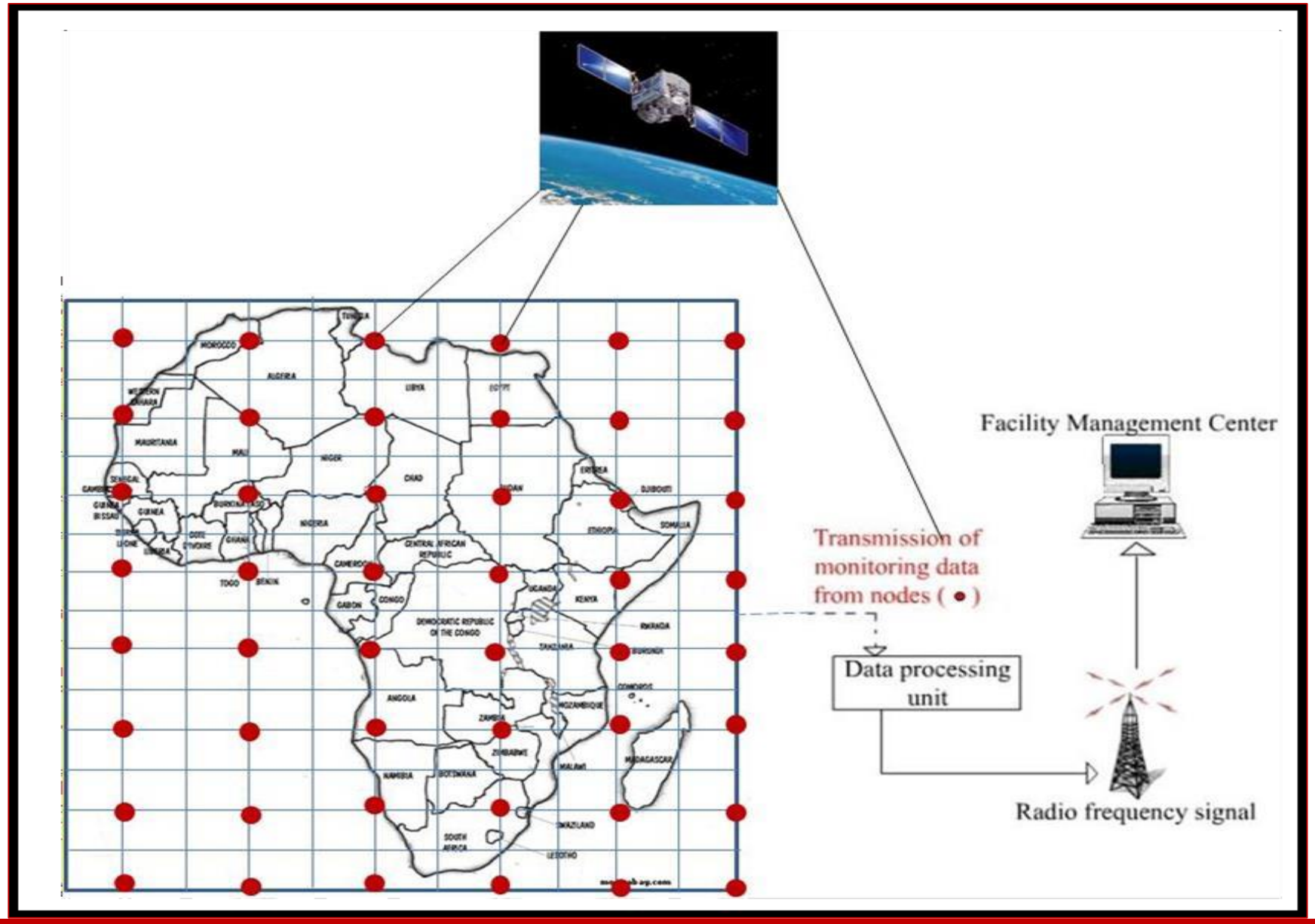
NATURAL RESOURCE EXTRACTION, PROCESSING AND MANUFACTURING PROCESSES HAS SUPPORTED ECONOMIC DEVELOPMENT BUT HAS GENERATED WASTES AND ECOLOGICAL CHALLENGES AT VARIOUS STAGES: GREEN ECONOMY SHOULD PROMOTE RECYCLING, REMANUFACTURING AND REUSE (RRR) AND WASTE MANAGEMENT LOOPS



CATALOG OF OPTIONS FROM WHICH MEASURES CAN BE SELECTED, OPTIMIZED AND IMPLEMENTED TO ADAPT TO ENVIRONMENTAL DAMAGES

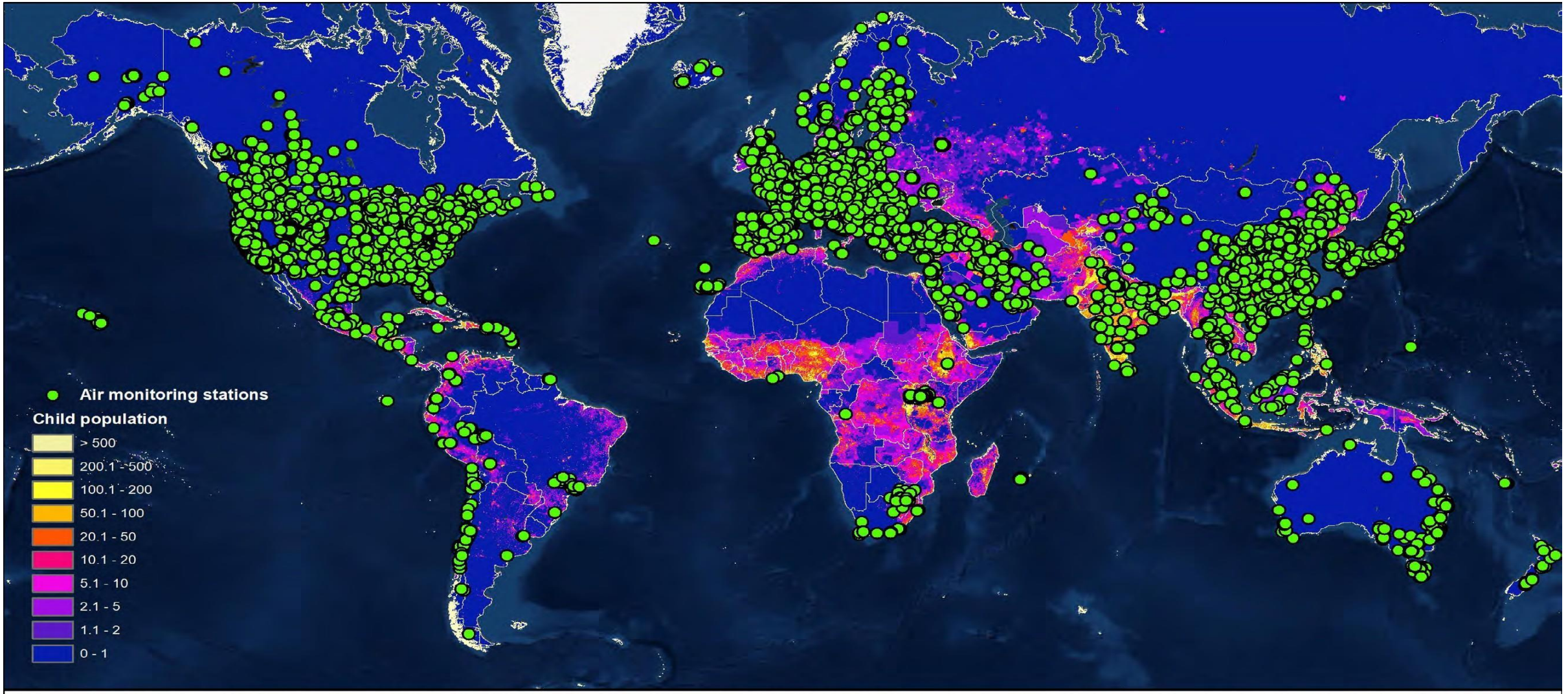
OPTION CATEGORIES	EXAMPLES OF SPECIFIC OPTIONS
1. Engineering	a. Revegetation b. Ground Stabilization c. Wind breaks d. Surface water cleanup
2. Communication/Education	a. Community outreach b. Formal education c. Technical guidance d. Research support
3. Regulation	a. Code of standards in construction b. Banning of products (in agriculture) c. Facility sitting controls (e.g. EIA) d. Facility controls
4. Enforcement	a. Litigation b. Fines
5. Market Incentives	a. Tax relief b. Relaxation of controls c. Subsidies for sustainable farming d. Direct purchase of friendly products
6. International/Inter-Governmental Cooperation	a. International treaties b. International standards (ISO) c. Tariffs on goods d. Foreign on goods
7. Environmental Management Systems	a. Application of technology and techniques to mitigate risks, and direct use by communities for operations and planning.

EXISTING DATA THAT ARE GIVEN VARIOUS SPATIO-TEMPORAL COORDINATES NEED TO BE INTERLINKED WITH MORE RECENT DATA THAT CAN BE GENERATED BY SATELLITES AND TRANSFERRED BY BOTH SATELLITE AND CABLE COMMUNICATION SYSTEMS



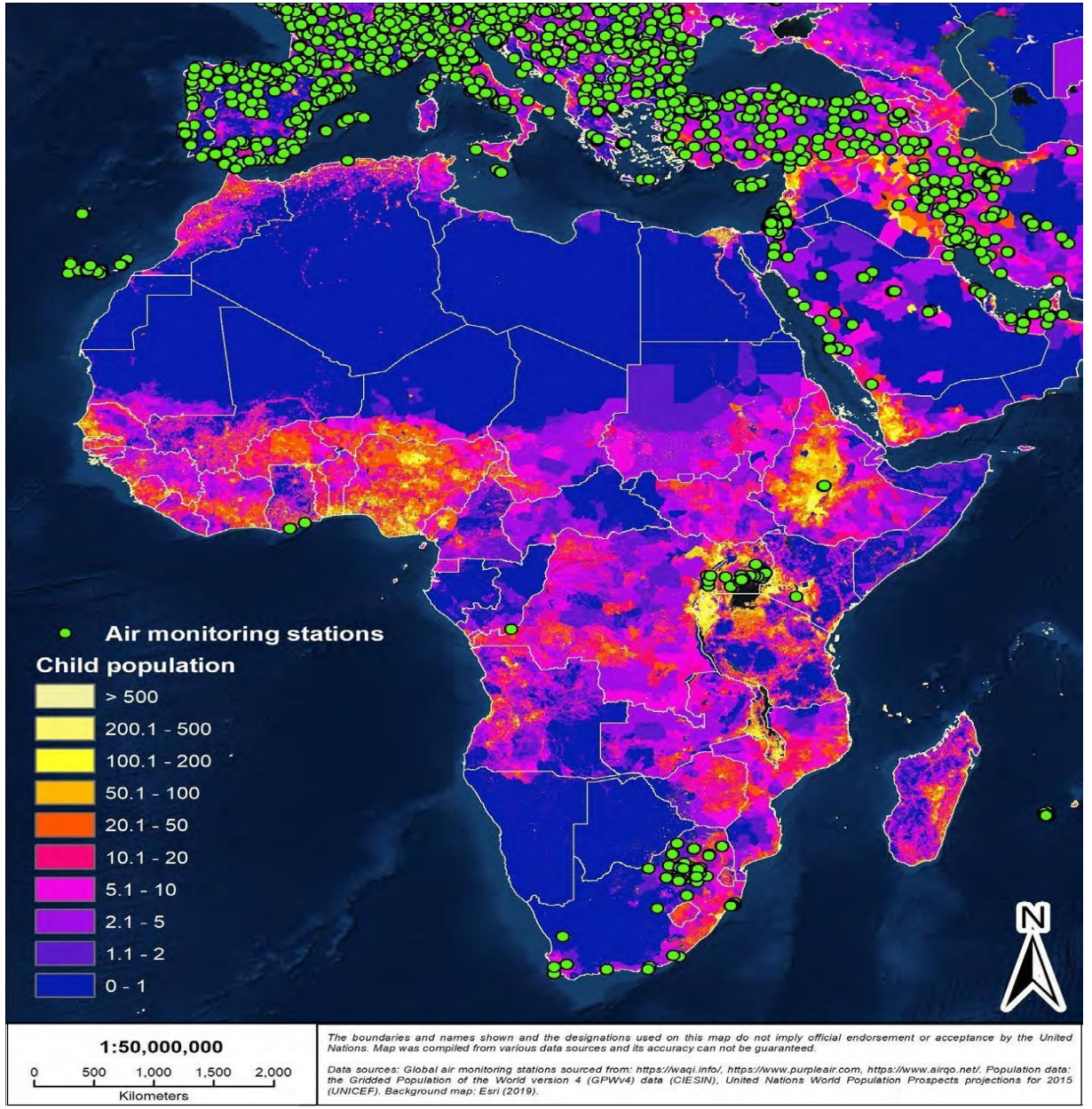
REAL-TIME AIR POLLUTION MONITORING STATIONS GLOBALLY

NOTE THE SPARSITY OF MONITORING STATIONS IN AFRICA



The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations. Map was compiled from various data sources and its accuracy can not be guaranteed. Data sources: Global air monitoring stations sourced from: https://waqi.info/, https://www.purpleair.com, https://www.airqo.net/. Population data: the Gridded Population of the World version 4 (GPWv4) data (CIESIN), United Nations World Population Prospects projections for 2015 (UNICEF). Background map: Esri (2019).

AIR POLLUTION MONITORING IN AFRICA



SECTION B

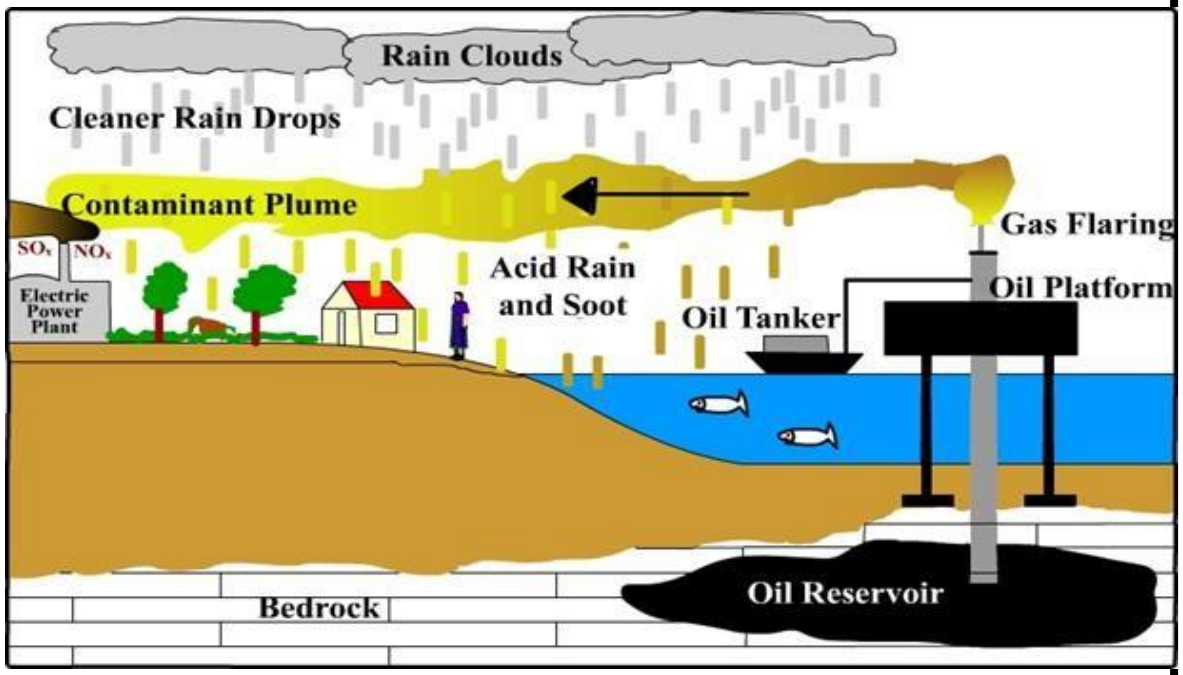
ECONOMIC DEVELOPMENT AS THE GENERATOR OF ENVIRONMENTAL POLLUTION AND ASSOCIATED SOCIAL CONFLICTS

AIR POLLUTION (1)

- Dust emissions
- Industrial stack emissions
- Acid rain

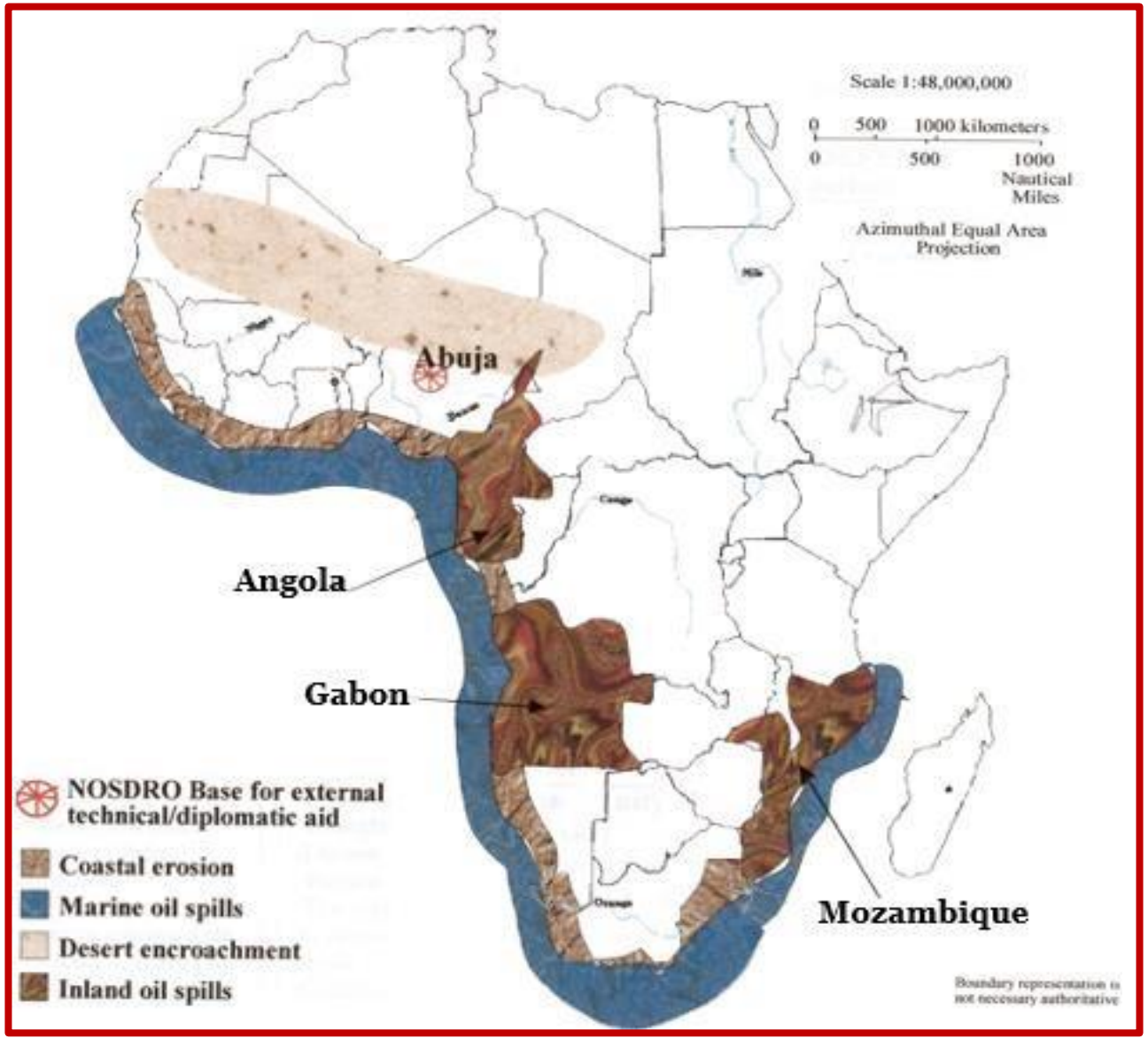
- Chemical vapors
- Noise pollution and control
- Ozone depletion

Air pollutant emissions from factories



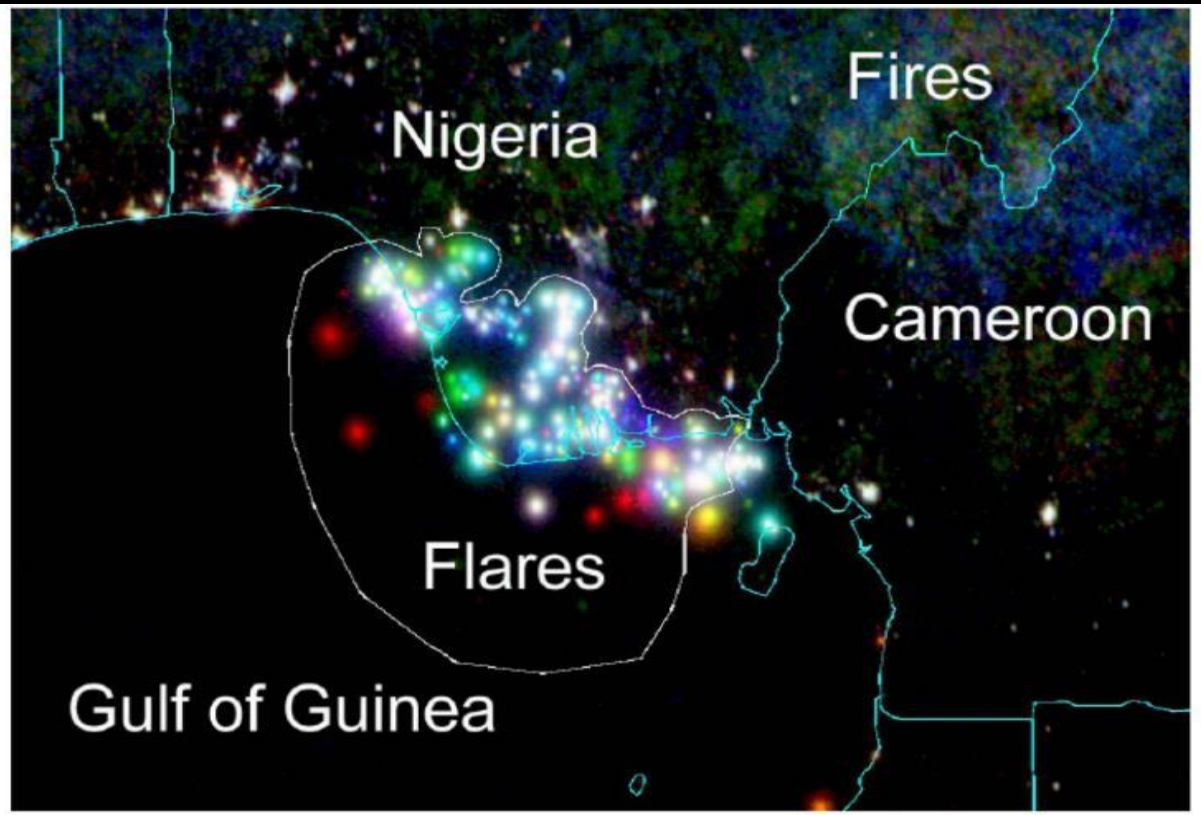
Depiction of air pollutant emissions from oil platforms through gas flaring (Inyang, 2010)

COASTAL COUNTRIES IN WEST, SOUTHERN AND EAST AFRICA HAVE COASTAL MARINE OIL POLLUTION PROBLEMS (INYANG, 2010)



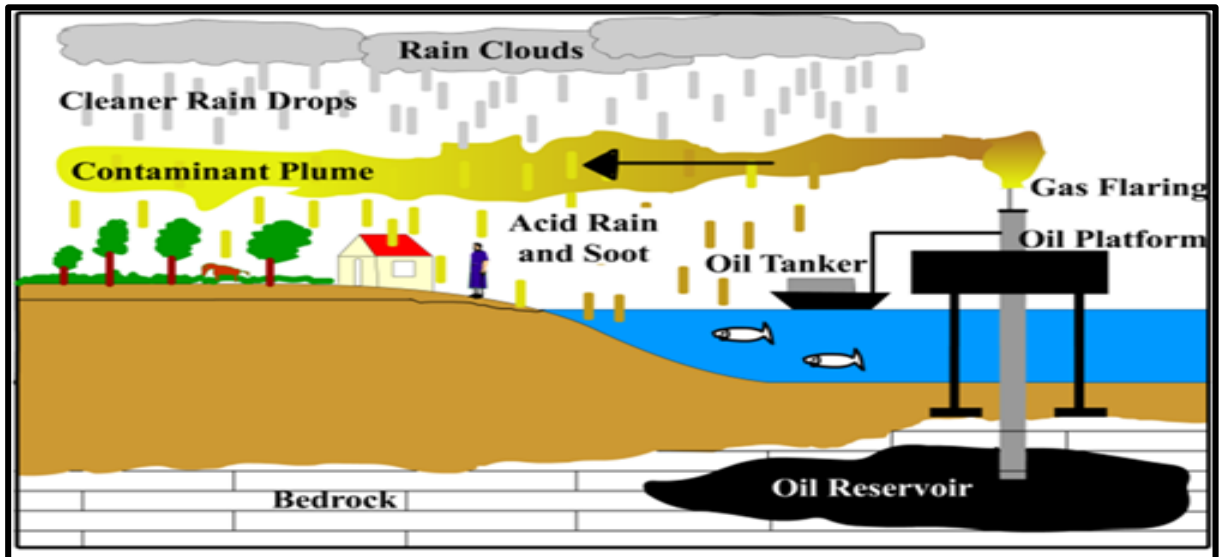
AIR POLLUTION (2)

NIGHT-TIME SATELLITE PICTURES HAVE SHOWN THE INTENSITY OF GAS FLARING IN THE NIGER DELTA OF NIGERIA



(Color Composite of Nighttime Gas Flares in The Coastal Region of Nigeria (1992 In Blue, 2000 In Green And 2006 In Red) (NASA)

DEPICTION OF GAS FLARING IN THE NIGER DELTA OF NIGERIA WHICH IS PARTLY RESPONSIBLE FOR ACID RAIN (Inyang)



Using the Gaussian Plume Equation (GPE),

$$C(x,y,z) = \frac{Q}{2\pi\sigma_y\sigma_z u}\exp\left\{-\frac{1}{2}\left[\frac{y^2}{\sigma_y^2}+\frac{(z-h)^2}{\sigma_z^2}\right]\right\}$$

x, y, and z = spatial coordinates of the pollutant receptor in meters

C = concentration of the pollutant at the point (x; y; z) in g/m3

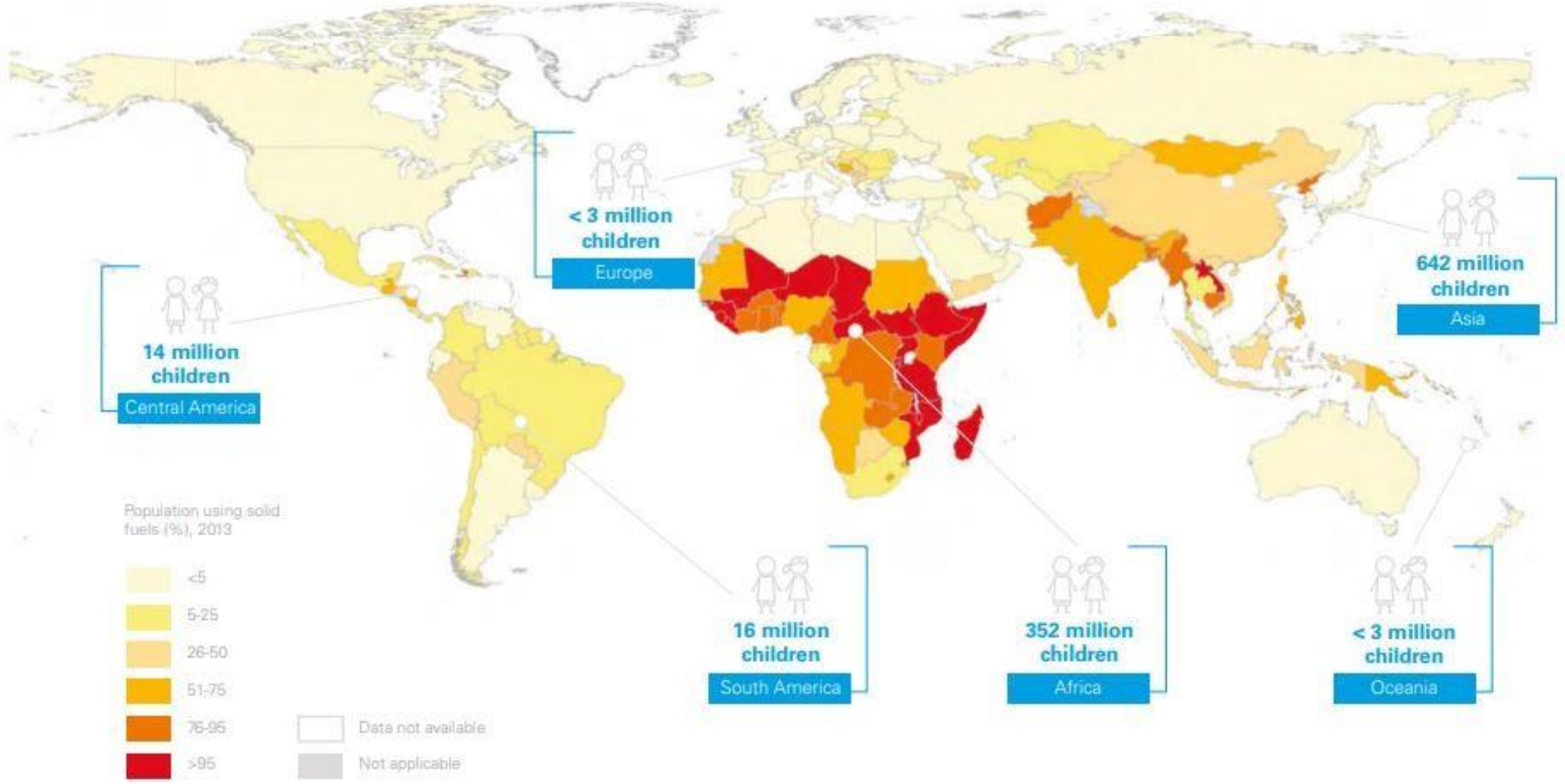
Q = emission rate in g s^{-1}, σ_y and σ_z are dispersion coefficients

u = wind speed in m s^{-1}

h = height (m) from the ground of the point of release of the pollutant.

OVER 1 BILLION CHILDREN LIVE IN HOMES WHERE SOLID FUELS ARE USED IN COOKING AND HEATING

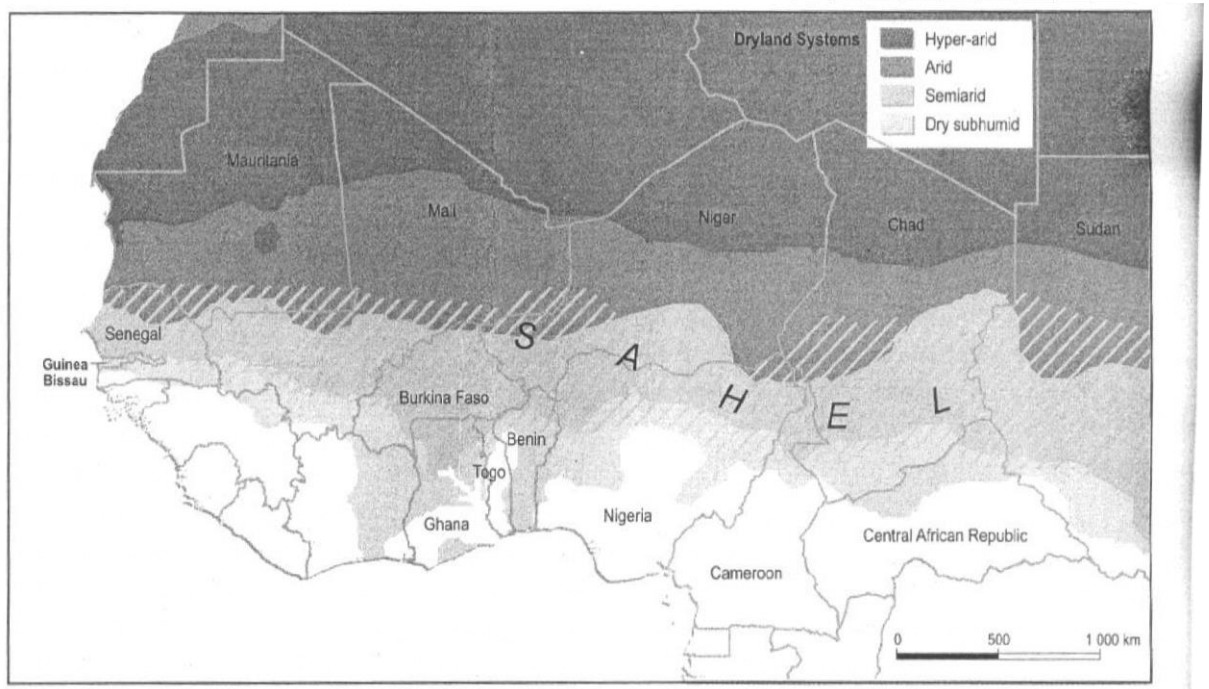
(POPULATION USING SOLID FUELS (%), 2013)



Data Source: World Health Organization Global Health Observatory Data Repository Map Production: Health Statistics and Information Systems (HSI),Global Health Observatory 2014.

ECOLOGICAL SYSTEM IMPACTS
DESERTIFICATION AND DROUGHTS

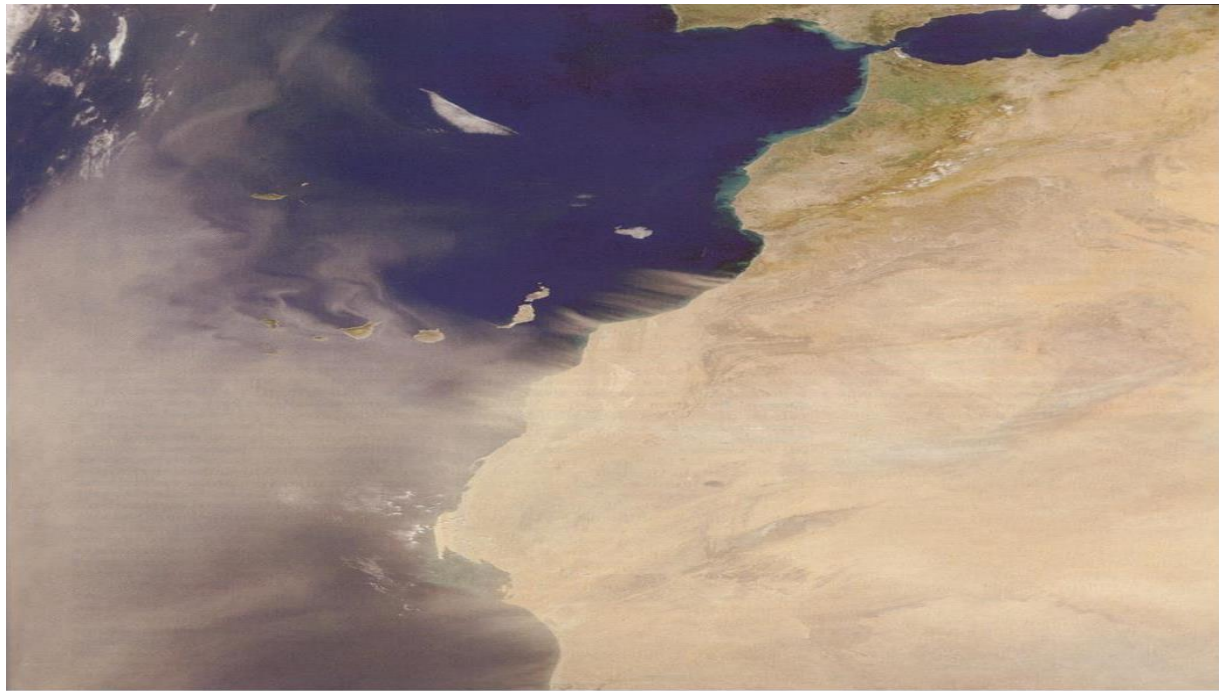
THE WEST AFRICAN SAHEL: WILL EXPAND SOUTHWARDS AS THE DESERTIFICATION GROWS AS AN IMPACT OF GLOBAL CLIMATE CHANGE. ABUJA MAY BE MARGINALLY AFFECTED BY DRY SPELLS.



Note: The Cape Verde Islands, although not included in the map, are also defined as Sahel. Prepared by Philippe Rekacewicz and Emmanuelle Bournay of UNEP/Grid-Arendal.
Source: Millennium Ecosystem Assessment (2005).

THE IMPACTS ARE NOT ONLY REGIONAL BUT GLOBAL AS THE INTERNATIONAL TRANSFER OF AIRBORNE SOIL PARTICLES CAUSES ECOLOGICAL PROBLEMS IN MANY COUNTRIES

(GIANT DUST STORM ABOVE NORTHWESTERN AFRICA BLOWS OUT INTO THE ATLANTIC OVER THE CANARY ISLANDS ON FEBRUARY 11, 2001)



Source: Dale, D. W., Kellogg, C.A., Garrison, V.H., and Shinn, E.A. (2002). "The Global Transport of dust: an intercontinental river of dust, microorganisms and toxic chemicals flows through the Earth's atmosphere". American Scientist Magazine, May-June Issue, pp. 228-235

RESOURCE DAMAGES, OCCUPATIONAL LOSSES, POLLUTION AND COMMUNAL CONFLICT FACTORS HAVE CONTINUED TO THREATEN ECOLOGICAL SAFETY OF COASTAL MARINE AREAS OF AFRICA (A AND B IN NIGERIA; AND C AND D IN SOUTH AFRICA)

A. Oil spillages and fish mortality due to spreading of contaminant resulting from climate change will diminish fishing as an occupation

Source: maryelikafoundation death of biodiversity.

B. Threats to farming by land losses (due to erosion and submergence) and pollution will increase in the Niger Delta

Source: inhabitat.com

C. Oil spill near Robben Island affects penguins (South Africa) | Posted by: The ocean update | September 3, 2012 (SABC)

D. Oil Spills in South Africa. By Jane | Ocean Adventure (December 2, 2014) | (https://oceanadventures.co.za/oil-spills-south-africa/)

THOUSANDS OF BURIED UNDERGROUND TANKS FOR PETROL ARE POSSIBLY LEAKING ALL OVER AFRICAN MUNICIPALITIES AND MAY CONTAMINATE BOREHOLE WATER WITH KNOWN IMPACTS ON HUMAN HEALTH WITHOUT MONITORING AND MITIGATIVE ACTIONS

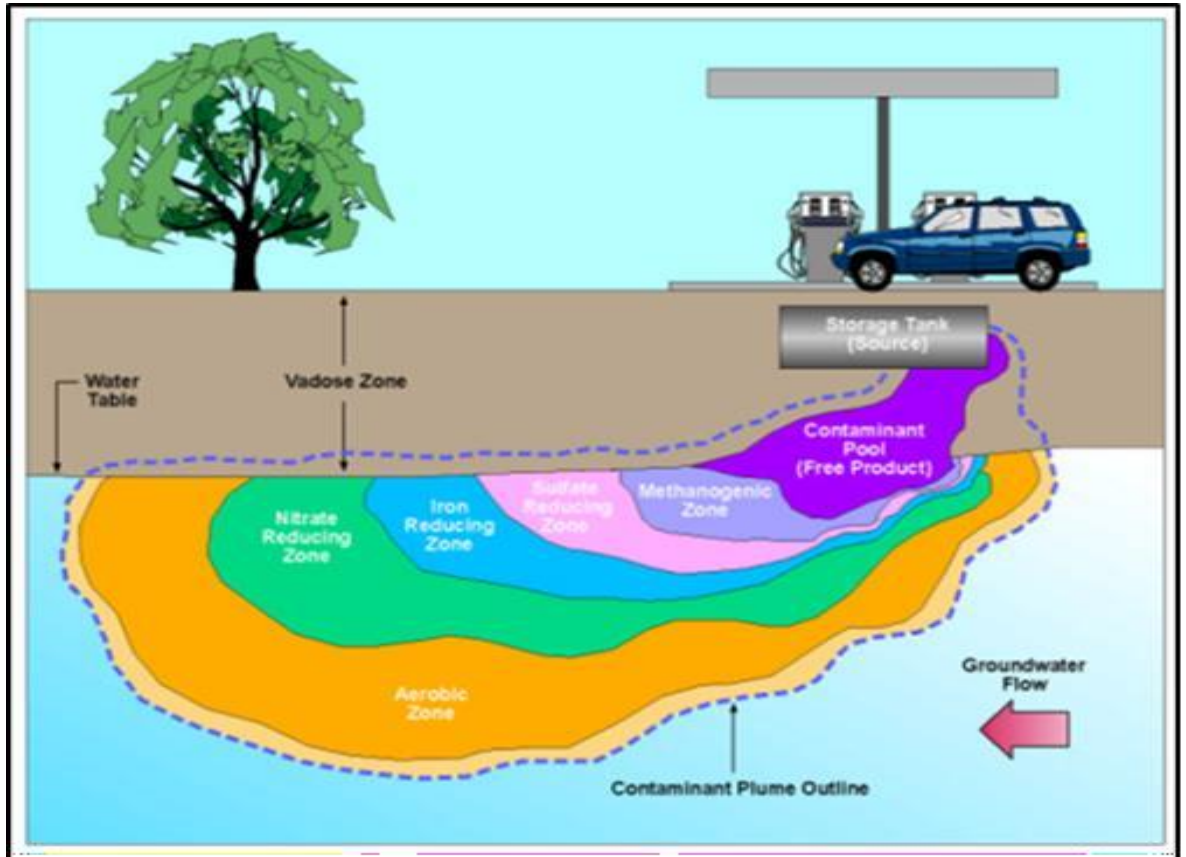
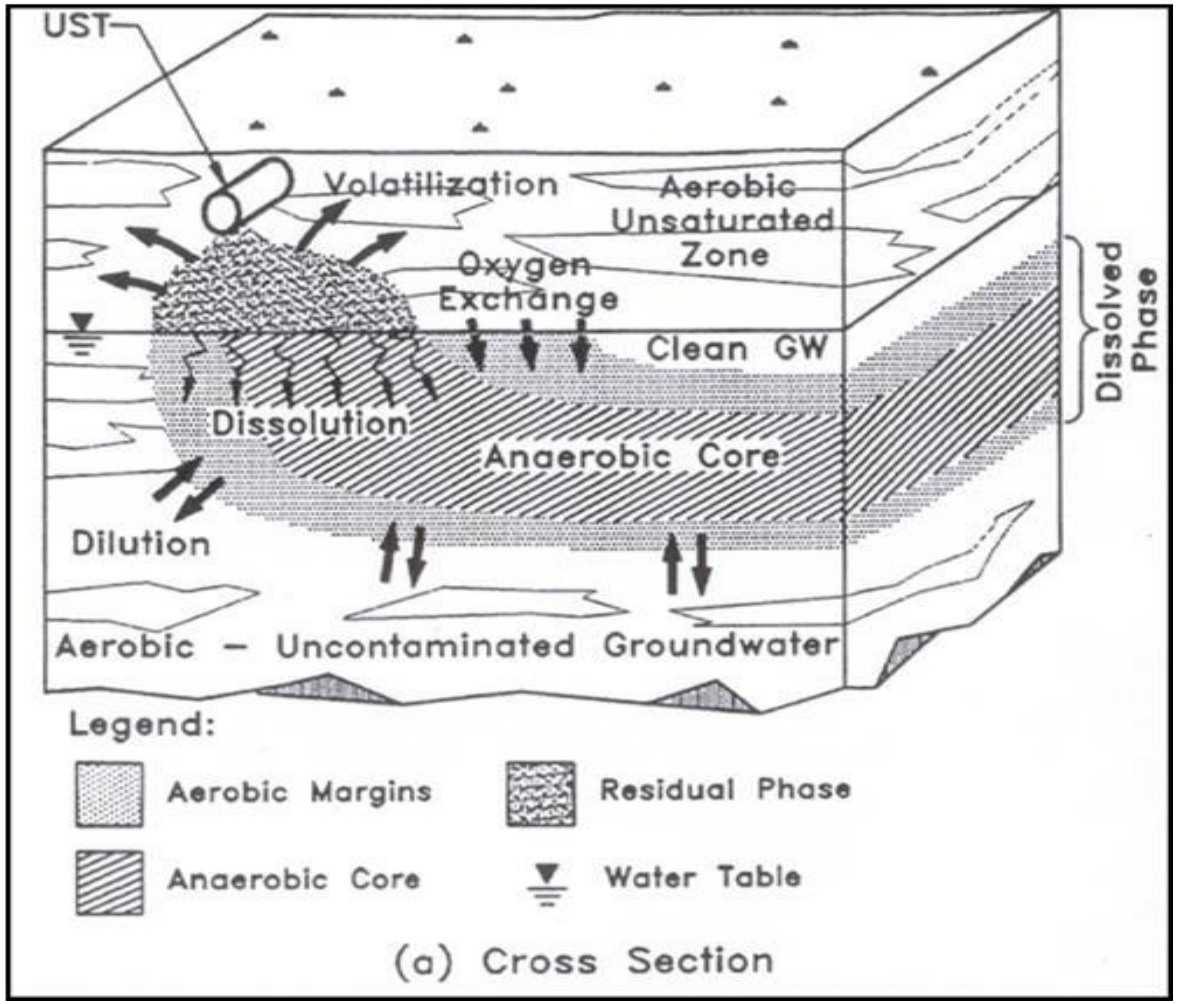


Illustration of the spatial distribution of biogeochemical zones that may occur at a site contaminated with petroleum hydrocarbons. (NAVAL FACILITIES ENGINEERING SERVICE CENTER User's Guide UG-2035-ENV, 1999)

DEPICTION OF PETROLEUM PRODUCTS FATE AND TRANSPORT PROCESSES IN THE SUBSURFACE: SOME PROCESSES WILL BE ENHANCED BY HIGHER SOIL TEMPERATURE AND ELEVATION OF THE WATER TABLE IN NIGERIA DURING WET SEASONS

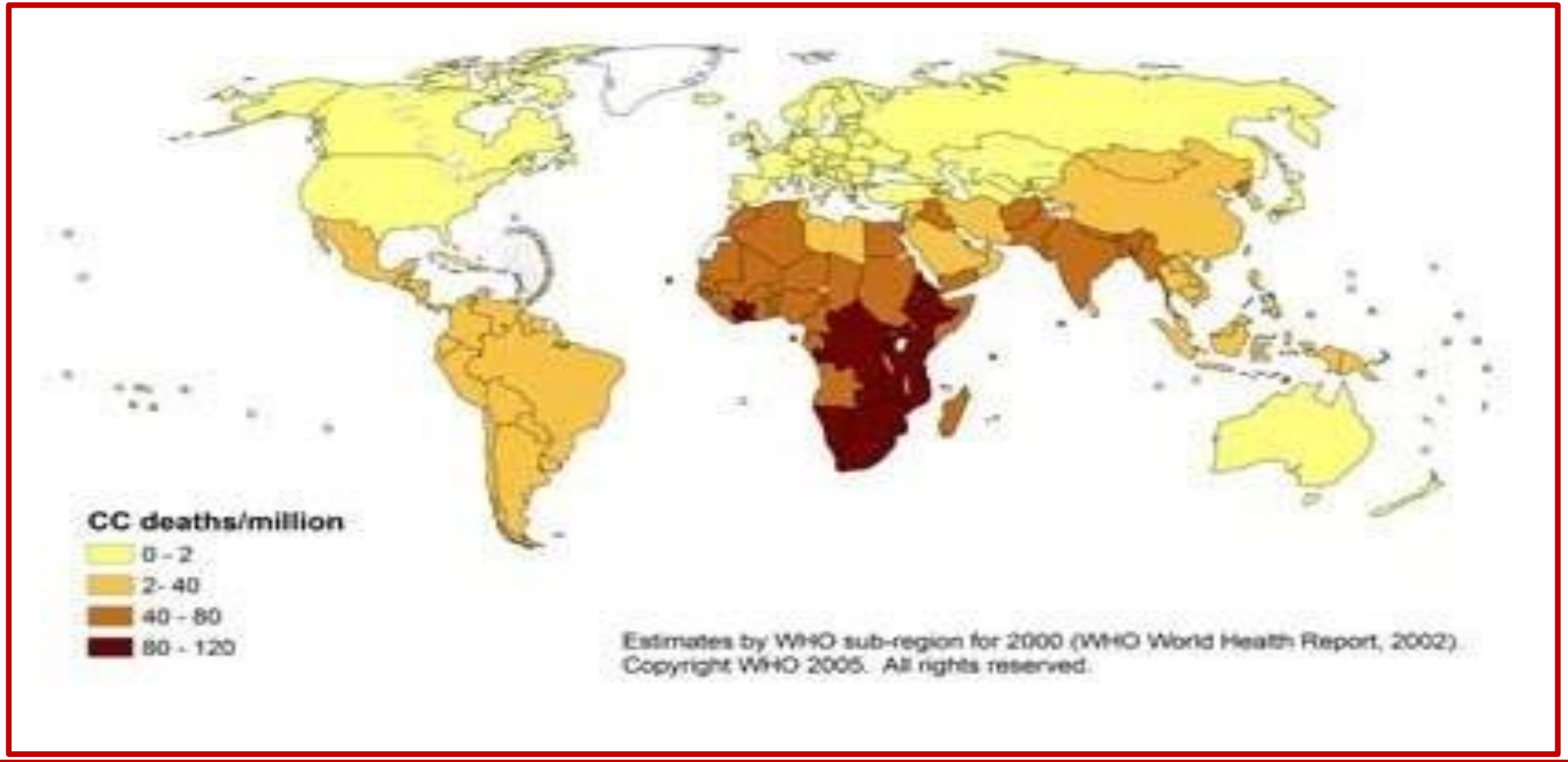


SECTION C

HUMAN HEALTH IMPACTS OF ENVIRONMENTAL POLLUTION AND CLIMATE CHANGE IN AFRICA

HUMAN MORTALITY IMPACTS OF GLOBAL CLIMATE CHANGE

DEATHS THAT CAN BE ATTRIBUTED TO CLIMATE CHANGE IN VARIOUS COUNTRIES



HEALTH IMPACTS OF GLOBAL CLIMATE CHANGE

HUMAN INTAKE OF CONTAMINANTS THAT WILL BE MADE MORE ACCESSIBLE BY GLOBAL CLIMATE CHANGE

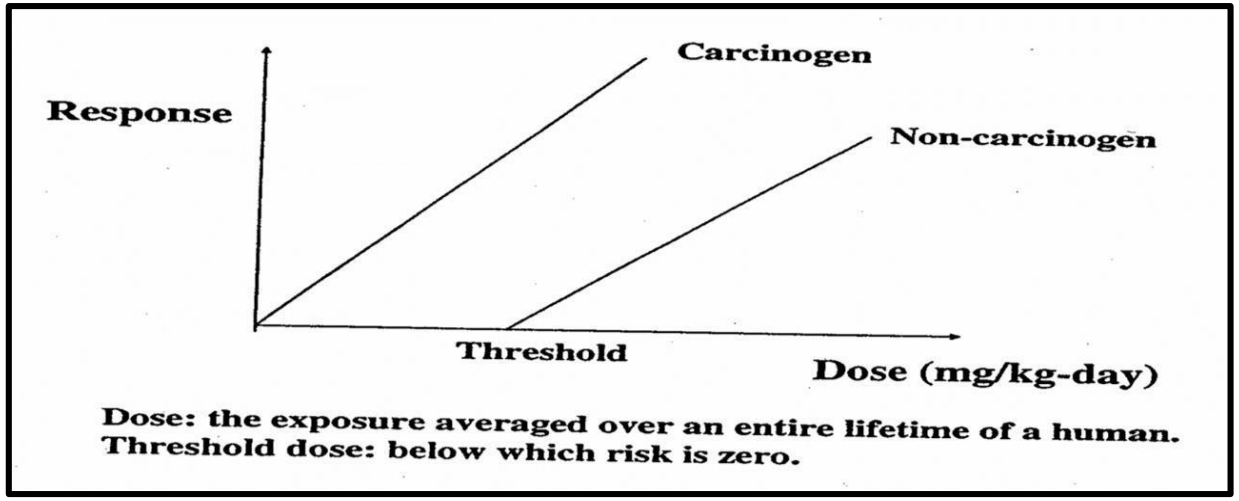
THERE ARE DIRECT QUANTITATIVE RELATIONSHIPS BETWEEN CONTAMINANT CONCENTRATION IN AIR, SOIL & WATER AND HUMAN INTAKE, WITH POTENTIAL HEALTH EFFECTS

THE BASIC EQUATION OF HUMAN EXPOSURE ASSESSMENT THAT CAN BE USED TO DETERMINE HOW MUCH CONTAMINATE IS TAKEN IN BY AN INDIVIDUAL WHO IS EXPOSED TO IT OVER A GIVEN TIME INTERVAL

$$IN = \frac{(C)(IR)(ABS)(EF)(ED)}{(BW)(AT)}$$

$$C(t) = f\left(\int_0^t V_t \partial t\right)$$

SOME CONTAMINANTS TAKEN IN BY RESIDENTS BY POLLUTED AREAS REQUIRE THRESHOLD DOSES FOR MANIFESTATION OF DISEASES JUST BECAUSE IT HAS NOT HAPPENED YET DOES NOT MEAN IT WILL NOT HAPPEN IN THE FUTURE

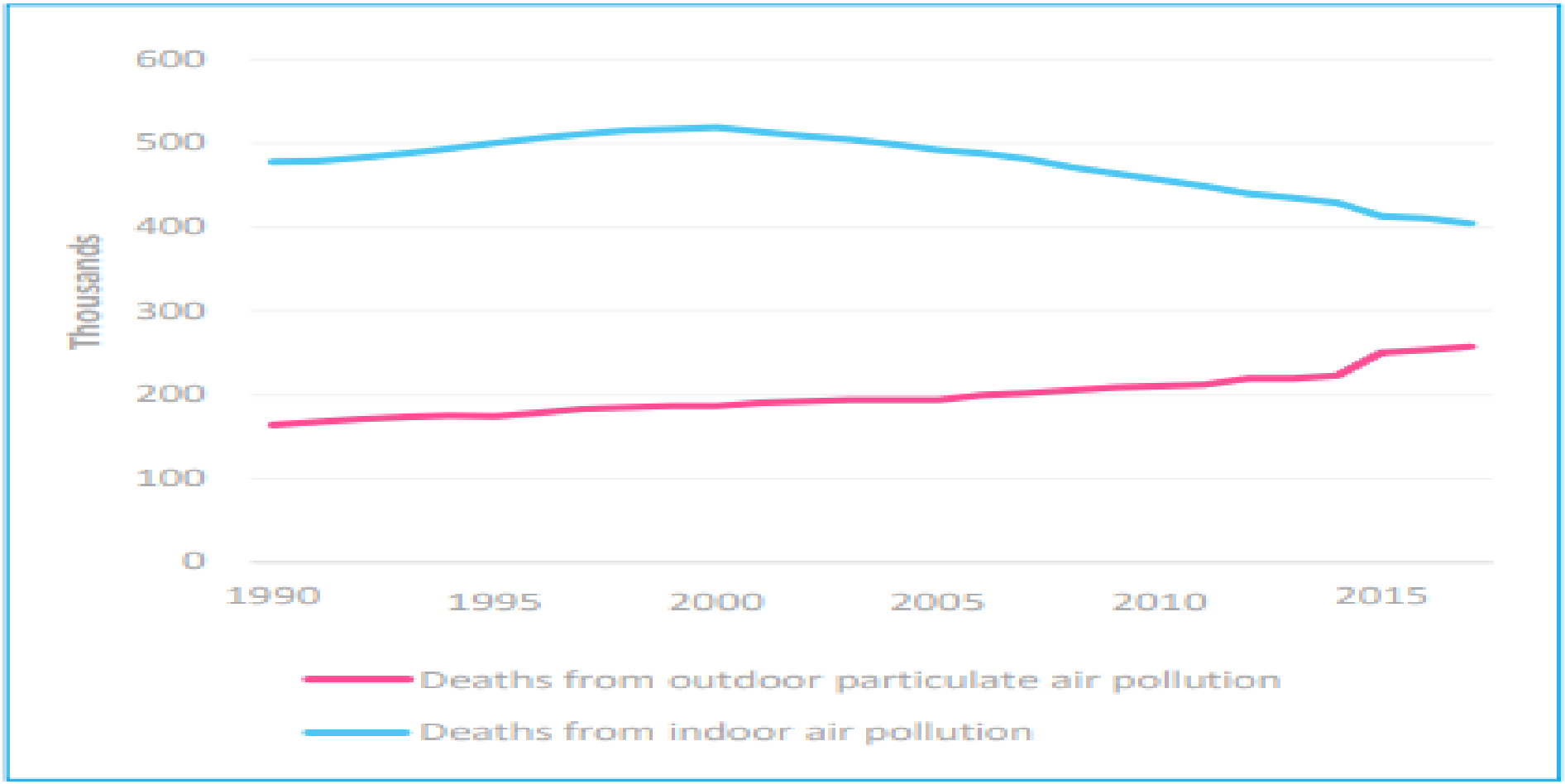


Dose: the exposure averaged over an entire lifetime of a human.
Threshold dose: below which risk is zero.

- IN = the intake defined as the amount of a specific chemical in a contaminated medium taken (mg/kg of body weight per day).
- C = the average chemical concentration contacted over the exposure period (mg/L for liquid and gases, and mg/mg for solids);
- IR = the intake rate defined as the amount of the contaminated medium contacted per unit of time or event (mg/day or L/day)
- ABS = fraction of contaminants that are absorbed
- EF = the upper-bound value of the exposure frequency (day/year)
- ED = the upper-bound value of the exposure duration (years)
- BW = the average body weight over the exposure period (kg)
- AT = the average time period over which exposure is averaged (exposure duration for non-carcinogens and 70 years for carcinogens)
- V_t = the volume of contaminant released at the performance time frame of interest, t

AIR POLLUTION AS THE MOST DAMAGING ENVIRONMENTAL HAZARD WITH RESPECT TO HUMAN MORTALITY AND HEALTH

ABSOLUTE NUMBER OF DEATHS ATTRIBUTED TO AMBIENT (OUTDOOR) AIR POLLUTION, AND TO HOUSEHOLD POLLUTION FROM COOKING AND HEATING (1990-2017)



Source: Institute of Health Metrics and Evaluation (IHME), Global Burden of Disease (GBD), 2017

MASS EXPOSURE OF PEOPLE TO HYDROCARBON FUMES DURING QUEUES AT PETROL STATIONS IN AFRICA IS DAMAGING TO HUMAN HEALTH

$$E_i = D_i C_{si} A_g \left(n^{4/3} \right) \frac{M_i}{d_e}$$

E_i = emission rate of contaminant i (M/T)

D_i = diffusion coefficient of contaminant i in air (L^2/T)

C_s= saturation vapor concentration of contaminant i (M/L^3)

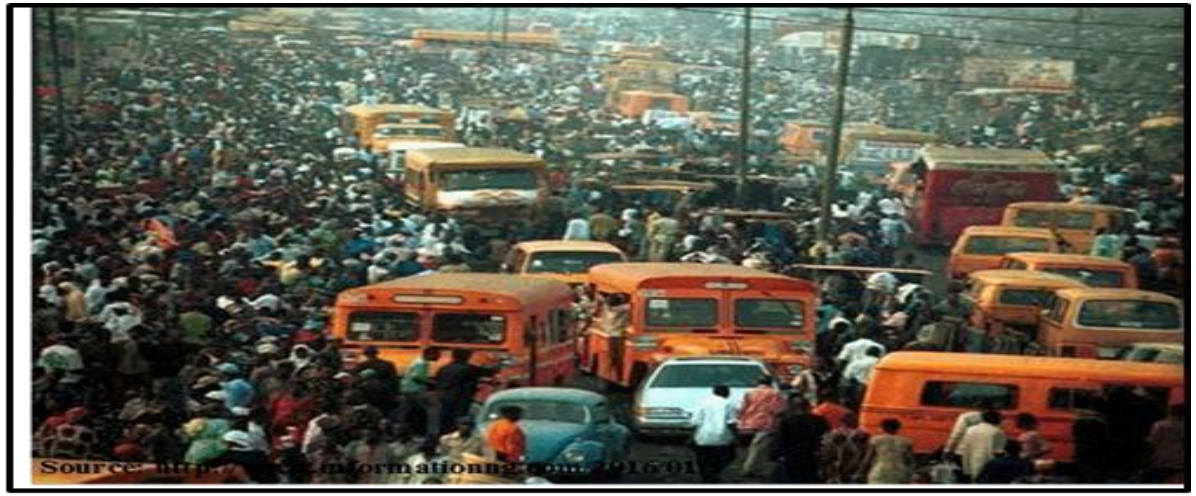
A_g= exposed area on the ground surface (L^2)

n = total porosity of the soil (fraction)

M_i= mole fraction of the toxic contaminant i in the waste (mole/mole)

d_e= effective depth of the soil cover

TRAFFIC JAMS IN MANY AFRICAN CITIES EXEMPLIFIED BY THE SITUATION IN LAGOS, ENABLES EXPOSURE OF THOUSANDS OF PEOPLE TO AUTO EMISSIONS DAILY



The Basic Equation of Human Exposure Assessment :

$$IN = \frac{(C)(IR)(ABS)(EF)(ED)}{(BW)(AT)}$$

$$C(t) = f(\int V_t \partial t)$$

- IN = the intake defined as the amount of a specific chemical in a contaminated medium taken (mg/kg of body weight per day).
- C = the average chemical concentration contacted over the exposure period (mg/L for liquid and gases, and mg/mg for solids);
- IR = the intake rate defined as the amount of the contaminated medium contacted per unit of time or event (mg/day or L/day)
- ABS = fraction of contaminants that are absorbed
- EF = the upper-bound value of the exposure frequency (day/year)
- ED = the upper-bound value of the exposure duration (years)
- BW = the average body weight over the exposure period (kg)
- AT = the average time defined as the time period over which exposure is averaged (exposure duration for non-carcinogens and 70 years for carcinogens)
- V_t = Volume of contaminant released at the performance time frame of interest, t

POTENTIALLY HARMFUL COMPONENTS OF COMMON (HOUSEHOLD) PRODUCTS IN MOST AFRICAN COUNTRIES, SOME OF WHICH MAY END UP IN DOMESTIC BOREHOLE WATER THAT IS CONSUMED (1)

PRODUCT	TOXIC OR HAZARDOUS COMPONENTS
Antifreeze (gasoline or coolant systems)	Methanol, ethylene glycol
Automatic transmission fluid	Petroleum distillates, xylene
Battery acid (electrolyte)	Sulfuric acid
Degreasers for driveways and garages	Petroleum solvents ,alcohols, glycol ether
Degreasers for engines and metal	Chlorinated hydrocarbons, toluene, phenols, dichloroperchloroethylene
Engine and radiator flushes	Petroleum solvents, ketones, butanol, glycol ether
Hydraulic fluid (brake fluid)	Hydrocarbons, fluorocarbons
Motor oils and waste oils	Hydrocarbons
Gasoline and jet fuels	Hydrocarbons
Diesel fuel, kerosene, #2 heating oil	Hydrocarbons
Grease, lubes	Hydrocarbons
Rustproofers	Phenols, heavy metals
Car wash detergents	Alkyl benzene sulfonates
Car waxes and polishes	Petroleum distillates, hydrocarbons
Asphalt and roofing tar	Hydrocarbons
Paints, varnishes, stains and dyes	Heavy metals, toluene
Paint and lacquer thinner	Acetone, benzene, toluene, butyl acetate, methyl ketones
Paint and varnish removers, deglossers	Methylene chloride, toulene, acetone, xylene, ethanol, benzene, methanol

POTENTIALLY HARMFUL COMPONENTS OF COMMON (HOUSEHOLD) PRODUCTS IN MOST AFRICAN COUNTRIES, SOME OF WHICH MAY END UP IN DOMESTIC BOREHOLE WATER THAT IS CONSUMED (2)

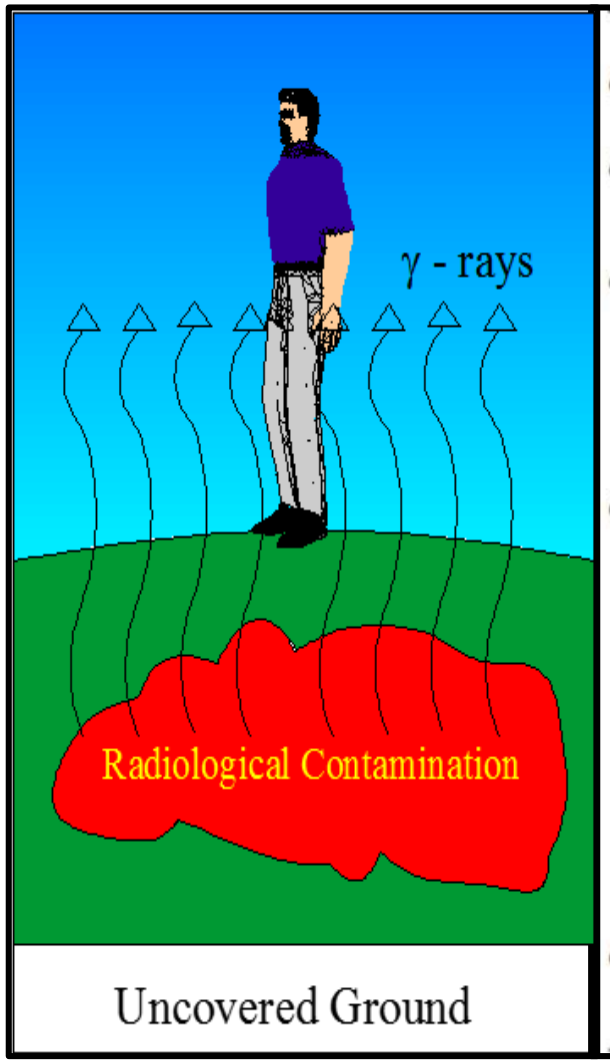
PRODUCT	TOXIC OR HAZARDOUS COMPONENTS
Paint brush cleaners	Hydrocarbons, toulene, acetone, methanol, glycol ethers, methyl ethyl ketones
Floor and furniture strippers	Xylene
Metal polishes	Petroleum distillates, isopropanol, petroleum naptha
Laundry soil and stain removers	Hydrocarbons, benzene, trichloroethylene, 1,1,1-trichloroethane
Other solvents	Acetone, benzene
Rock salt	Sodium concentration
Refrigerants	1,1,2-trichloro-1,2,2-trifluoroethane
Bug and tar removers	Xylene, petroleum distillates
Household cleansers, oven cleaners	Xylenols, glycol ethers, isopropanol
Drain cleaners	1,1,1-trichloroethane
Toilet cleaners	Xylene, sulfonates, chlorinated phenols
Cesspool cleaners	Tetrachloroethylene, dichlorobenzene, methylene chloride
Disinfectants	Cresol, xylenols
Pesticides (all types)	Naphthalene, phosphorous, xylene, chloroform, heavy metals, chlorinated hydrocar
Photochemicals	Phenols, sodium sulfite, cyanide, silver halide, potassium bromide
Printing ink	Heavy metals, phenol-formaldehyde
Wood preservatives (creosote)	Pentachlorophenols
Swimming pool chlorine	Sodium hypochlorite
Lye or caustic soda	Sodium hydroxide

MINING WASTE PILES IN SOUTH AFRICA AND MANY MINERAL-RICH AFRICAN COUNTRIES CAN GENERATE HEALTH-DAMAGING GAMMA RADIATION THROUGH RADIOACTIVE DECAYS OF RADIOLOGICAL WASTES:

THIS PROBLEM HAVE NOT BEEN INVESTIGATED MUCH IN AFRICA

Drilling and blasting creates large volumes of radioactive dust. Photo: Andrey Serebryakov. (Dr Stefan Cramer (2016). Uranium mining threatens South Africa's iconic Karoo. Ecologist.

Johannesburg's Soweto Riverlea neighbourhood in the shadow of a gold mine slag heap. Photograph: Alamy



C_1 $$C_1(t)=C_1(0)e^{-\lambda_1 t}$$

C_2 $$C_2(t)=\frac{\lambda_1}{\lambda_2-\lambda_1}C_1(0)e^{-\lambda_1 t}+\left(\frac{\lambda_1 C_1(0)}{\lambda_1-\lambda_2}+C_2(0)\right)e^{-\lambda_2 t}$$

C_3 $$C_3(t)=\frac{\lambda_1\lambda_2 C_1(0)}{(\lambda_2-\lambda_1)(\lambda_3-\lambda_1)}e^{-\lambda_1 t}+\left[\frac{\lambda_1\lambda_2 C_1(0)}{(\lambda_1-\lambda_2)(\lambda_3-\lambda_2)}+\frac{\lambda_2 C_2(0)}{\lambda_3-\lambda_2}\right]e^{-\lambda_2 t}$$
$$+\left[\frac{\lambda_1\lambda_2 C_1(0)}{(\lambda_1-\lambda_3)(\lambda_2-\lambda_3)}+\frac{\lambda_2 C_2(0)}{\lambda_2-\lambda_3}+C_3(0)\right]e^{-\lambda_3 t}$$

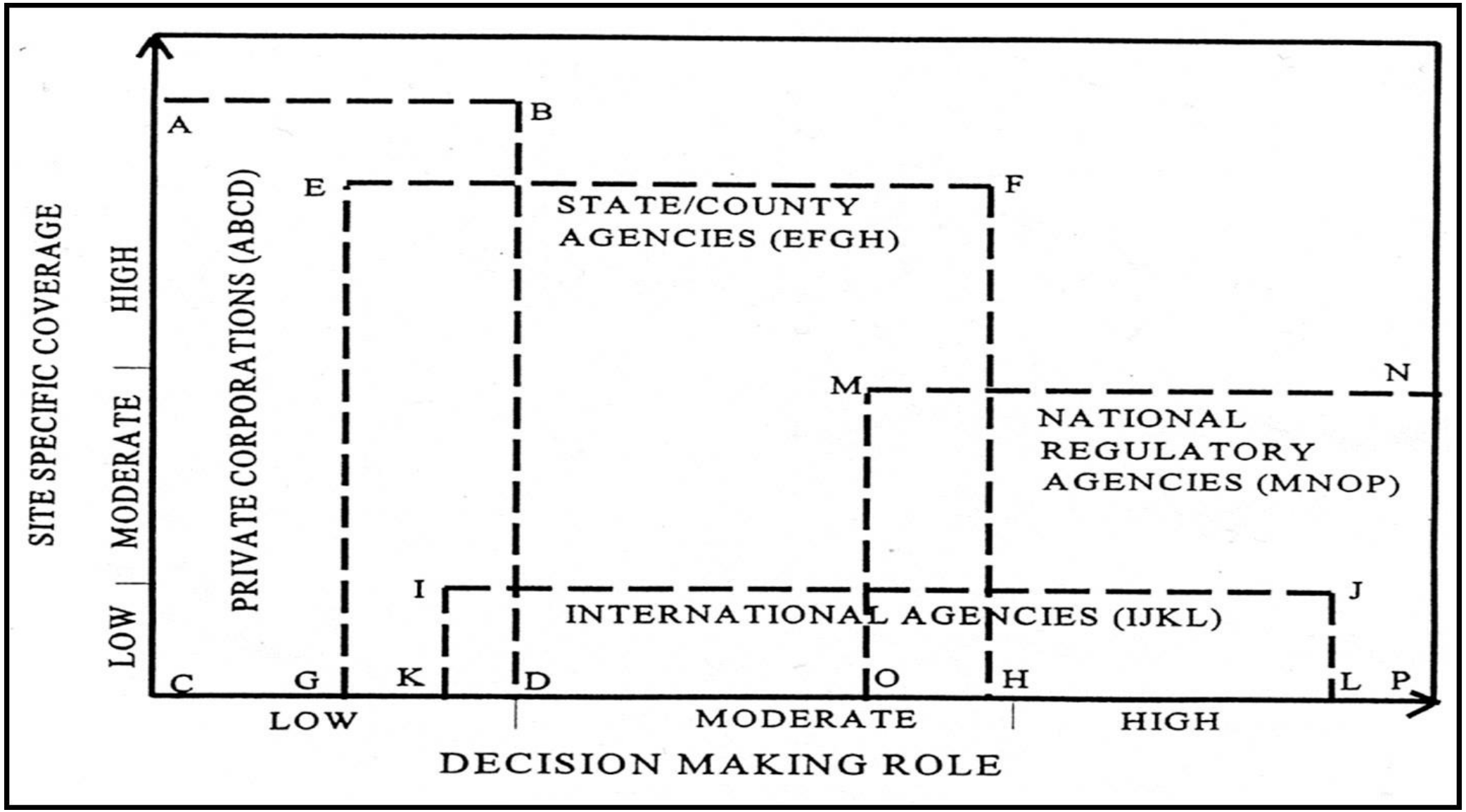
C_4 $$C_4(t)=\frac{\lambda_1\lambda_2\lambda_3 C_1(0)}{(\lambda_2-\lambda_1)(\lambda_3-\lambda_1)(\lambda_4-\lambda_1)}e^{-\lambda_1 t}$$
$$+\left[\frac{\lambda_1\lambda_2\lambda_3 C_1(0)}{(\lambda_1-\lambda_2)(\lambda_3-\lambda_2)(\lambda_4-\lambda_2)}+\frac{\lambda_2\lambda_3 C_2(0)}{(\lambda_3-\lambda_2)(\lambda_4-\lambda_2)}\right]e^{-\lambda_2 t}$$
$$+\left[\frac{\lambda_1\lambda_2\lambda_3 C_1(0)}{(\lambda_1-\lambda_3)(\lambda_2-\lambda_3)(\lambda_4-\lambda_3)}+\frac{\lambda_2\lambda_3 C_2(0)}{(\lambda_2-\lambda_3)(\lambda_4-\lambda_3)}+\frac{\lambda_3 C_3(0)}{(\lambda_4-\lambda_3)}\right]e^{-\lambda_3 t}$$
$$+\left[\frac{\lambda_1\lambda_2\lambda_3 C_1(0)}{(\lambda_1-\lambda_4)(\lambda_2-\lambda_4)(\lambda_3-\lambda_4)}+\frac{\lambda_2\lambda_3 C_2(0)}{(\lambda_2-\lambda_1)(\lambda_3-\lambda_4)}+\frac{\lambda_3 C_3(0)}{\lambda_3-\lambda_4}+C_4(0)\right]e^{-\lambda_4 t}$$

C_n $$c_n(t,\lambda_1,\ldots,\lambda_{n-1},\lambda_n)=\Pi_{j=1}^{n-1}\lambda_{j+1}\Sigma_{i=1}^{n}\frac{c_1(t,\lambda_i)}{\Pi_{j=1(j\neq i)}^{n}(\lambda_j-\lambda_i)}$$

SECTION D

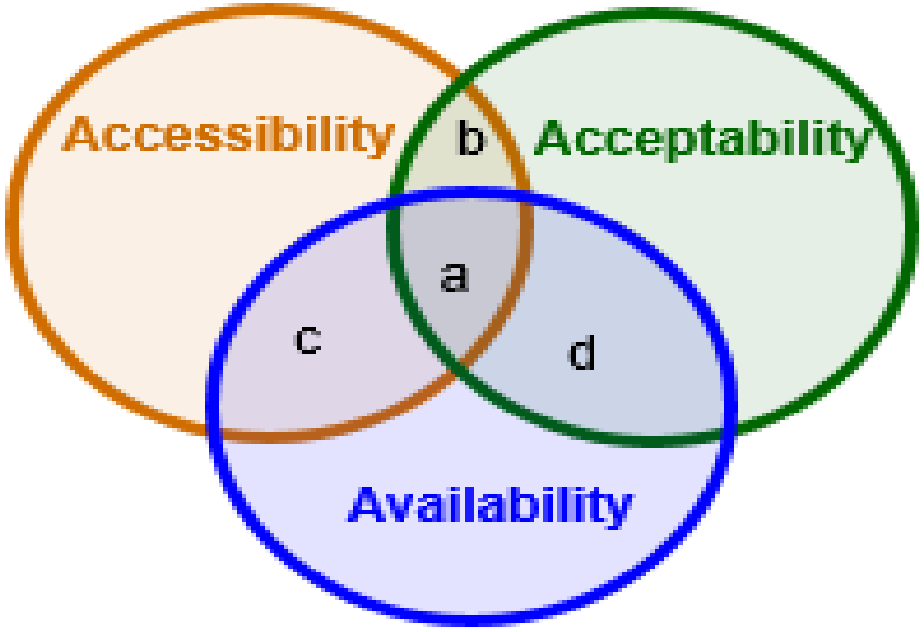
FRAMING GREEN ECONOMY TO SUPPORT SUSTAINABLE DEVELOPMENT IN VARIOUS SECTORS

JURISDICTIONAL COVERAGE OF ROLES AND RESPONSIBILITIES ON IMPROVEMENT OF ENVIRONMENTAL SYSTEMS



THE ENERGY SECTOR IS CRITICAL TO GREEN ECONOMY DEVELOPMENT AND A MAJOR SECTOR ON WHICH TO ENGAGE THE PRIVATE SECTOR

1. **Energy Accessibility:** Affordability of reliable energy services for which payment is made
2. **Energy Availability:** Continuous availability of reliable and efficient energy
3. **Energy Acceptability:** amenability of the energy sources to be produced, transmitted, and used in ways that preserve the environment and gain public acceptance



a. Excellent market prospects
b. Very good market prospects
c. Fair market prospects
d. Low market prospects

OPTIONAL ENERGY SYSTEMS
(MAIN CATEGORIES)

- Coal-fired Systems
- Hydrocarbon Oil or Gas-fired Systems
- Solar Energy Systems
- Wind Energy Systems
- Nuclear Energy Systems
- Hydropower Systems
- Geothermal Energy Systems
- Renewable Fuels

  Biofuels; Hydrogen; Fuel Cells; and Others

POSSIBLE MARKET EXPANSION MEASURES FOR RENEWABLE ENERGY SYSTEMS THAT THE PUBLIC SECTOR SHOULD PROMOTE IN ORDER TO GREEN THE ECONOMY (1)

1. Expansion of Renewable Portfolio Standards (RPS)

- Pushing for **Net-Zero 20XX** energy policies
- Locally appropriate time-frame
- Trading of renewable energy credits
- Provision of tax incentives

2. Improvement (Technical & Policy) of Connectivity of Distributed Energy Systems to General Grids

- Grid blockage systems for maintenance
- Development of power quality requirements for renewables connection

POSSIBLE MARKET EXPANSION MEASURES FOR RENEWABLE ENERGY SYSTEMS THAT THE PUBLIC SECTOR SHOULD PROMOTE IN ORDER TO GREEN THE ECONOMY (2)

3. Public Ownership of Interconnection Equipment

- Synchronizing relays
- Isolation transformers
- Over and under-voltage protection equipment
- Inverters (DC to AC)

4. Liberalization of the Energy Market Including:

- Development of legal and institutional frameworks
- Investment risk assessment & management
- Cost based pricing mechanisms
- Cross-border cooperation and integration

5. Development of International and Inter-regional-transmission Lines with Multiple Connection Points, Especially, in Developing Countries

POSSIBLE TECHNOLOGICAL ADVANCEMENT METHODS TO SUPPORT THE ENERGY SECTOR FOR PROMOTION OF GREEN ECONOMY IN AFRICA (1)

A. Increase Research Support to the Levels of other Economic Sectors

- Reduction of costs and improvement of efficiency
- Improvement of energy storage systems
- Development of industrial-scale hybrid renewable systems

B. Generate Innovation In Electric Power Systems

- Increase in renewables to 30%
- Implementation of cleaner coal technologies
- Promotion of coal gasification technologies
- Construction of combined cycle power plants
- Switching from coal-fired to gas-fired power plants

POSSIBLE TECHNOLOGICAL ADVANCEMENT METHODS TO SUPPORT THE ENERGY SECTOR FOR PROMOTION OF GREEN ECONOMY IN AFRICA (2)

C. Transportation Fuels

- Environmentally-friendly drilling procedures
- Use of biodegradable and non-toxic drilling fluids
- Better management of brine, oil spillages & refinery wastes
- Cessation of gas flaring
- Reduction in the use of charcoal
- Switch to biofuels (diversify raw material use)
- Control of emissions from automobiles & fueling stations

INTRODUCTION TO THE SPEAKER: Prof. Hilary I. Inyang

h.inyang26@gmail.com

Prof. Hilary I. Inyang, a US Ambassador's Distinguished Scholar to Ethiopia is a world-renowned researcher, expeditionist and educator in the areas of environmental science and engineering, geohazards, energy systems and international development. He is a member of the Education Caucus of the United Nations Commission on Sustainable Development and served for two terms (1997-2001) as Chair of the Science Advisory Board (Engineering Committee) of USEPA in Washington DC, USA. He is a former Duke Energy Distinguished Professor and Director of the Global Institute of Energy and Environmental Systems of the University of North Carolina, Charlotte, USA: former DuPont Professor of Environmental Engineering and Science and Director of CEEST, University of Massachusetts, Lowell, USA, former President of the African University of Science and Technology, Abuja, Nigeria, and former Vice Chancellor of the Botswana International University of Science and Technology. He chaired the Steering Committee of the Africa Science Plans under the auspices of the International Council for Science, UNESCO and the United Nations Economic Commission for Africa. Currently, he is a UNESCO Consultant on Water Security and Visiting Professor at the Indian Institute of Technology, Bombay (IIT-B), Mumbai, India. He has authored several research proposals and won research grants from several agencies including the US National Research Foundation, Sandia National Laboratories (USA), General Electric Corporation, US Environmental Protection Agency, and the African Development Bank. He has won more than 20 professional prizes and is a former AAAS/USEPA Environmental Science and Engineering Fellow, US National Research Council Young Investigator and Eisenhower/Randolph Fellow. He has authored about 275 publications and served on 29 journal editorial boards. He won the 2013 Nigerian National Order of Merit (NNOM) in science and technology and is a Fellow of both the African Academy of Science and the Geological Society of London. He is also a Proost Poet.

ADDITIONAL REFERENCES FOR QUOTED DATA AND CITATIONS

(SOME CITATION AND THEIR REFERENCES HAVE ALSO BEEN PROVIDED DIRECTLY ON THE VIEWGRAPHS)

IPCC. 2014. Climate Change 2014 Synthesis Report. Intergovernmental Panel on Climate Change, Geneva, Switzerland, 151 pages.

GMOPIG. 2022. Regional reports on the state of the marine and coastal environment. Global Marine Oil Pollution and Information Gateway, operated by UNEP, 2 pages.

Chapman, P. and Watling, R. J. 1980. Oil pollution studies in South Africa. South African Journal of Science, Vol. 16, December, pp. 534-535.

Swanepoel, E. 2020. oil spills in the Western Indian Ocean: national contingency plans fall short. Institute for Security Studies (ISS), Africa Report, December, pp. 1-12.

Ogbuka, J. C., Nwanmuoh, E. E., Ogbo, A. I. and Achoru, F. E. 2022. Offshore oil spill response base and management of deepwater/offshore oil resources in the Nigerian marine waters. International Journal of Environmental Impacts, Vol. 5, No. 1, pp. 65-81.

FFD. 2021. South Afica's updated draft Nationally Determined Contributions (NDC) launched. Department of Fisheries and the Environment, Republic of South Africa. Pretoria, South Africa. 3 pages.

UNESEC. 2011. A green economy in the context of sustainable development and poverty eradication: what are the implications for Africa? Background Report of the Africa Regional Preparatory Conference for the United Nations Conference on Sustainable Development (Rio+20), Addis Ababa, Ethiopia.

Inyang, H. I. 2016. Configuration of sustainable development systems with coverage of climate change adaptation: state-level elements. A Keynote Lecture in the Proceedings of the First Akwa Ibom State Climate Change & Clean Energy Summit, July 26-30, 2016. Organised by the Akwa Ibom State Government, Uyo, Nigeria. pp. 9-82.

Inyang, H. I. 2008. The necessary framework for regulatory Acts to support policies and technical systems for mitigation of Nigeria's environmental hazards toward attainment of Vision 2020. The Text of a Presentation to the Senate of the Federal Republic of Nigeria, Abuja, FCT, Nigeria, 6 pages.

Inyang, H. I. 2016. A roadmap for sustainable (green) development of Akwa Ibom State of Nigeria (2016-2030) with coverage of climate resilience, creation of green jobs and assurance of inclusiveness, Developed Under the Auspices of the Ministry of Environment and Mineral Resources of the Government of Akwa Ibom State, Uyo, Nigeria, 87 pages.

Inyang, H. I. 2010. Environment, climate change and green economy. An invited Special Lecture, Delivered Under the Auspices of the Government of Delta State of Nigeria in Asaba, Delta State, Nigeria, 80 pages.

Inyang, H. I. 2010. An assessment of the impacts of global climate change on water, food production and human health in Nigeria. An Invited Lecture at the National Climate Change Conference of the Environmental Management Association of Nigeria, Abuja, Nigeria, Dec. 15-18, 27 pages.

The Africa Report. 2021. Climate crisis-tomorrow's pandemic today. Africa Report No. 114, January – February, pp. 42 -43.

United Nations. 2022. Sustainable development goals. United Nations – Welcome to the United Nations, New York.

Masullo, I. and Brown, L. H. 2014. Lessons from South Africa: mobilizing investment in renewable energy. World Resources Institute, Washington, DC. USA. 5 pages.