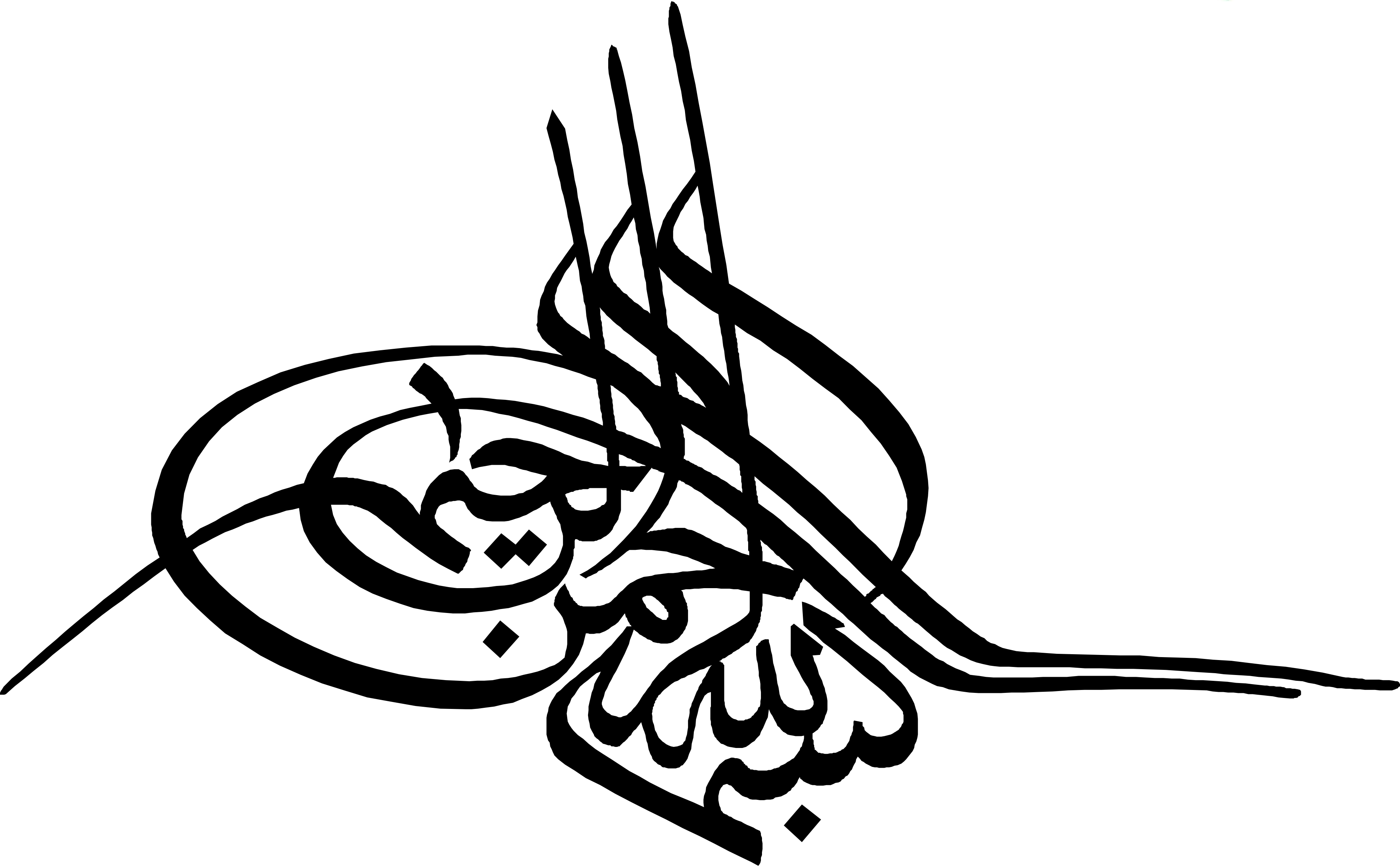
جمهوری اسلامی ایران
وزارت جهادکشاورزی

موسسه پژوهش‌های برنامه‌ریزی، اقتصادکشاورزی و توسعه روستایی

APERDRI



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APERDRI

روش جامع برای توسعه پایدار

ارایه دهنده: فاطمه ساسانی

معاونت آب و خاک

دفتر امور آب و خاک کشاورزی

مرداد ۱۳۹۷

جمهوری اسلامی ایران
وزارت جهادکشاورزی

موسسه پژوهش‌های برنامه‌ریزی،
اقتصادکشاورزی و توسعه روستایی

APERDRI

ITEC Training Programme on

Integrated Approach Towards Sustainable Development

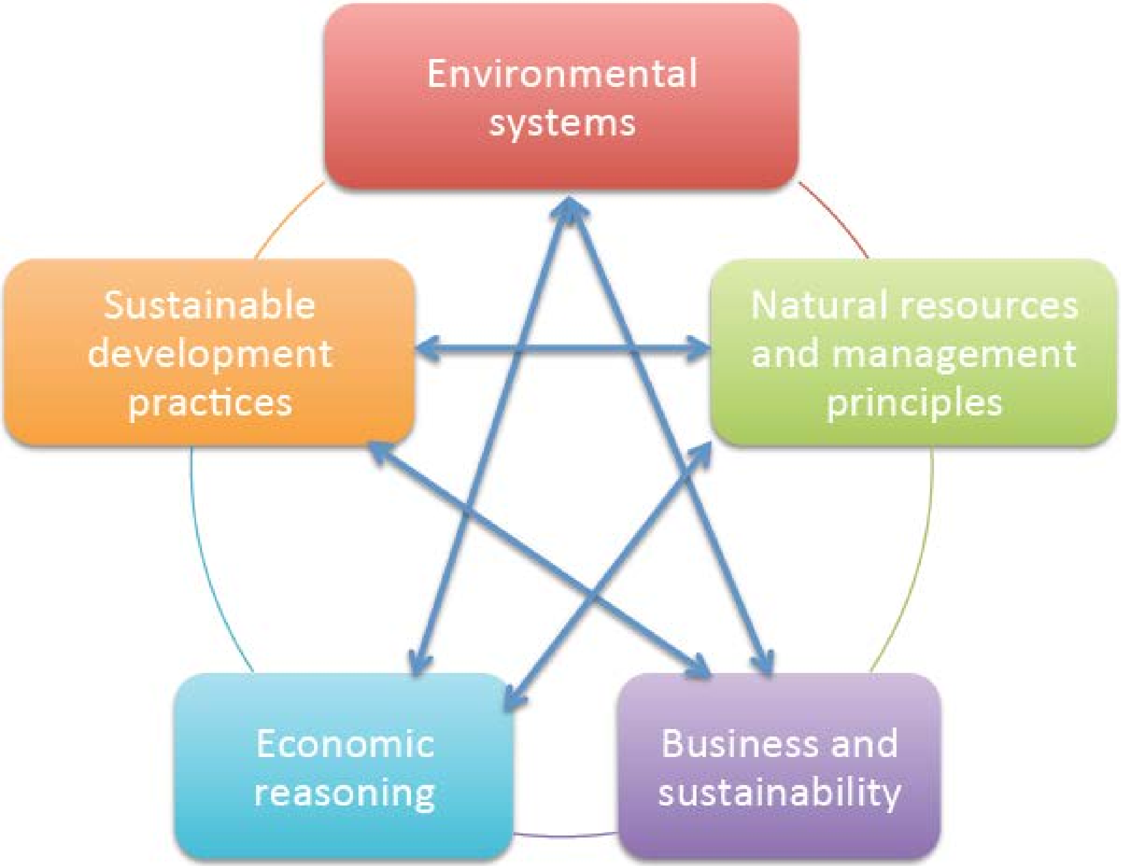
27 March – 14 April 2017, India

Organized by The Energy and Resources Institute, New Delhi, India

Under the Indian Technical Economic Cooperation (ITEC) Programme and Special Commonwealth African Assistance Programme (SCAAP) of the Ministry of External Affairs, Government of India

هدف

کسب دانش و مهارت در وارد نمودن و گنجاندن دغدغه های پایداری در سیاستگذاری و تصمیم گیری های مدیریتی با استفاده از رویکردهای اصولی



Environmental systems

Sustainable development practices

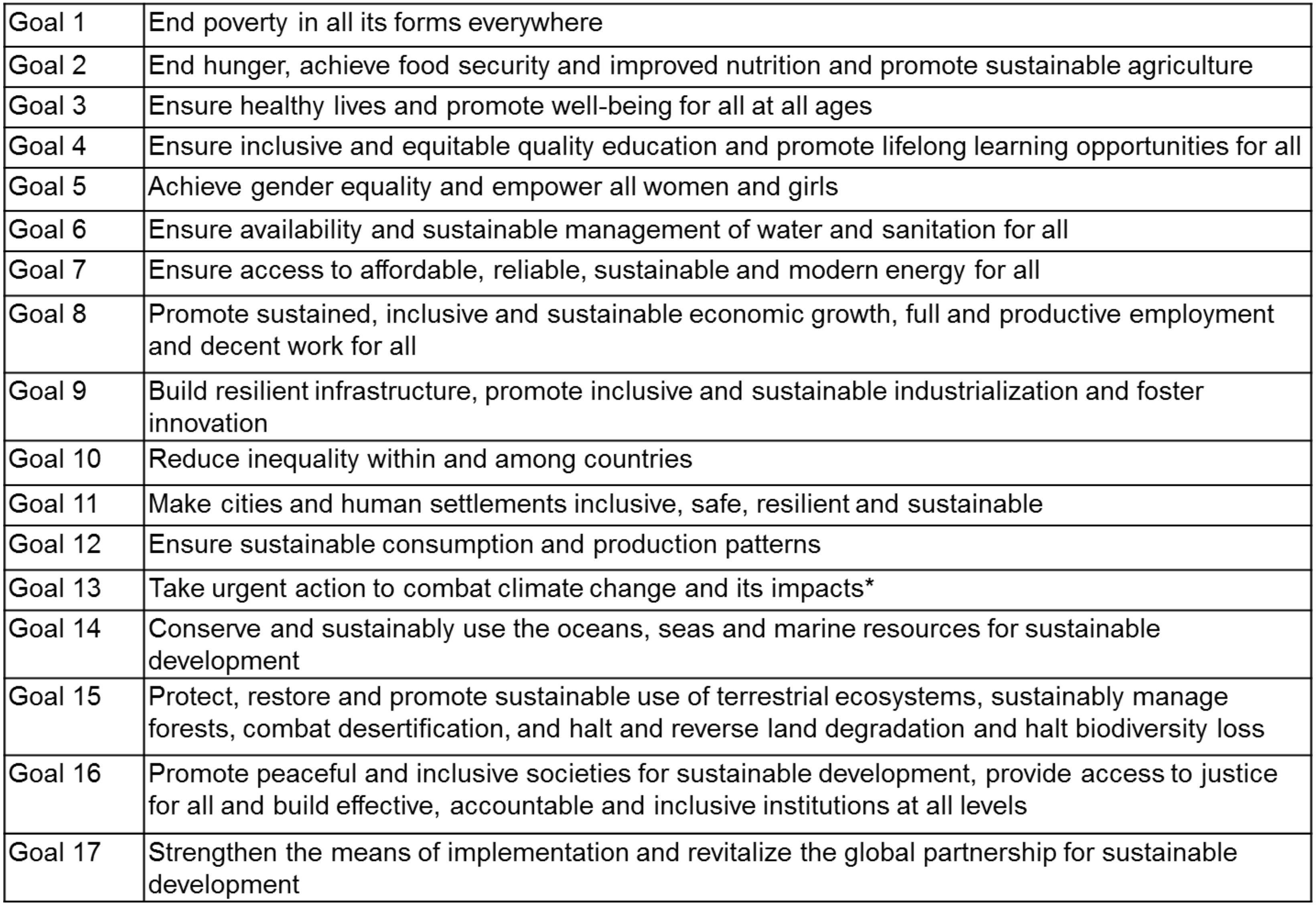
Natural resources and management principles

Economic reasoning

Business and sustainability

SDGs (Sustainable Development Goals)

SDGs (Sustainable Development Goals)



Goal 1	End poverty in all its forms everywhere
Goal 2	End hunger, achieve food security and improved nutrition and promote sustainable agriculture
Goal 3	Ensure healthy lives and promote well-being for all at all ages
Goal 4	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
Goal 5	Achieve gender equality and empower all women and girls
Goal 6	Ensure availability and sustainable management of water and sanitation for all
Goal 7	Ensure access to affordable, reliable, sustainable and modern energy for all
Goal 8	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all
Goal 9	Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation
Goal 10	Reduce inequality within and among countries
Goal 11	Make cities and human settlements inclusive, safe, resilient and sustainable
Goal 12	Ensure sustainable consumption and production patterns
Goal 13	Take urgent action to combat climate change and its impacts*
Goal 14	Conserve and sustainably use the oceans, seas and marine resources for sustainable development
Goal 15	Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss
Goal 16	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
Goal 17	Strengthen the means of implementation and revitalize the global partnership for sustainable development

What does sustainability mean to you?

"Sustainability is something everyone can work towards... whether it is picking up garbage you see on the street or boycotting a company that practices environmentally harmful business methods, we all can make a difference."

At individual/household level, we could do the following to promote sustainability

- Walking to work if we live close to work, using a bike or using public transport. save energy and reduce greenhouse gases
- Using energy efficient electrical products/appliances
- Buying products made of recycled materials will generally save materials and energy, cut greenhouse gases and toxic pollution, and reduce impacts on living things in the wild.
- Installing a water tank and low flow shower can save water.
- Using food in season or from local sources and organically grown can cut impacts from chemicals, save energy and reduce greenhouse gases.
- Investing savings in ethical investments can help accelerate the creation of an environmentally-sustainable economy

Sustainability (and development)

- Many people however felt uneasy with the notion of 'development' as it is often associated with the destruction of environmental and social attributes that they value, so they felt better talking about 'sustainability' rather than 'sustainable development'.

- Overtime 'sustainability' and 'sustainable development' came to be treated by many people as synonyms.

- Sustainability is about *continuity and development is about change. There are many* things about life that we want to sustain (maintain) and many that we want to change.

- Sustainability is the action oriented variant of Sustainable Development. There are some principles of sustainability which include the following-
  - Protecting Nature
  - Thinking long-term
  - Understanding systems within which we live
  - Recognizing limits
  - Practicing fairness
  - Embracing creativity

Key Questions:

What?
… to Sustain?
… to Develop?

What is to be sustained?

- Three major categories—nature, life support systems, and community—as well as intermediate categories for each, such as Earth, environment, and cultures.
- Commonly, emphasis was placed on life support systems, which defined nature or environment as a source of services for the utilitarian life support of humankind.
- The study of ecosystem services has strengthened this definition over time.
- In contrast, some of the sustainable development literature valued nature for its intrinsic value rather than its utility for human beings.
- There were also parallel demands to sustain cultural diversity, including livelihoods, groups, and places that constitute distinctive and threatened communities.

What is to be developed?

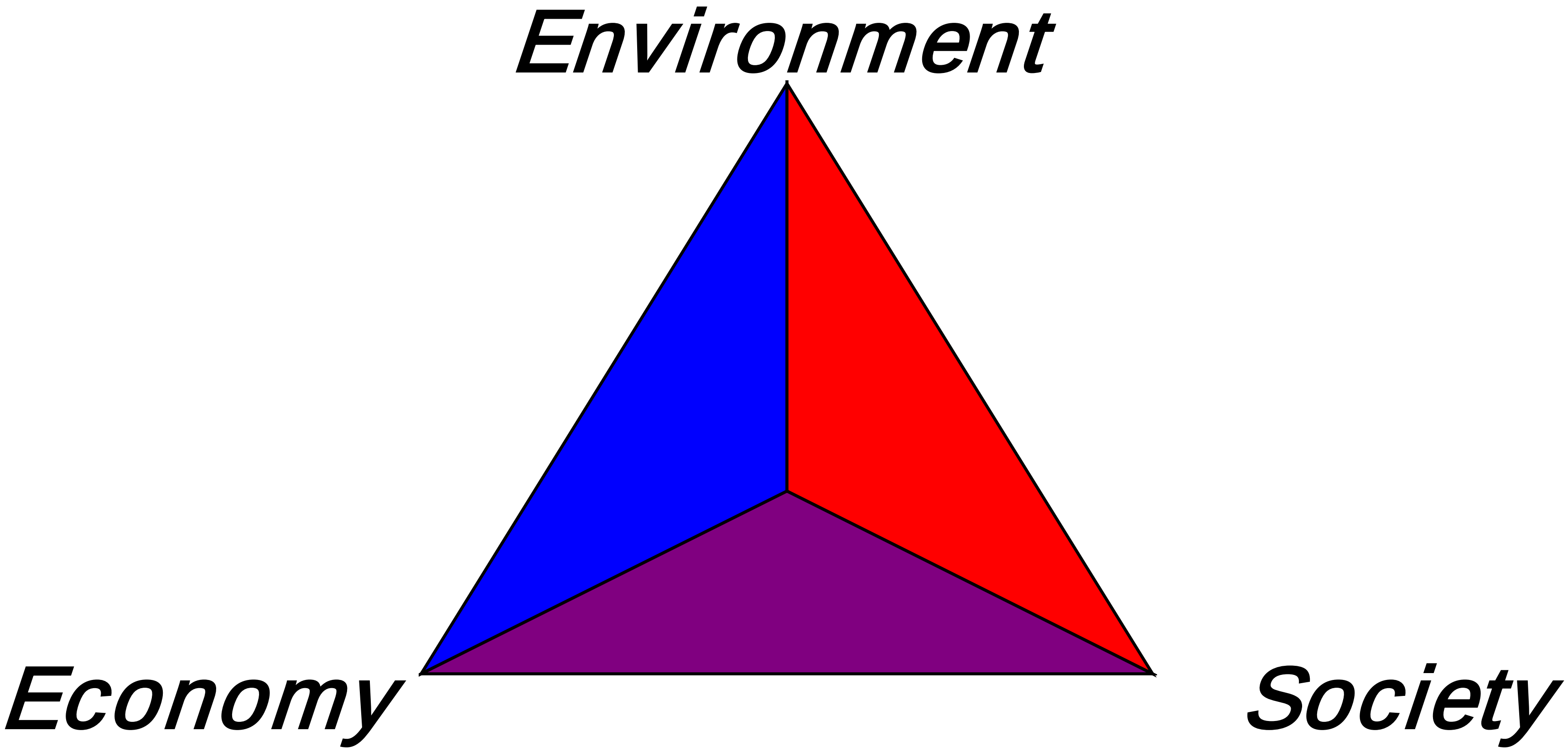
- People, economy, and society

- Early literature focused on economic development, with productive sectors providing employment, desired consumption, and wealth.

- Recently attention shifted to human development, including an emphasis on values and goals, such as increased life expectancy, education, equity, and opportunity.

- Develop society that emphasized the values of security and well-being of national states, regions, and institutions as well as the social capital of relationships and community ties.

Elements of sustainability



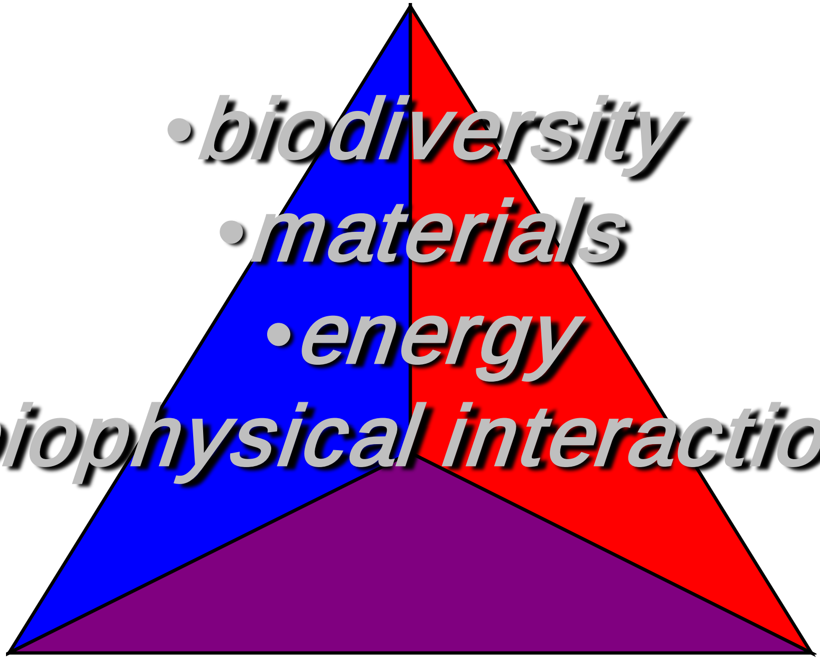
Environment

Economy

Society

- World Commission on Environment and Development, 1987

Elements of sustainability



Environment

- biodiversity
- materials
- energy
- biophysical interactions

- World Commission on Environment and Development, 1987

Elements of sustainability

- *money and capital*
- *employment*
- *technological growth*
- *investment*
- *market forces*

Economy

- World Commission on Environment and Development, 1987

Elements of sustainability

- *human diversity (cultural, linguistic, ethnic)*
- *equity (dependence / independence)*
- *quality of life*
- *institutional structures and organization*
- *political structures*

Society

Elements of sustainability

- Environmental Sustainability : "the ability to maintain things or qualities that are valued in the physical (including both natural and biological) environment. Ecological integrity is maintained, all of earth's environmental systems are kept in balance while natural resources within them are consumed by humans at a rate where they are able to replenish themselves.
    - Some of the issues that pose major environmental sustainability problems include:
        - destruction of the living environments (habitats) of native species
        - discharge of polluting chemicals and other materials into the environment
        - emission of greenhouses gases into the atmosphere than can cause climate change
        - depletion of low cost oil and other fossil fuels

- Economic Sustainability: Human communities across the globe are able to maintain their independence and have access to the resources that they require, financial and other, to meet their needs. Economic systems are intact and activities are available to everyone, such as secure sources of livelihood.

- Social Sustainability: Universal human rights and basic necessities are attainable by all people, who have access to enough resources in order to keep their families and communities healthy and secure. Healthy communities have just leaders who ensure personal, labour and cultural rights are respected and all people are protected from discrimination

Why to talk about sustainability of development

Sustainability of well-being as much as resources
Well-being: income, health, dignity of life, quality of life
Resources: land, water, forests, minerals, man-made capital, human resources

Many Dimensions of Development

- Improved environmental status
- Increase in real income per capita
- Opportunity to have a satisfying livelihood
- A fairer distribution of income
- Improvement in health and nutritional status
- Improvement in education status
- Access to resources
- Assurance of basic human rights
- Participation in decision making processes

What is measuring sustainability?

- Measuring sustainability denotes the measurements used as the quantitative basis for the informed management of sustainability

- The metrics used for the measurement of sustainability (involving the sustainability of environmental, social and economic domains, both individually and in various combinations) are still evolving

- They include indicators, benchmarks, audits, indexes and accounting, as well as assessment, appraisal and other reporting systems
- They are applied over a wide range of spatial and temporal scales

Why measure sustainability?

- How do we know if what we're doing is helping or hurting, or having no effect at all on sustainable development?
- How do we know that one way of doing or making things is more sustainable than another?
- How do we know that a city, region or country is doing well in terms of sustainable development?
- How do we calculate today's needs and measure our progress in meeting them?
- How can we get some idea of how our decisions will affect our own future and our children's?
- What resources do we need to keep track of and what are the different factors that contribute to our quality of life and well-being?

Source: OECD

The Need for Indicators

- The goal of sustainability indicators is to give organizations enough information to…
  - set objective, attainable goals for sustainability, and then
  - make evidence-based policy decisions that bring them closer to those goals

“By measuring progress, we foster progress.”

Enrico Giovannini, OECD Chief Statistician

Most common sustainable development indicator themes in policy-based sets

1. Management of natural resources
2. Climate change and energy
3. Sustainable consumption and production
4. Public health
5. Social inclusion
6. Education
7. Socio-economic development
8. Transport
9. Good governance
10. Global dimension of sustainable development
11. Research & Development, Innovation

Indices

Index	Brief Description	Dimensions		
		Env	Econ	Soc
Ecological Footprint	Bio capacity of land and sea relative to human demands	**yes**	no	no
Genuine Progress Indicator	Alternative to GDP that includes externalized costs	**yes**	**yes**	**yes**
Environmental Performance Index	Progress of national environmental policies	**yes**	no	no
Human Development Index	Health, education, quality of life	no	**yes**	**yes**
Happy Planet Index	Longevity and life satisfaction per ecological footprint	**yes**	no	**yes**

Environmental indices

- Ecological Footprint: was developed by the organization - Redefining Progress (Wackernagel, Monfreda and Deumling 2002)

  Consumption for different items is calculated, which fall into six broad categories: food, housing, goods, services, transportation and waste. This consumption is then converted into global hectares (or a global acre), which is defined as one hectare (acre) of land with average world productivity.

Economical indices

- Genuine Progress Index (GPI)

GPI= Gross personal consumption+ Value of benefits (value of household work and parenting, value of volunteering, services of highways and streets among others)- Costs (economic, social and environmental costs)*

*Economic costs include net capital investment, net foreign investment and income inequality. Social costs include crime, commuting, family breakdown and automobile accidents. Environmental costs include water, air and noise pollution, loss of farmland and wetland, long term environmental damage and non-renewable resource depletion

Environmental indices

- Environmental Sustainability Index (ESI): developed by the World Economic Forum in collaboration with the Yale Centre for Environmental Law and Policy and the Centre for International Earth Science Information Network at Colombia University

- The ESI score represents an equally weighted average of the 21 indicator scores. Each indicator build between 2 and 12 data sets for a total of 76 underlying variables

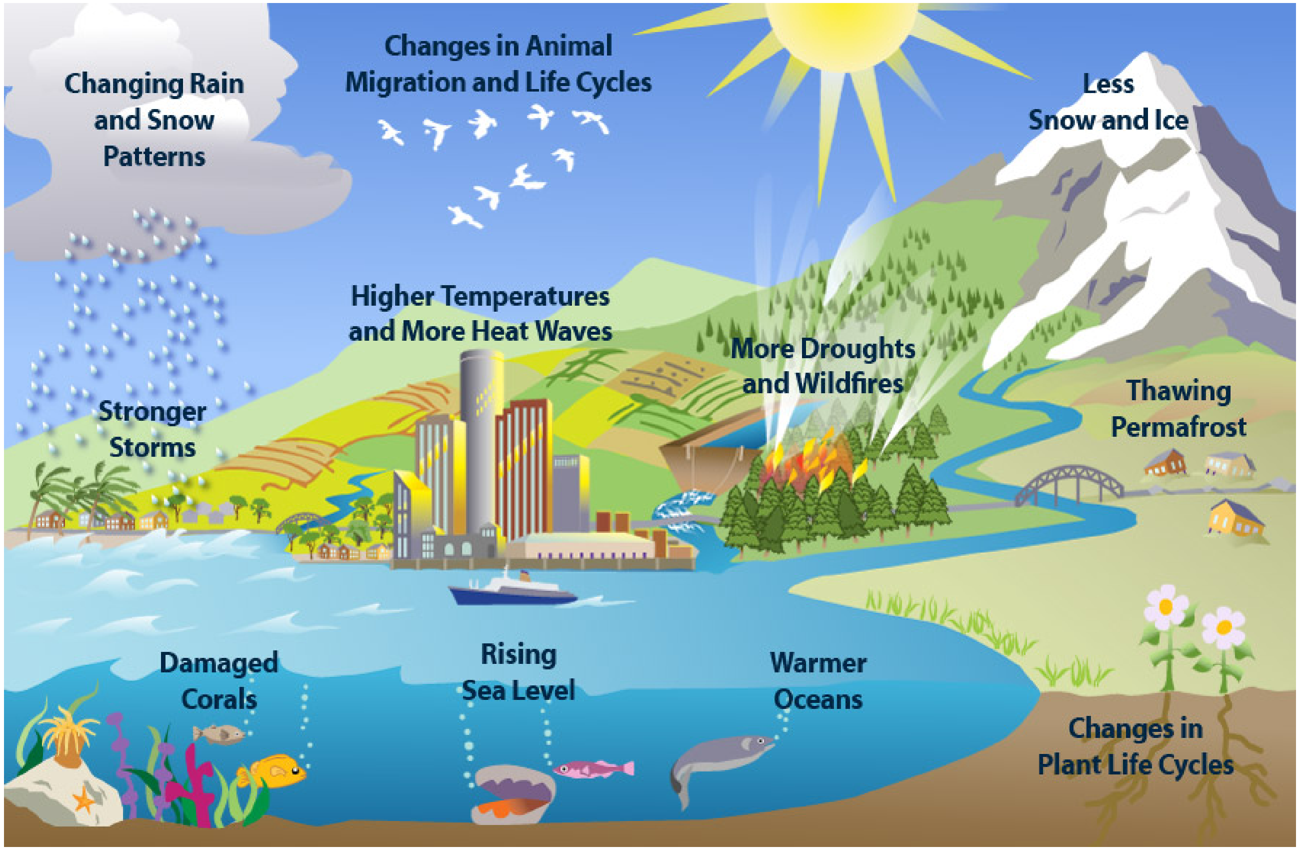
Social indices

- UN Human Development Index
- UN Gender Related Development Index
- UN Gender Empowerment Measure
- UN Human Poverty Index for Developing Countries
- UN Human Poverty Index for Developed Countries
- National Human Development Index
- National Human Poverty Index
- National Gender Equality Index

ردپای کربن

ردپای کربنی

- میزان انتشارات گازهای گلخانه ای (**GHG**) که به طور مستقیم یا غیر مستقیم از فعالیت های مختلف ایجاد می شود.
- مجموع انتشارات گازهای گلخانه ای که در طول زندگی یک محصول و یا خدمات ایجاد می شود.



GHG در اقتصاد

GDP x Energy Intensity x Carbon Intensity = Emissions

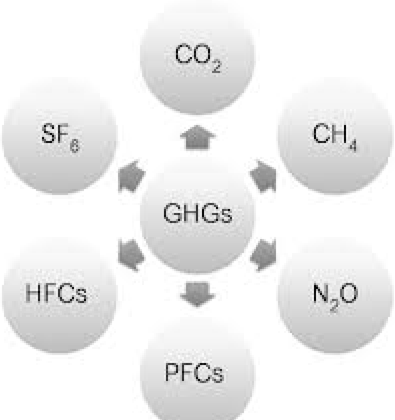
\$	*Joules/\$*	*Tons/Joules*	*Tons*

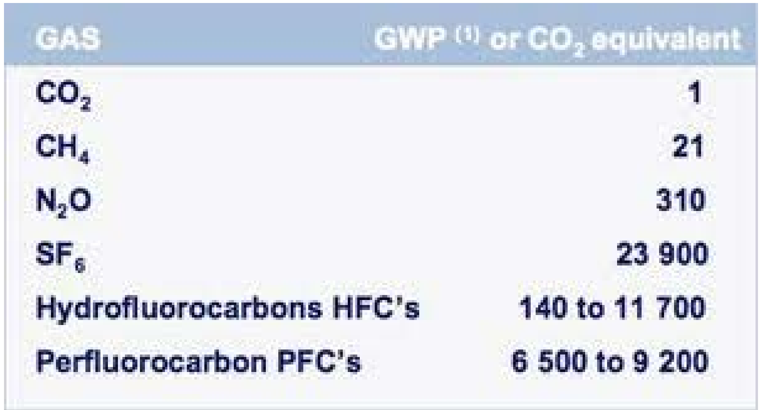
محاسبه ردپای کربنی

CF = Activity Data (quantity) X Emission Factor

- **Activity Data: Mass / Volume/ Kwh/ km**
- **Emission Factor: CO2 equivalent per unit (GWP)**

پتانسیل گرم شدن جهانی



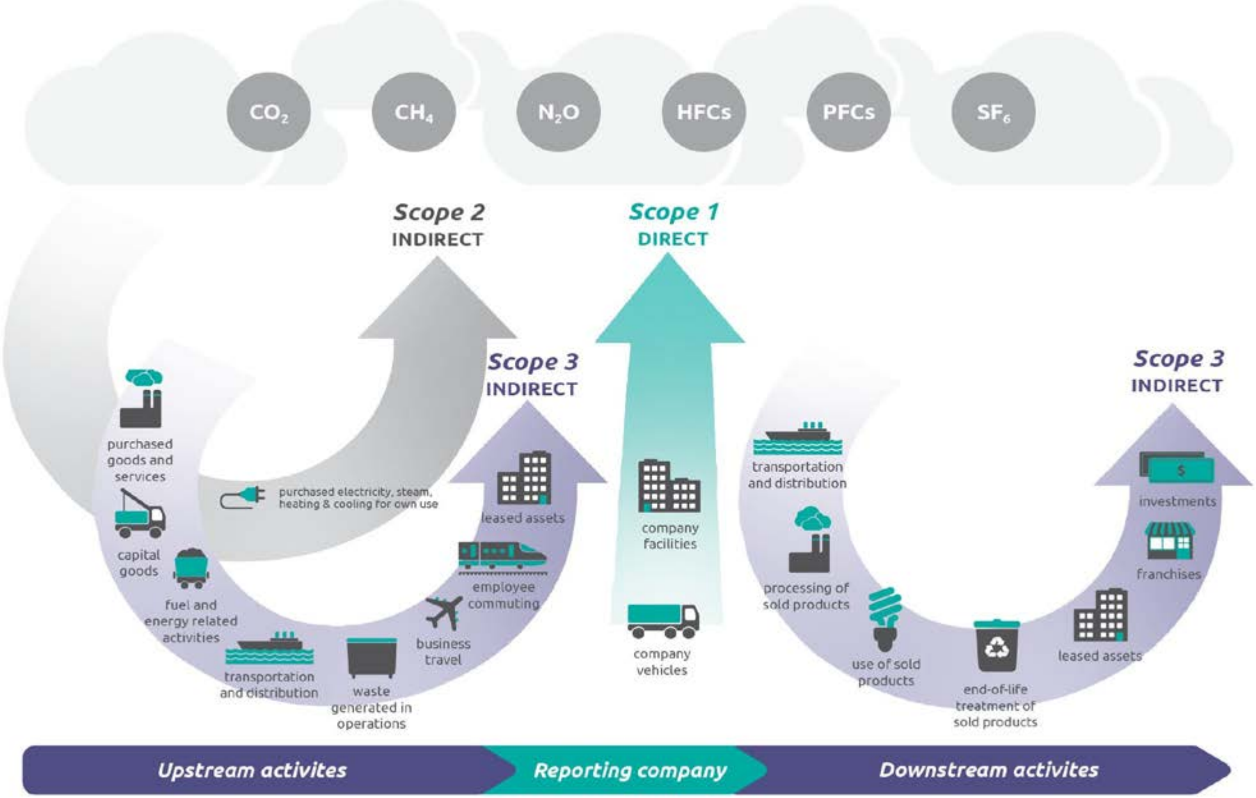


GAS	GWP [1] or CO_2 equivalent
CO_2	1
CH_4	21
N_2O	310
SF_6	23 900
Hydrofluorocarbons HFC's	140 to 11 700
Perfluorocarbon PFC's	6 500 to 9 200

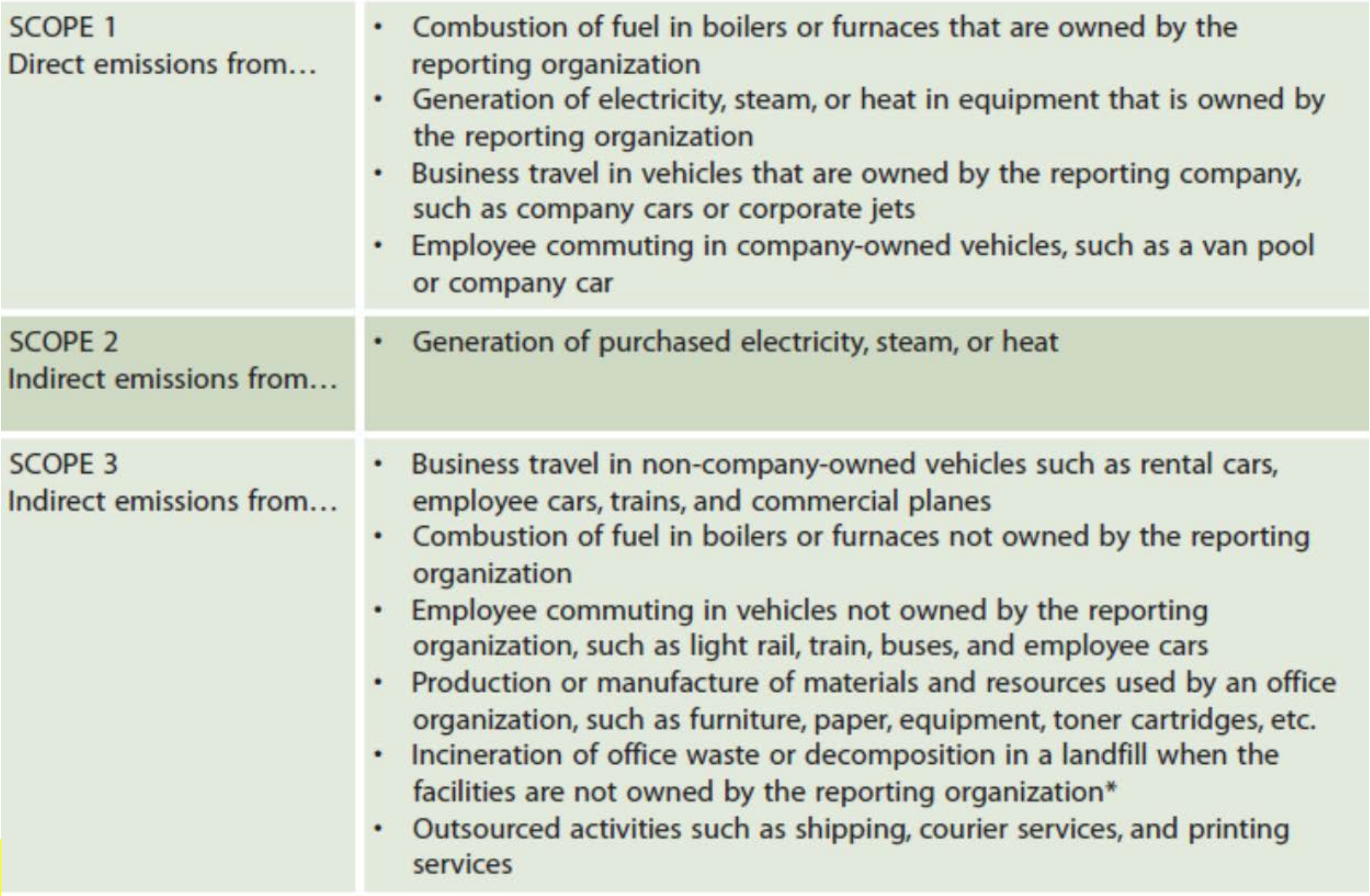
پروتکل GHG

- گسترده ترین استاندارد که توسط تولیدکنندگان GHG در سازمان ها و تجارت های مختلف استفاده می گردد.
- این پروتکل به وسیله مؤسسه منابع جهان (WRI) و انجمن جهانی توسعه پایدار (WBSCD) تعریف و توسعه یافته است.

مروری بر حوزه های پروتکل GHG و انتشارات گازهای گلخانه ای در طول زنجیره ارزش



SCOPES



SCOPE 1 Direct emissions from…	• Combustion of fuel in boilers or furnaces that are owned by the reporting organization • Generation of electricity, steam, or heat in equipment that is owned by the reporting organization • Business travel in vehicles that are owned by the reporting company, such as company cars or corporate jets • Employee commuting in company-owned vehicles, such as a van pool or company car
SCOPE 2 Indirect emissions from…	• Generation of purchased electricity, steam, or heat
SCOPE 3 Indirect emissions from…	• Business travel in non-company-owned vehicles such as rental cars, employee cars, trains, and commercial planes • Combustion of fuel in boilers or furnaces not owned by the reporting organization • Employee commuting in vehicles not owned by the reporting organization, such as light rail, train, buses, and employee cars • Production or manufacture of materials and resources used by an office organization, such as furniture, paper, equipment, toner cartridges, etc. • Incineration of office waste or decomposition in a landfill when the facilities are not owned by the reporting organization* • Outsourced activities such as shipping, courier services, and printing services

Emission Factors - Energy

Source	Emission	Unit
Diesel	2.67	Kg CO2/ Liter
LPG	2.98	Kg CO2/ kg
Coal	2.29	Kg CO2/ kg
Electricity (Indian Grid)	0.81	Kg CO2/ kWh

Emission Factors - Transportation

Source	Emission	Unit
Air Flight	0.100	kg CO_2/p km
Railways	0.0096	kg CO_2/p km
Metro Rail	0.0441	kg CO_2/p km
CNG Bus	0.0202	kg CO_2/p km
MUV (Diesel)	0.25598	kg CO_2/p km
Petrol Car	0.14354	kg CO_2/p km

Emission Factors – Other Sources

Source	Emission	Unit
Waste	0.8421	kg CO_2/kg
Paper (Virgin)	1.8670	kg CO_2/kg
Letters	0.02	kg CO_2/letter

CASE STUDY

CF Calculation for a Service Organization

Employee Strength = 100

SCOPE 1

- Emissions from Company Owned Vehicles

  - Source :2 Petrol Cars
  - Quantity :25,000 km (Annual Running per car)
  - Total distance :50,000 km
  - Emission Factor :0.14354 kg CO_2/p km

  - CF = Total km * EF = 7177 kg CO_2 per ann

SCOPE 1

- Emissions from Diesel Generator

  - Source :DG Set
  - Quantity :1000 liters per annum
  - Emission Factor :2.6765 kg CO_2/lit

  - CF = Total consumption * EF = 2676 kg CO_2 per annum

SCOPE 2

- Emissions from Purchase of Grid Electricity

  - Source :Grid Power
  - Quantity :1,00,000 kWh per annum
  - Emission Factor :0.8 kg CO_2/kWh (Indian Grid)

  - CF = Total consumption * EF = 80,000 kg CO_2 per annum

SCOPE 3

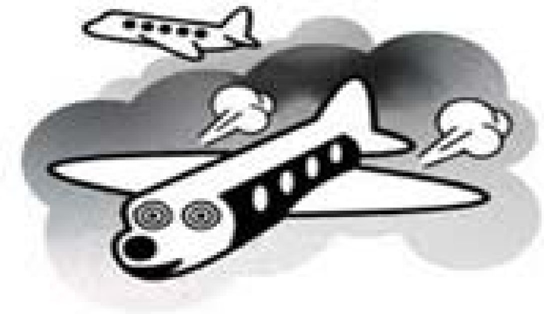
- Emissions from Business Travel
  - Source :Railway
  - Quantity :1,00,000 km per annum
  - Emission Factor :0.0096 kg CO_2/p km
  - CF = Total travel * EF = 960 kg CO_2 per annum

SCOPE 3

- Emissions from Business Travel

  - Source :Air
  - Quantity 1,00,000 passenger km per annum
  - Emission Factor :0.1 kg CO_2/p km

  - CF = Total travel * EF = 10,000 kg CO_2 per annum



SCOPE 3

- Emissions from Employee Commute

  - Source :Petrol Car
  - No of Employees :100
  - Travel Per day :10 km (Average)
  - Working Days :300 per annum
  - Total Travel :30,000 km
  - Emission Factor :0.1435 kg CO_2/km

  - CF = Total travel * EF = 4805 kg CO_2 per annum

SCOPE 3

- Emissions from Employee Commute
  - Source :Metro Rail
  - Quantity :20,000 passenger km
  - Emission Factor :0.0441 kg CO_2/p km

  - CF = Total travel * EF = 882 kg CO_2 per annum

SCOPE 3

- Emissions from Employee Commute

  - Source :CNG Bus
  - Quantity :50,000 km per annum
  - Emission Factor :0.0202 kg CO_2/p km

  - CF = Total travel * EF = 1010 kg CO_2 per annum

SCOPE 3

- Emissions from Paper Consumption

  - Source :Paper
  - Quantity :200 paper reams per annum
  - Weight :2.5 kg per ream
  - Total Weight :500 kg
  - Emission Factor :1.867 kg CO2/kg paper

  - CF = Total paper * EF = 933 kg CO_2 per annum

SCOPE 3

- Emissions from Waste

  - Source :Waste
  - Quantity :1000 kgs per annum
  - Emission Factor :0.8421 kg CO2/ kg

  - CF = Total waste* EF = 842 kg CO_2 per annum

SCOPE 3

- Emissions from letters postage
  - Source :Letter (Post)
  - Quantity :1000 letters per annum
  - Emission Factor :0.02 kg CO2/ letter

  - CF = Total letters * EF = 20 kg CO_2

CF Calculation

SCOPE	Sources	GHG Emission (Tons CO2 eq.)
SCOPE 1	Company Vehicles	7.177
	DG Sets	2.676
SCOPE 2	Grid Electricity	80.000
SCOPE 3	Business Travel	10.960
	Employee Commute	6.197
	Paper Consumption	0.933
	Waste disposal	0.842
	Postage of Letters	0.020
TOTAL (1+2+3)		108.805

GHG Emissions (per capita per annum)
1.1 T CO2eq

Electricity

Rooftop PV system to reduce grid power consumption

Purchasing Green Power (Wind & Solar)

Building Energy Needs

Using double-glazed glass with low heat transfer

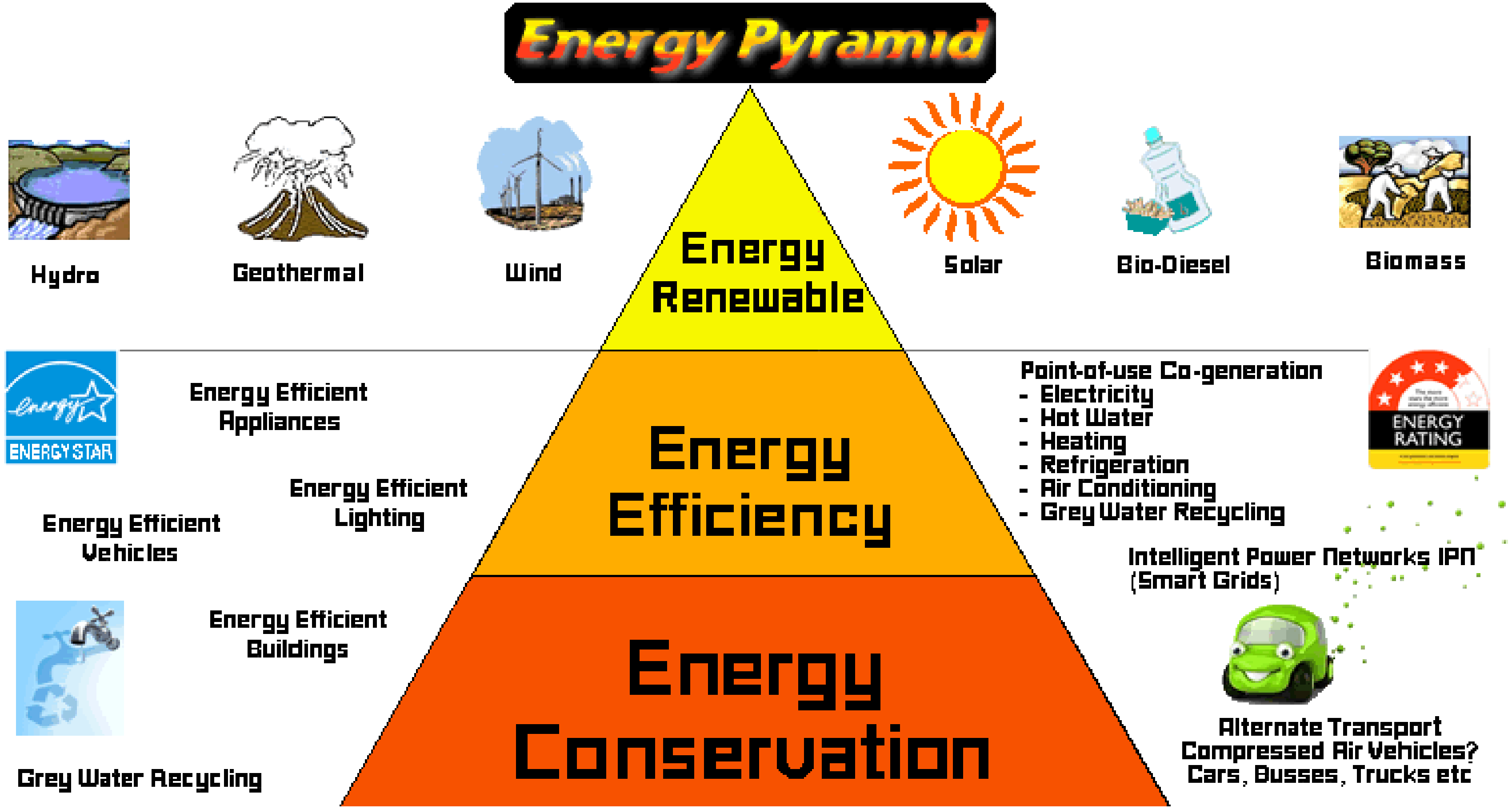
Insulation of roof to reduce HVAC load

Solar Hot Water system

Waste to Biogas

Using compostable waste to generate biogas for kitchen fuel and automotive purposes

Energy Conservation: Measures



Energy Efficient Appliances

Energy Efficient Lighting

Energy Efficient Vehicles

Energy Efficient Buildings

Grey Water Recycling

Point-of-use Co-generation
- Electricity
- Hot Water
- Heating
- Refrigeration
- Air Conditioning
- Grey Water Recycling

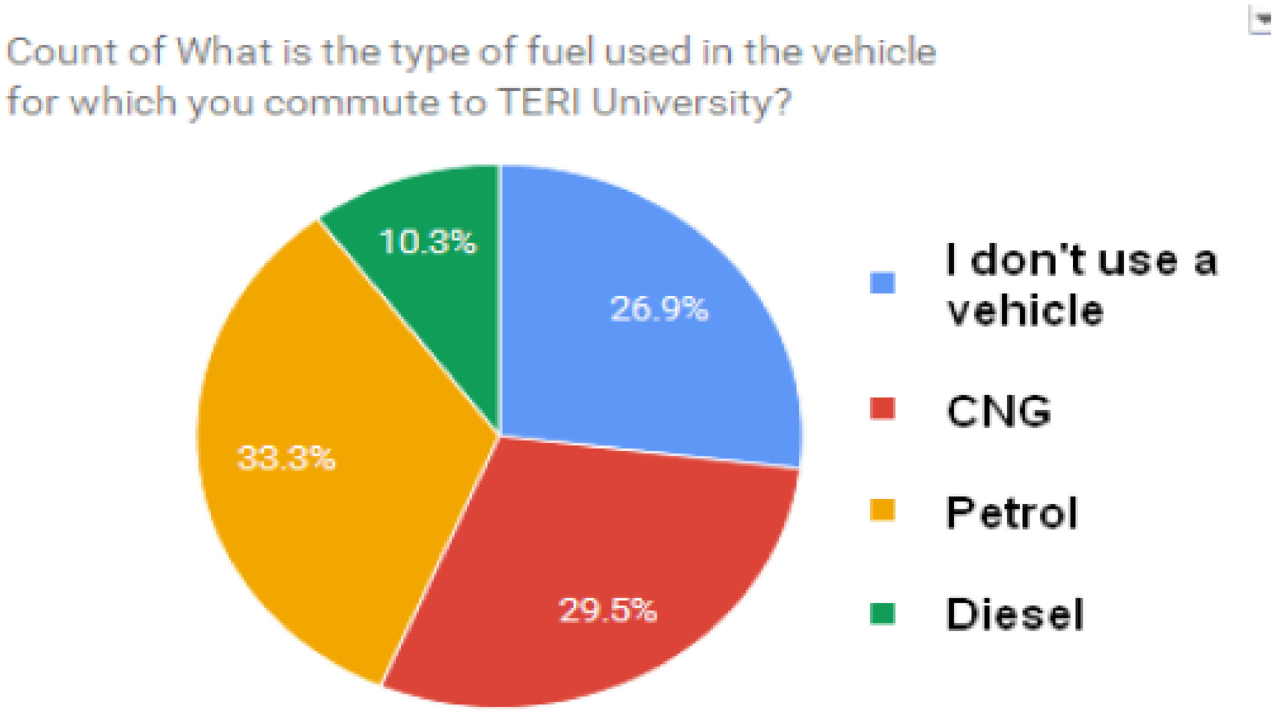
Intelligent Power Networks IPN (Smart Grids)

Alternate Transport
Compressed Air Vehicles?
Cars, Busses, Trucks etc

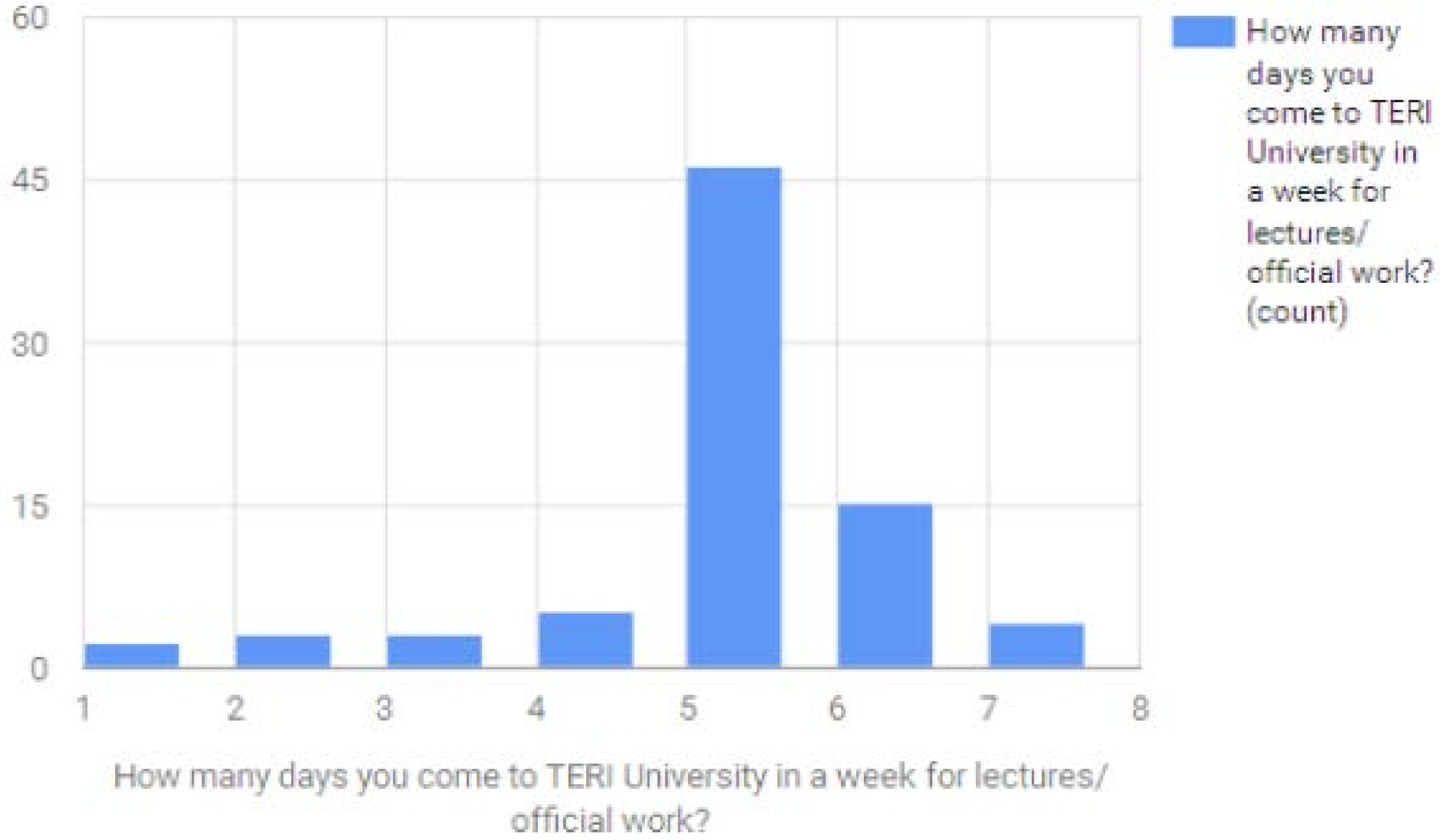
1. CARBON FOOTPRINT CALCULATION FOR TERI UNIVERSITY

Base Year: July 2014 to June 2015

For Strength of 600*

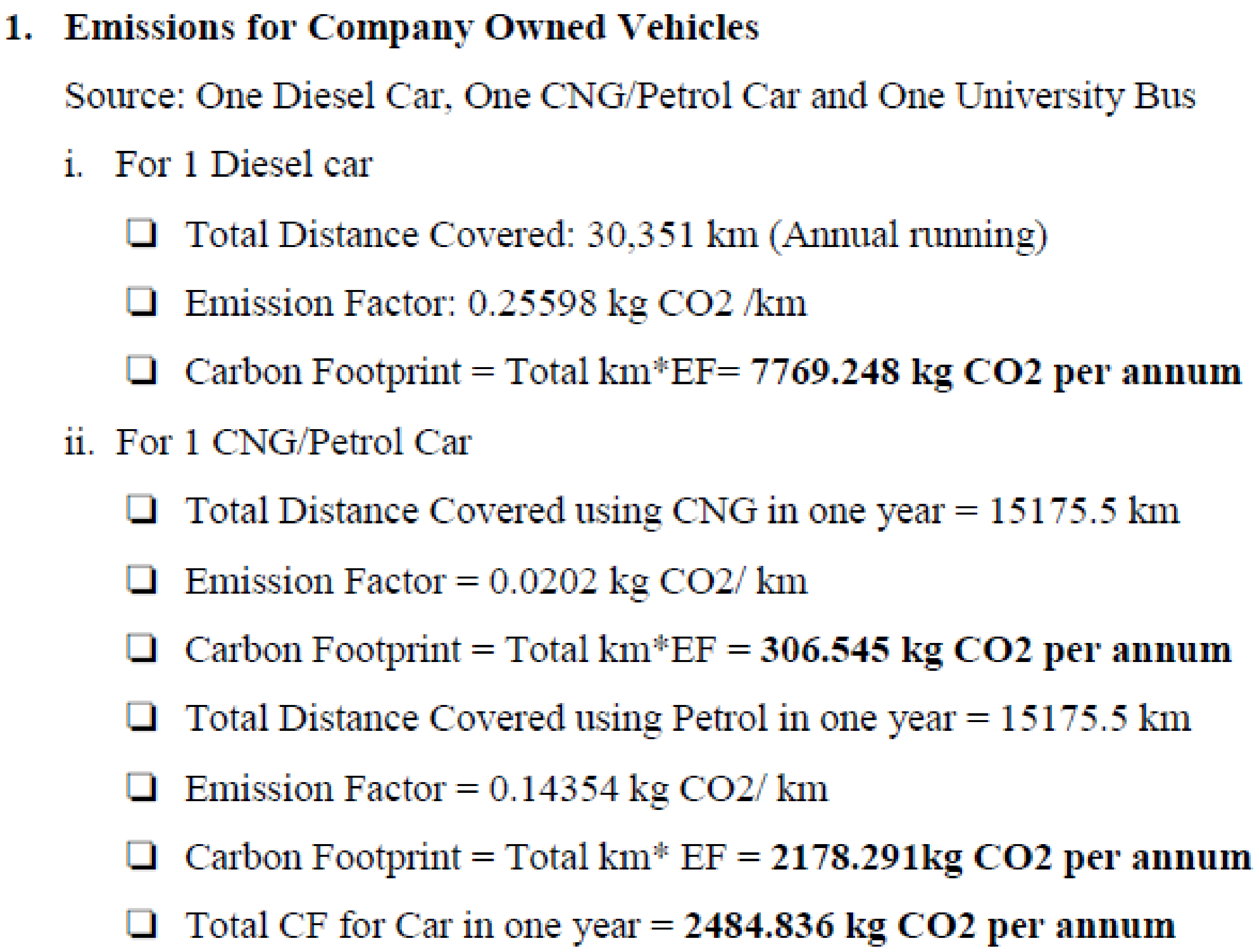


Count of What is the type of fuel used in the vehicle for which you commute to TERI University?



Histogram of How many days you come to TERI University in a week for lectures/official work?

Scope 1



1. **Emissions for Company Owned Vehicles**

Source: One Diesel Car, One CNG/Petrol Car and One University Bus

i. For 1 Diesel car

- ☐ Total Distance Covered: 30,351 km (Annual running)
- ☐ Emission Factor: 0.25598 kg CO2 /km
- ☐ Carbon Footprint = Total km*EF= **7769.248 kg CO2 per annum**

ii. For 1 CNG/Petrol Car

- ☐ Total Distance Covered using CNG in one year = 15175.5 km
- ☐ Emission Factor = 0.0202 kg CO2/ km
- ☐ Carbon Footprint = Total km*EF = **306.545 kg CO2 per annum**
- ☐ Total Distance Covered using Petrol in one year = 15175.5 km
- ☐ Emission Factor = 0.14354 kg CO2/ km
- ☐ Carbon Footprint = Total km* EF = **2178.291kg CO2 per annum**
- ☐ Total CF for Car in one year = **2484.836 kg CO2 per annum**

iii. For TERI Official Bus

- Total Distance Covered in one year = 7800 km (Taking average 195 working days)
- Emission Factor (CNG) = 0.0202 kg CO2/ km
- Carbon Footprint = **157.56 kg CO2 per annum**

Total Emissions by Company Owned Vehicles = **10411.644 kg CO2 per annum**

2. Emissions from DG Sets

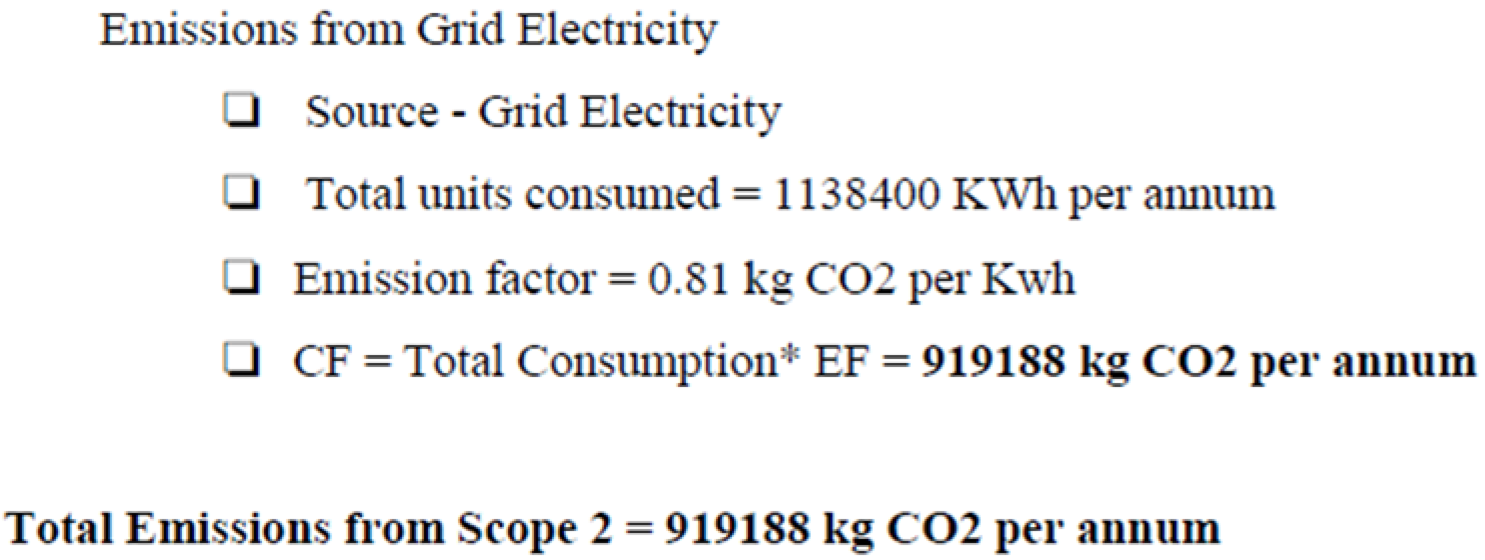
- Source - 380 kVA Diesel Generator used by TERI University
- Quantity of Diesel used = 1111.8 litres per annum
- Emission factor = 2.6765 kg CO2 per litre
- Carbon Footprint = Consumption*EF = **2975.7327 kg CO2 per annum**

3. Emissions from Kitchen Fuel

- Source - Cylinders used in TERI Cafeteria
- Amount of LPG consumed = 5244 kg CO2 per annum
- Emission Factor = 2.98 kg CO2 per kg
- Carbon Footprint = Consumption* EF = **15627.12 kg CO2 per annum**

Total Emissions from Scope 1 = 29014.4967 kg CO2 per annum

Scope 2

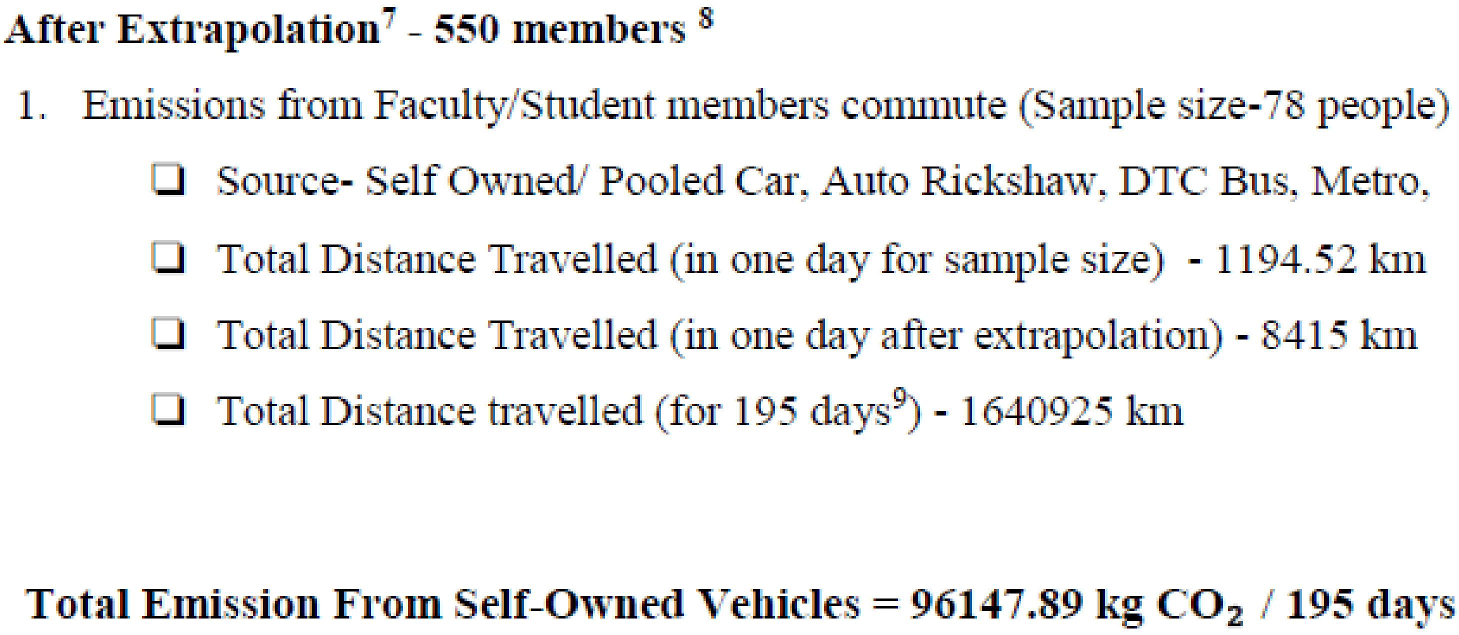


Emissions from Grid Electricity

- ❑ Source - Grid Electricity
- ❑ Total units consumed = 1138400 KWh per annum
- ❑ Emission factor = 0.81 kg CO2 per Kwh
- ❑ CF = Total Consumption* EF = **919188 kg CO2 per annum**

Total Emissions from Scope 2 = 919188 kg CO2 per annum

Scope 3 (Sample size-78 people)



After Extrapolation[7] - 550 members [8]

1. Emissions from Faculty/Student members commute (Sample size-78 people)
    - ☐ Source- Self Owned/ Pooled Car, Auto Rickshaw, DTC Bus, Metro,
    - ☐ Total Distance Travelled (in one day for sample size) - 1194.52 km
    - ☐ Total Distance Travelled (in one day after extrapolation) - 8415 km
    - ☐ Total Distance travelled (for 195 days[9]) - 1640925 km

Total Emission From Self-Owned Vehicles = 96147.89 kg CO_2 / 195 days

2) DTC/Private Bus

- Percentage of DTC/Private Bus members (in one day for sample size)- 9.2%
- Distance of DTC/Private Bus members (in one day after extrapolation)- 774.18 km[12]
- Distance of DTC/Private Bus members (for 195 days) - 150965.1 km[13]
- Emission Factor = 0.0202 kg CO_2 /km
- Carbon Footprint = 3049.49 kg CO_2 / 195 days

Total Emission From DTC/Private Bus = **3049.49 kg CO_2 / 195 days**

3) Auto

- ❑ Percentage of Auto members (in one day for sample size)- 7.3%
- ❑ Distance of Auto members (in one day after extrapolation)- 614.29 km[14]
- ❑ Distance of Auto members (for 195 days) - 119765.62 km[15]
- ❑ Emission Factor = 0.0202 kg CO_2 /km
- ❑ Carbon Footprint = 2419.26 kg CO_2 / 195 days

Total Emission From Auto = **2419.26 kg CO_2 / 195 days**

4) Metro

- Percentage of Metro members (in one day for sample size)- 25.28%

- Distance of Metro members (in one day after extrapolation)- 2127.31 km[16]
- Distance of Metro members (for 195 days) - 414825.84 km[17]
- Emission Factor = 0.0441 kg CO_2 /km
- Carbon Footprint = 18293.81 kg CO_2 / 195 days

Total Emission From Auto = **18293.81 kg CO_2 /195 days**

5) Taxi

- Percentage of Taxi members (in one day for sample size)- 5.65%
- Distance of Taxi members (in one day after extrapolation)- 475.44 km[18]
- Distance of Taxi members (for 195 days) - 92712.26 km[19]
- Emission Factor = 0.0202 kg CO_2 /km
- Carbon Footprint = 1872.78 kg CO_2 /195 days

Total Emission From Taxi = **1872.78 kg CO/ 195 days**

Total Emissions by Students and Staffs commute = 121783.23 kg CO/ 195 days

2. Emissions from Trip Purposes of Students

- Distance travelled by 7 Buses for trips = 6004 km
- Emission Factor for Diesel Buses = 0.25598 kg CO2/ km
- CF = Distance*EF = **1536.9039 kg CO2 per annum**

3. Emissions from Paper Consumption

- Source - Reams of paper, Posters, Brochures, Paper used for letters postage

Emissions by Reams

- Total Reams used in one year = 1567

- Weight of all reams = 3917.5 kg
- Emission Factor for paper = 1.8670 kg CO2 per kg
- CF = Weight of reams*EF = **7313.9725 kg CO2 per annum**

Emissions by Posters and Brochures

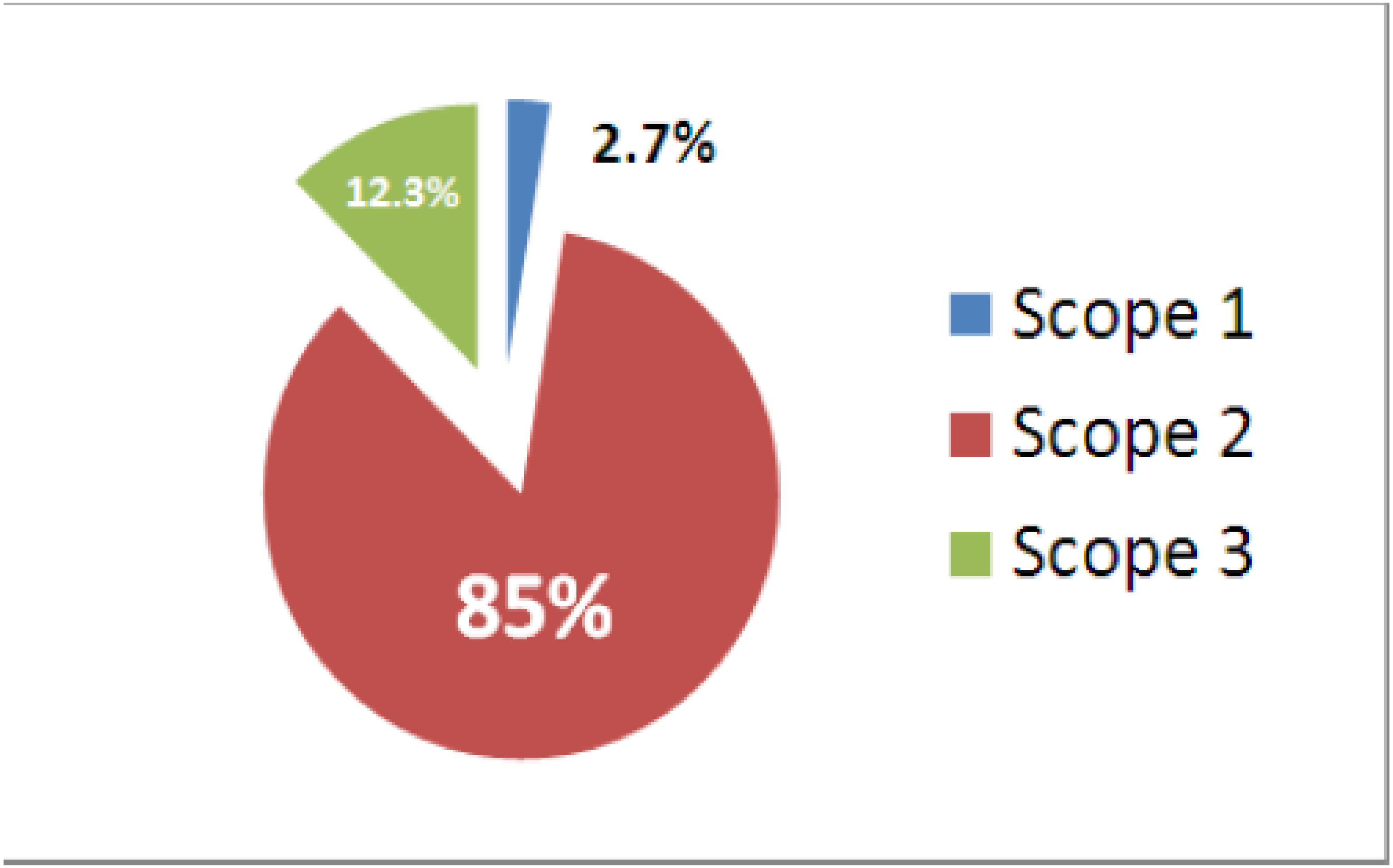
- Total weight of Posters and Brochures = 350 kg
- Emission Factor = 1.8670 kg per CO2 per kg
- CF = Weight of paper*EF = 653.45 kg CO2 per annum

Total emissions by paper in an year = **7967.4225 kg CO2 per annum**

4. Emissions from Waste

- Source = Kitchen and other waste
- Waste produced in one day = 15kg
- Total waste produced = 4140 kg per annum
- Emission Factor = 0.8421 kg CO2 per Kg
- CF = Total waste*EF = **3486.294 kg CO2 per annum**

Total Emissions from Scope 3 = 134773.9 kg CO2 per annum


2.7%
12.3%
85%
Scope 1
Scope 2
Scope 3

Measures that we can take in TERI University to reduce its carbon footprint.

1) Students and staff living within 1 km distance of the TERI campus can opt to walk to campus daily rather than taking a vehicle.
2) More people (students and staff) should come forward and travel in public transport or pooled in vehicles.
3) Food waste and other compostable waste can go in a bio digester plant to produce fertile manure as well as biogas (which though won’t cater to the kitchen fuel needs on the entire university but can help to light one burn per day)

4) Solar cookers are highly efficient for cooking of rice and dal. Since these two are the food items cooked everyday solar cookers can be used to cook these basic meals which will help to cut down on LPG usage.

5) In this era of e-technology the Minor and Major project reports that students of TERI prepare can be sent and read through soft copies rather than get a printed one.

6) Selection letters that ares sent to all students after selection can be done via e-mails rather than by post.

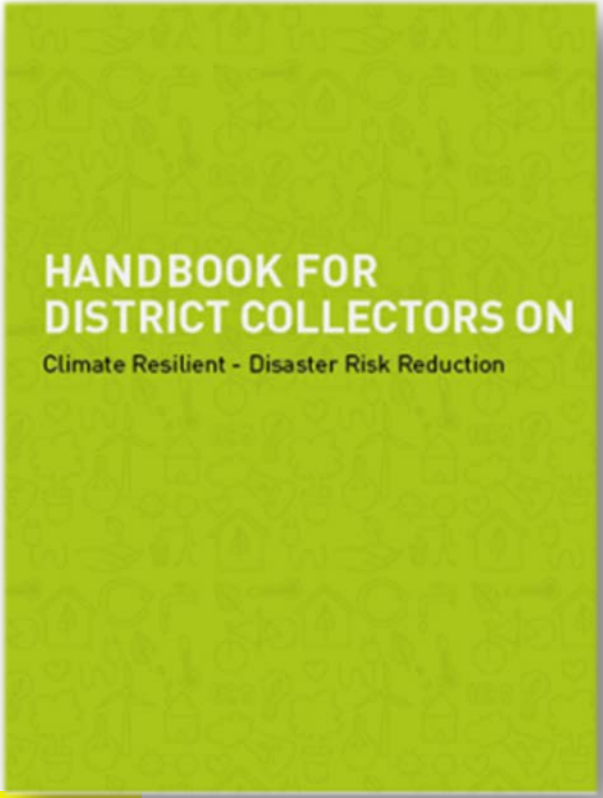
7) The university already has a solar water heating system for the Girls' Hostel which helps to reduce geysers usage to a great extent for warm water during winters. More such renewable energy based appliances can be used to cut down on conventional fuel and electricity.

8) Changing electrical appliances to more efficient ones.

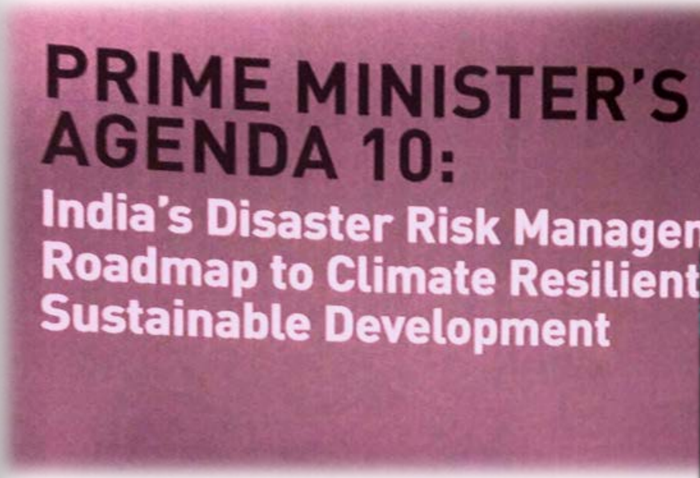
9) Using the stairs instead of taking the elevator whenever possible.

10) Bringing in habitual changes in everyday life like switching off appliances while leaving the room, turning off power switches of computers while closing the doors etc.

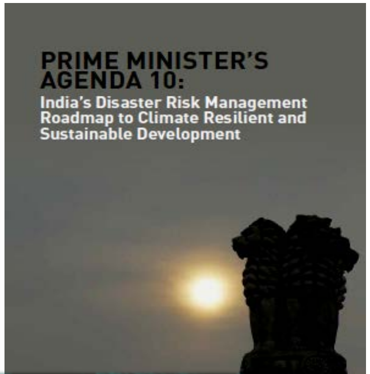
CLIMATE RESILIENCE and Disaster Risk Management



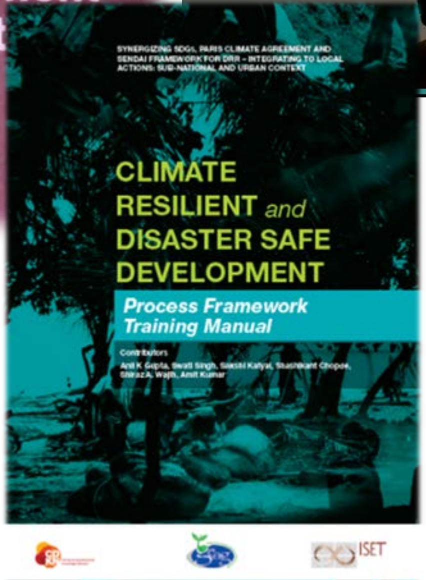
HANDBOOK FOR DISTRICT COLLECTORS ON
Climate Resilient - Disaster Risk Reduction



PRIME MINISTER'S AGENDA 10:
India's Disaster Risk Management Roadmap to Climate Resilient Sustainable Development



PRIME MINISTER'S AGENDA 10:
India's Disaster Risk Management Roadmap to Climate Resilient and Sustainable Development



SYNERGIZING SDGs, PARIS CLIMATE AGREEMENT AND SENDAI FRAMEWORK FOR DRR - INTEGRATING TO LOCAL ACTIONS: SUB-NATIONAL AND URBAN CONTEXT

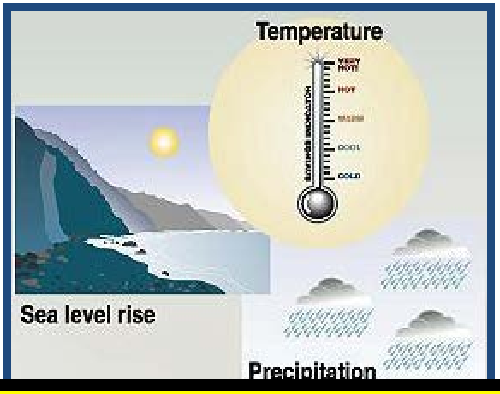
CLIMATE RESILIENT *and* DISASTER SAFE DEVELOPMENT

Process Framework Training Manual

Contributors
Anil K Gupta, Swati Singh, Sakshi Kalyal, Shashikant Chopde, Shiraz A. Wajih, Amit Kumar

Issues

- Global recession – economic slowdown
- Ecological slowdown (MA2005)
- Climate change
- Lifestyles and sustainable development
- Adaptation to changes? Limits to?
- Disaster risk reduction – paradigm shifts to sustainability (through risk) management



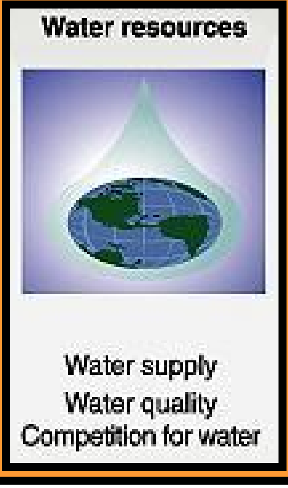
Climate Change Impacts

Health

Weather-related mortality
Infectious diseases
Air-quality respiratory illnesses

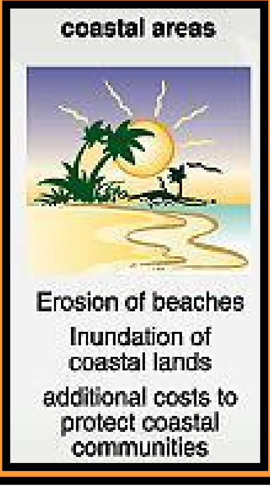
Agriculture

Crop yields
Irrigation demands



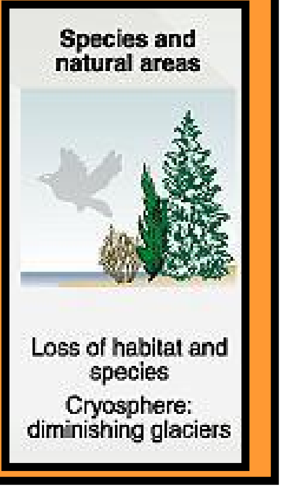
Water resources

Water supply
Water quality
Competition for water



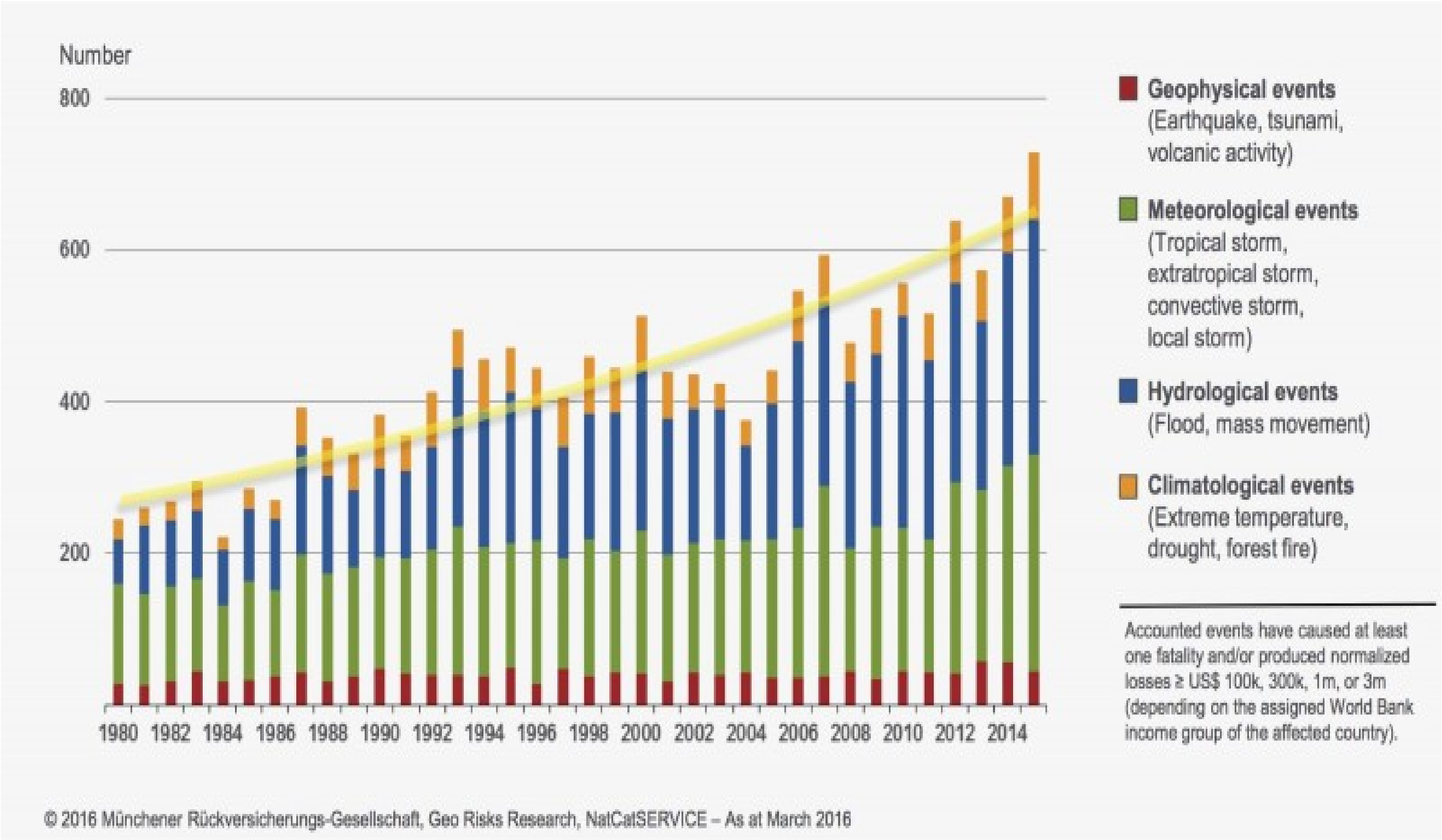
coastal areas

Erosion of beaches
Inundation of coastal lands
additional costs to protect coastal communities



Species and natural areas

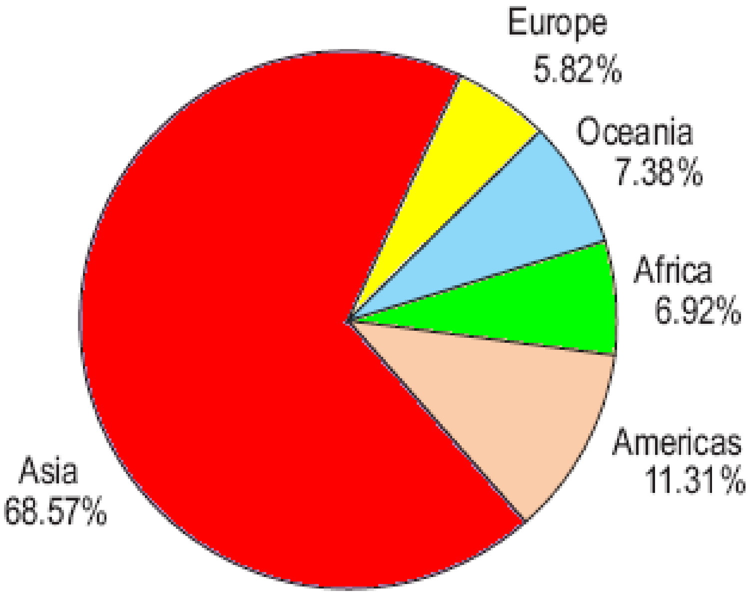
Loss of habitat and species
Cryosphere: diminishing glaciers



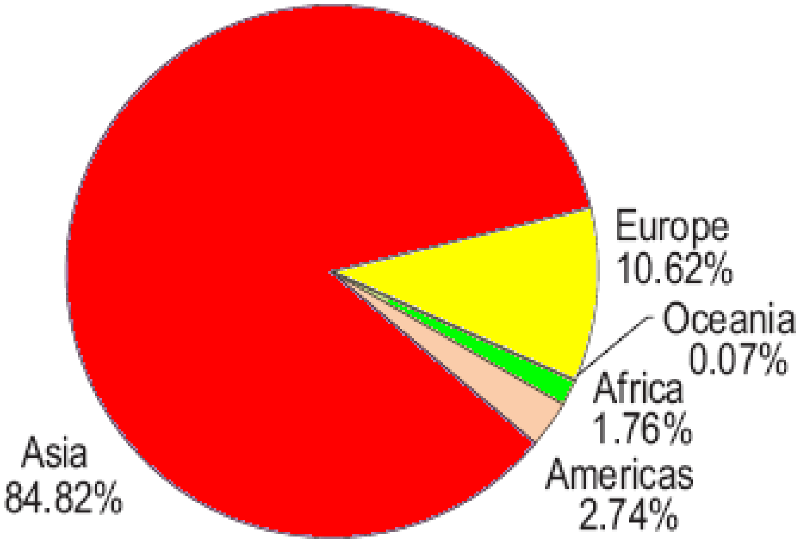
Accounted events have caused at least one fatality and/or produced normalized losses ≥ US$ 100k, 300k, 1m, or 3m (depending on the assigned World Bank income group of the affected country).

© 2016 Münchener Rückversicherungs-Gesellschaft, Geo Risks Research, NatCatSERVICE – As at March 2016

Percentage of people killed by natural disasters by region



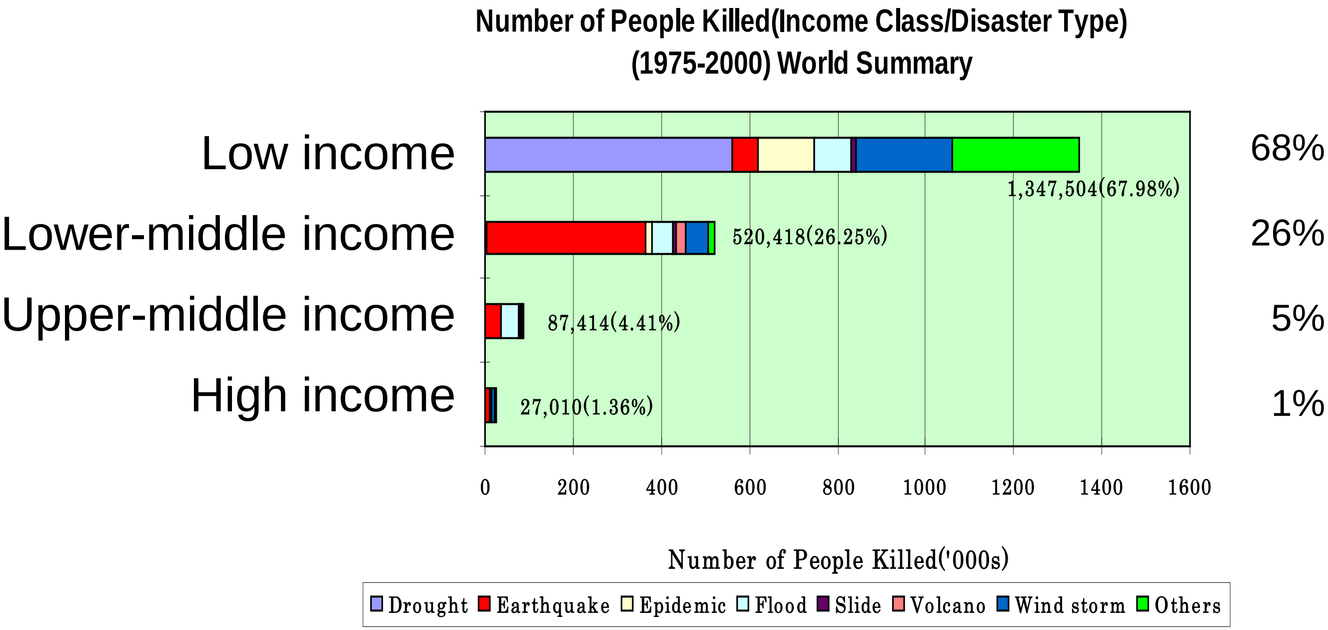
2009



Average 2000-2008

Who is Most Affected by Disasters?

The poor: most vulnerable to current hazards and to expected climate change impacts

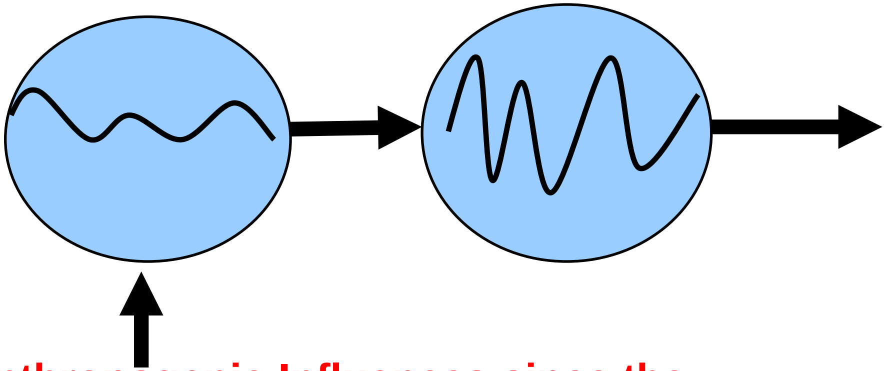


Source: ADRC, OFDA/CRED

جمهوری اسلامی ایران
وزارت جهادکشاورزی

موسسه پژوهش‌های برنامه‌ریزی،
اقتصادکشاورزی و توسعه روستایی

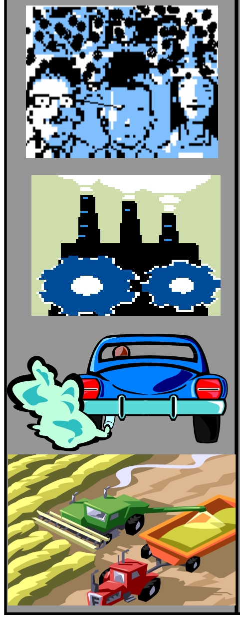
APERDRI



Natural Climate Variability

Climate Change
Natural + Anthropogenic

Anthropogenic Influences since the Industrial revolution



Spiraling Population

High pace of Industrialization

Increasing use of Fossil Fuels in Industry & Transport

Deforestation for Agriculture and Urbanization

CLIMATE CHANGE

Global Warming

Increased Precipitation & its Uneven Distribution

Melting of Glaciers & Snow

Sea level Rise

Increase in Frequency & Intensity of Extreme Weather Events

IMPACTS

Uncertainty in Water Availability

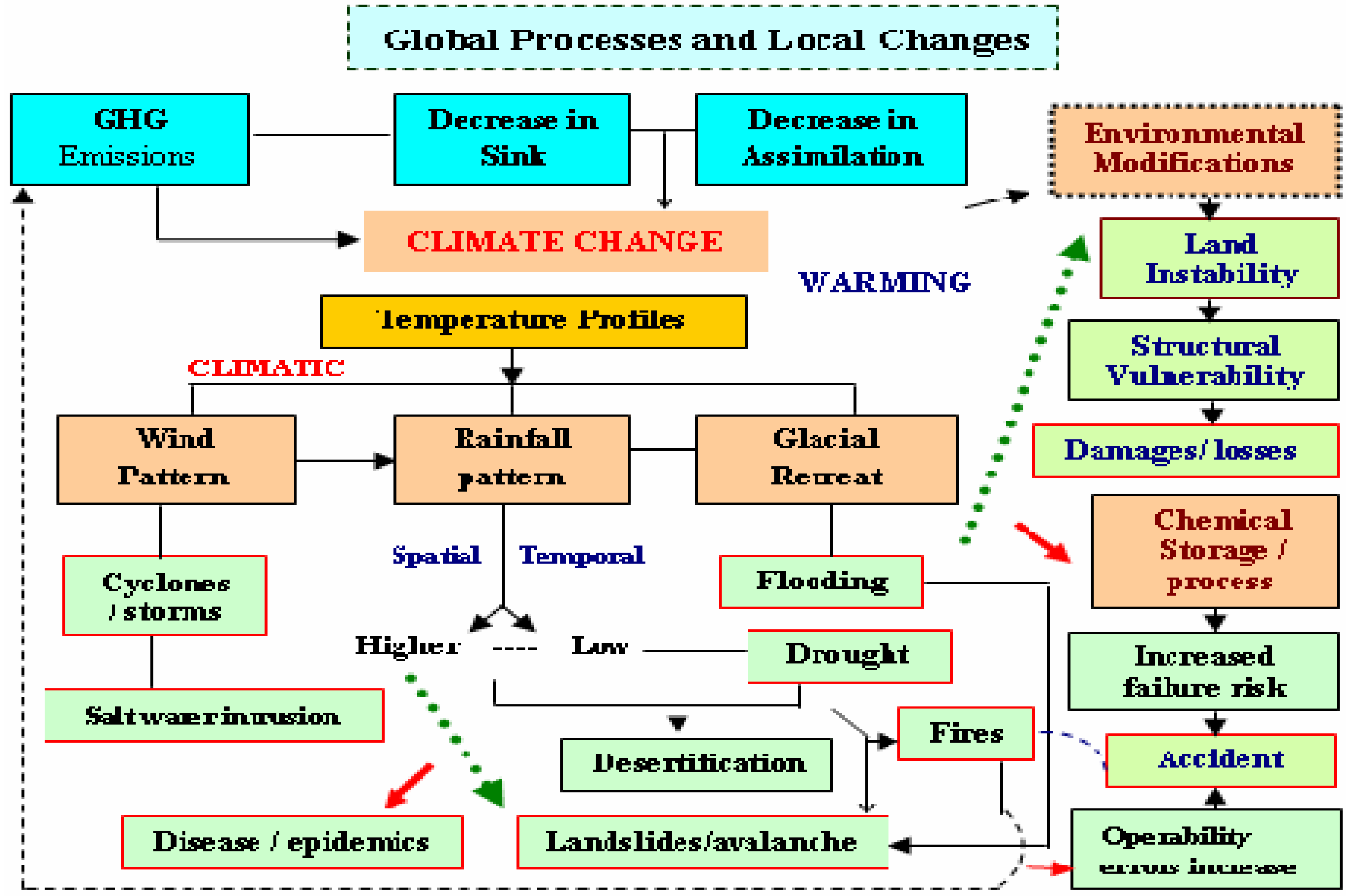
Decrease in Crop Yields

Newer perspective for sources of energy

Loss of Biodiversity

Increased Health Risks

Environment, climate-change and disasters



Global Processes and Local Changes

GHG Emissions

Decrease in Sink

Decrease in Assimilation

CLIMATE CHANGE

WARMING

Temperature Profiles

CLIMATIC

Wind Pattern

Rainfall pattern

Glacial Retreat

Spatial

Temporal

Cyclones / storms

Saltwater intrusion

Flooding

Higher ---- Low

Drought

Fires

Desertification

Disease / epidemics

Landslides/avalanche

Environmental Modifications

Land Instability

Structural Vulnerability

Damages/ losses

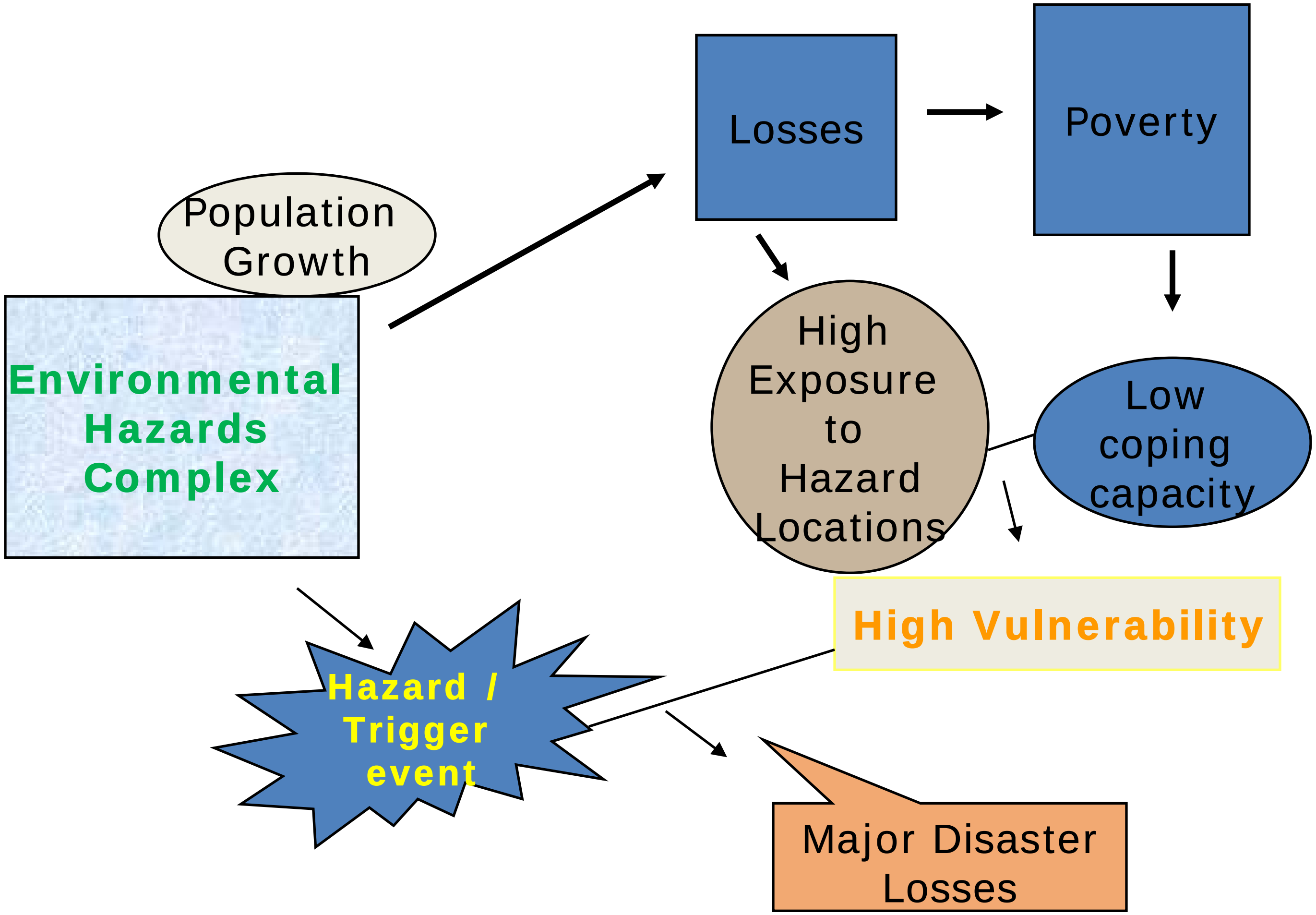
Chemical Storage / process

Increased failure risk

Accident

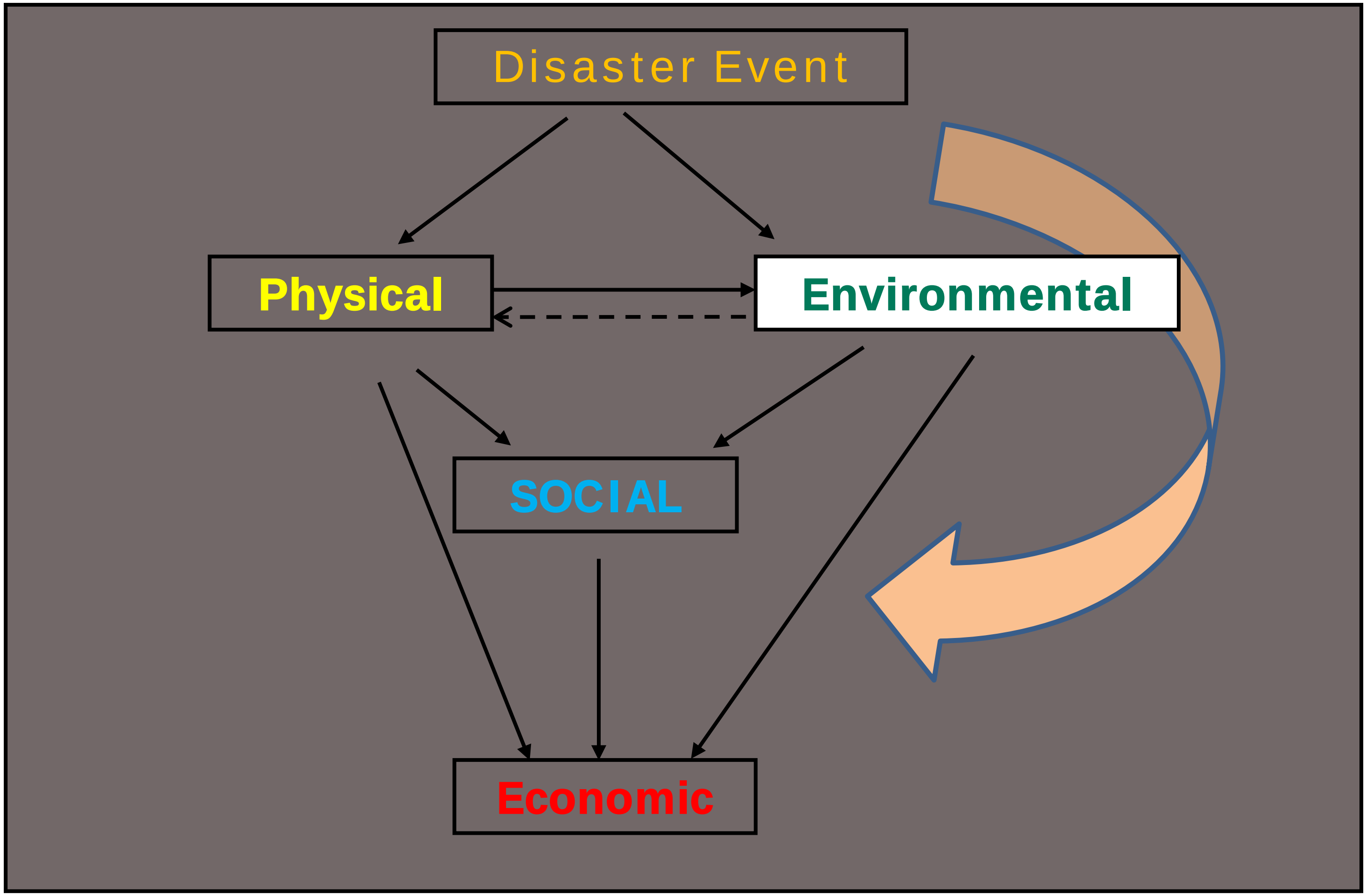
Operability errors increase

Environ-disaster interface



Source: 2008(5) Publication

Disaster Impacts



Disaster Event

Physical

Environmental

SOCIAL

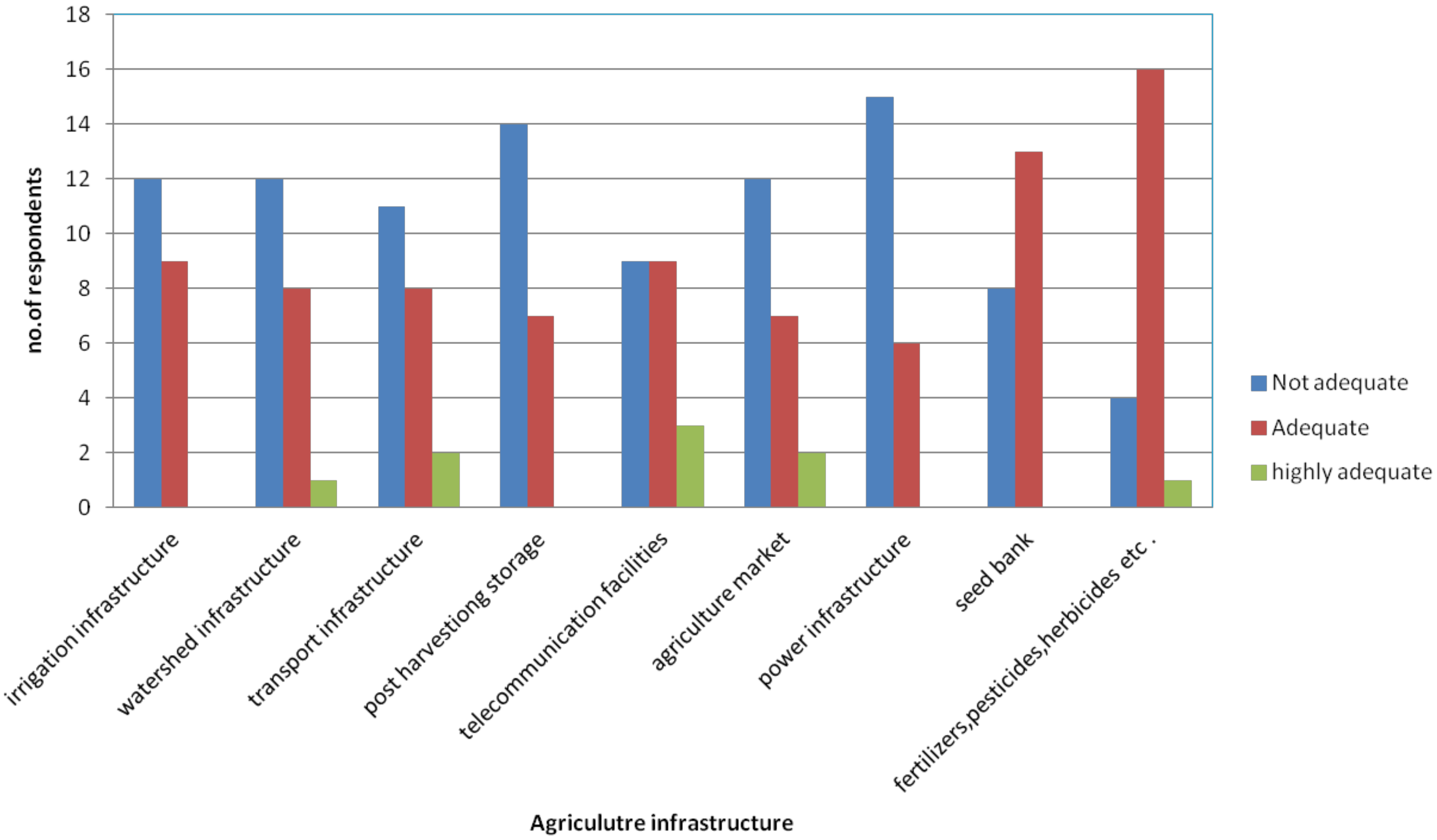
Economic

Disaster-Environment Impact Matrix

	Air	Water	Land	Crops	Wildlife	Livestock	Forests	Waste
Flood	S	D	D	D	D	D	D	D
Cyclone	D	D	D	D	D	D	D	D
Drought	I	D	D	D	D	D	D	I
Earthquak	S, C	I, C	I	--	L	D	--	D
Landslide	--	S	D	--	I	--	D	D
Chemical	D	D	D	D	D, C	D	D, C	D
Nuclear	D	D, S	D	D, S	D	D	D, L	D
Biological	S	D, C	S	C	C	C	C	D
Civil	C	C	C, I	--	--	--	--	C
Transport	C	C	C	L	--	--	--	D

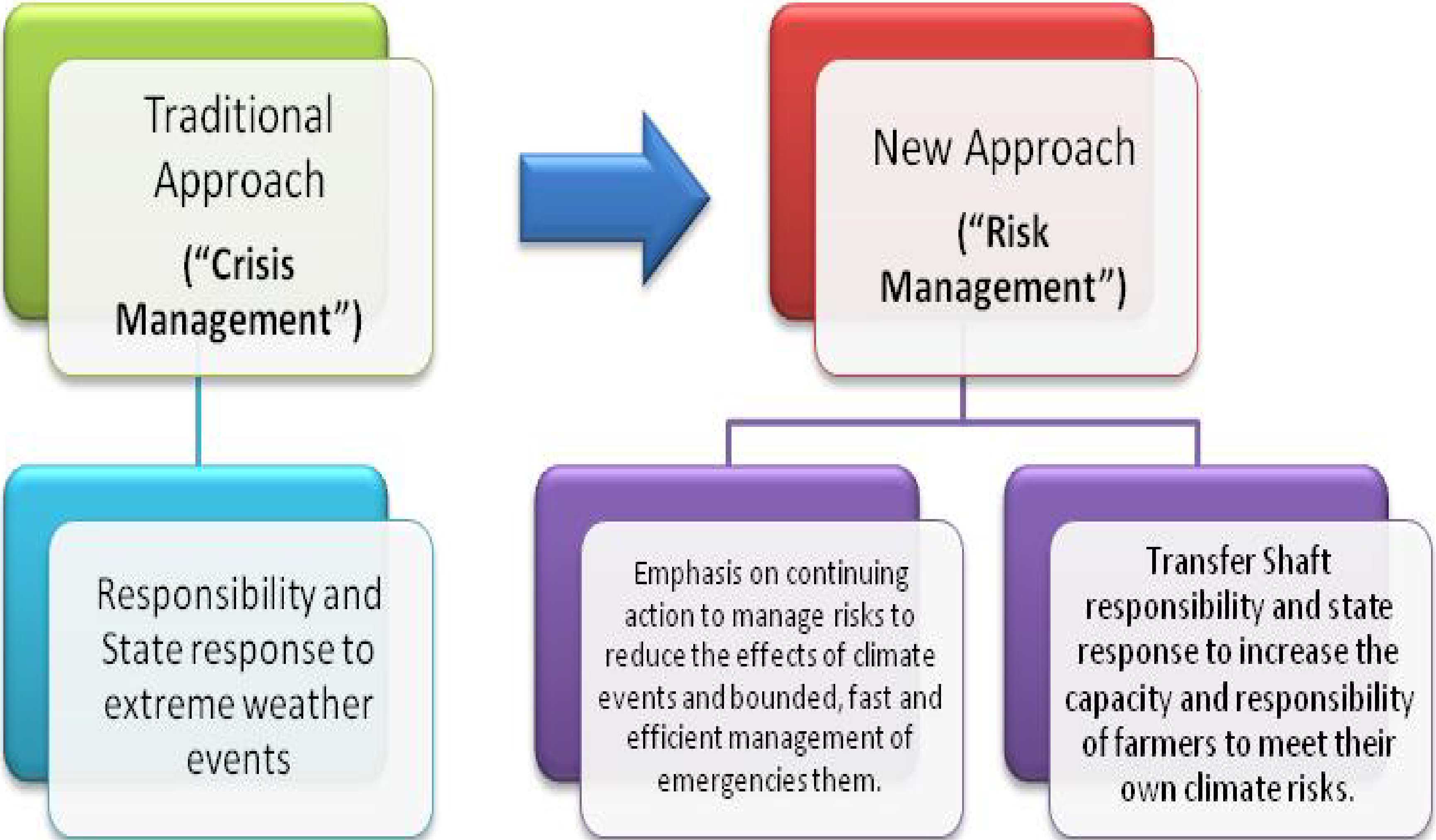
D=Direct, I=Indirect, S=Secondary, L=Less, C=Case specific

Agriculture Infrastructure Status in South Asia



HOW DO WE DO IT

NEW EMPHASIS



Traditional Approach

("Crisis Management")

Responsibility and State response to extreme weather events

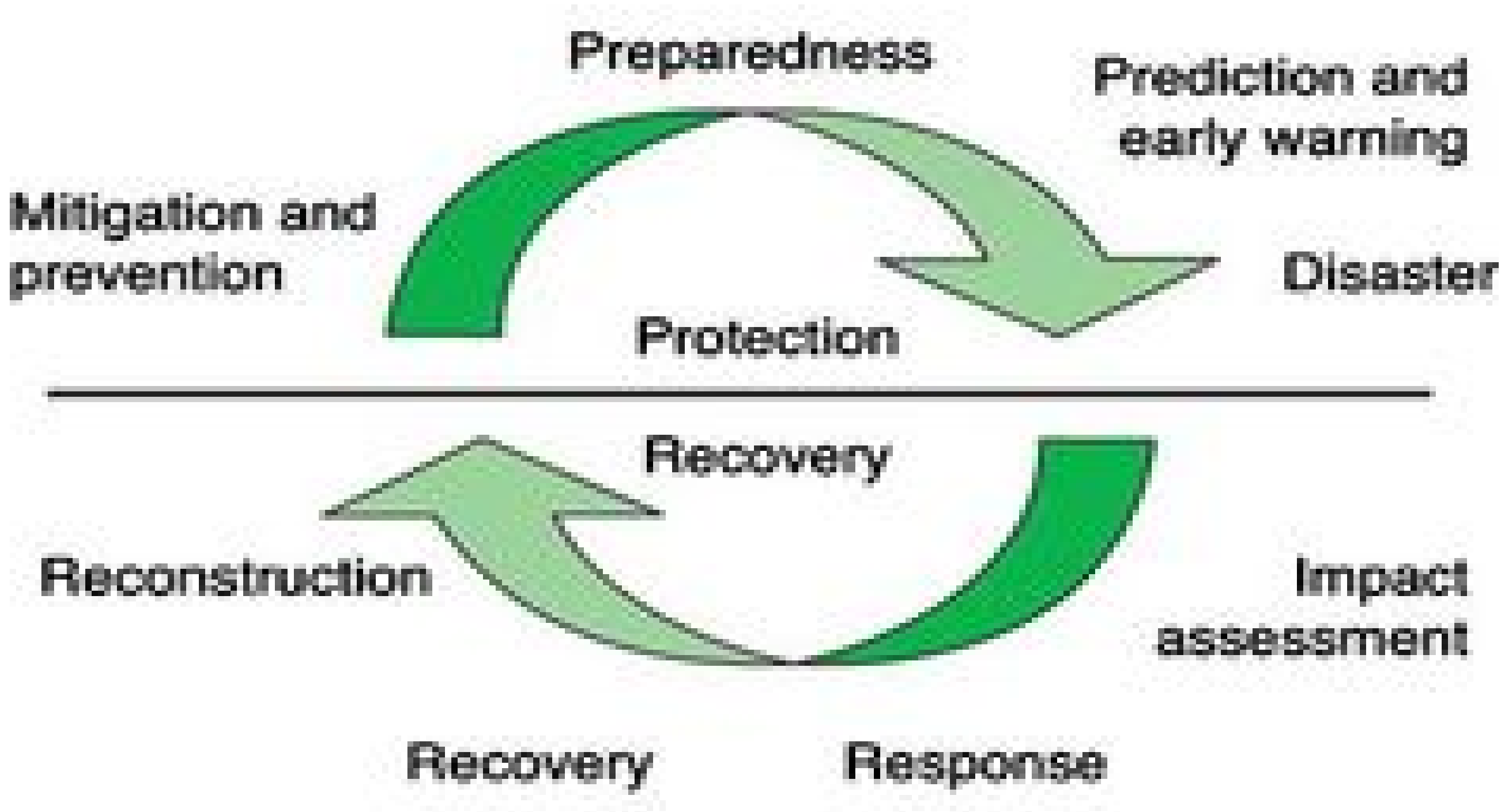
New Approach

("Risk Management")

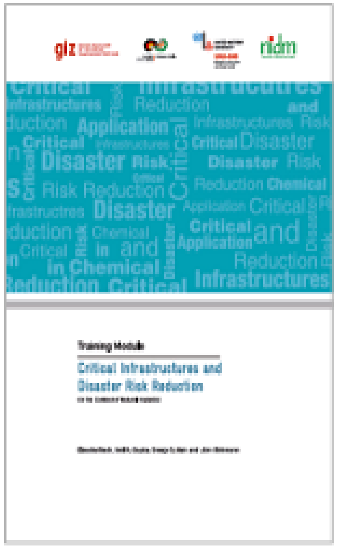
Emphasis on continuing action to manage risks to reduce the effects of climate events and bounded, fast and efficient management of emergencies them.

Transfer Shaft responsibility and state response to increase the capacity and responsibility of farmers to meet their own climate risks.

RISK MANAGEMENT

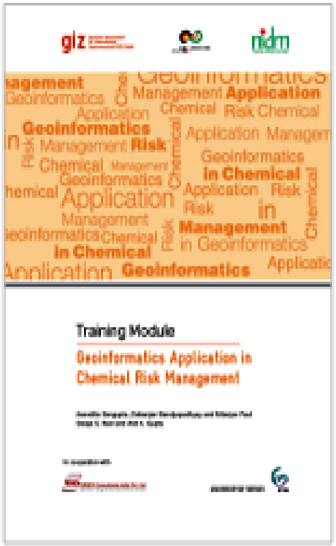


CRISIS MANAGEMENT



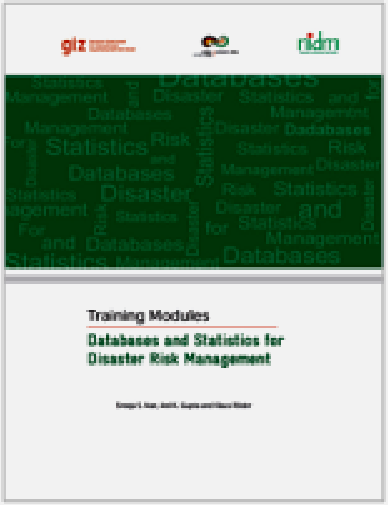
Training Module
Critical Infrastructures and Disaster Risk Reduction

Critical infrastructures and Disaster Risk Reduction in the Light of Natural Hazards
ISBN: 978-3-944152-13-4
Claudia Bach,
Anil K. Gupta,
Sreeja S. Nair and
Jörn Birkmann



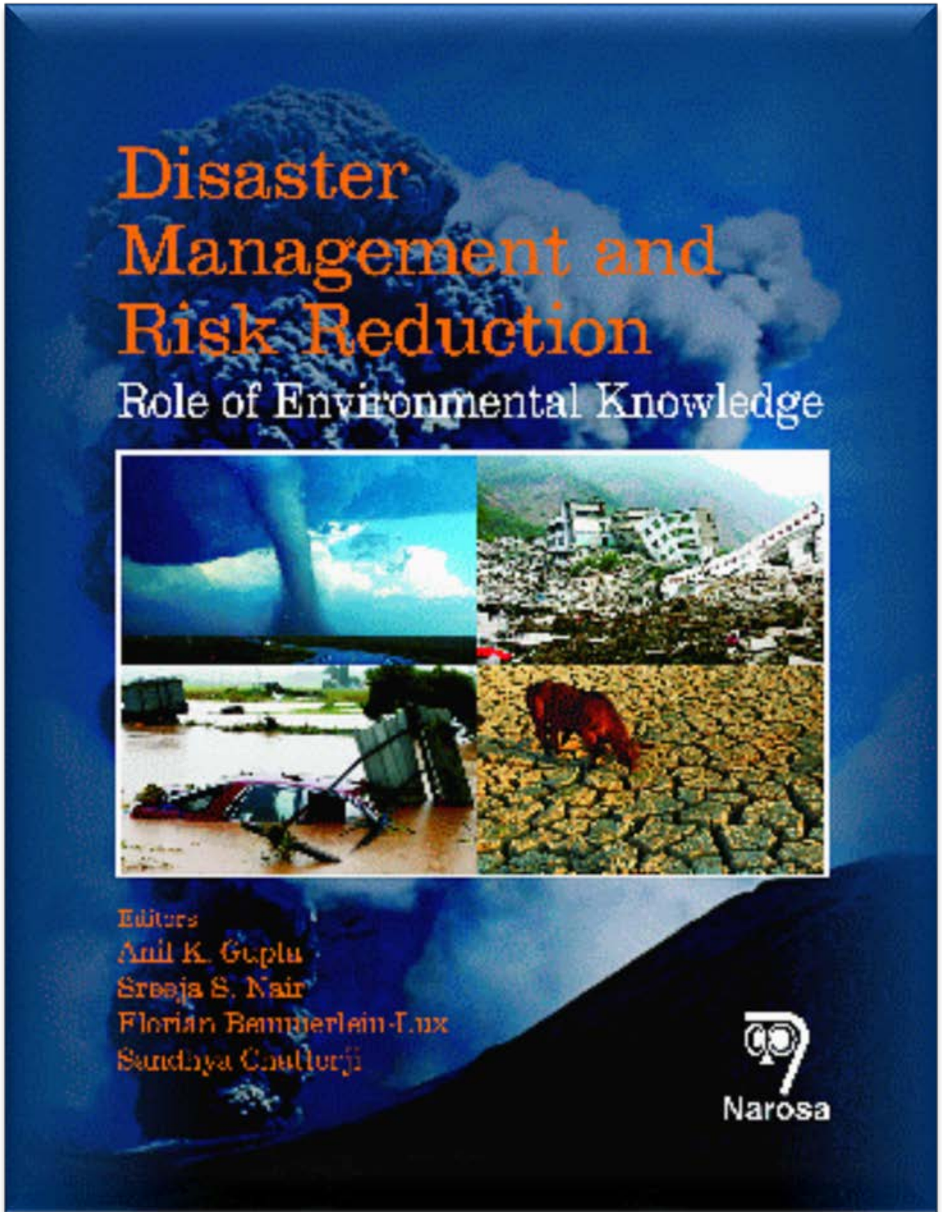
Training Module
Geoinformatics Application in Chemical Risk Management

Geoinformatics Application in Chemical Risk Management
ISBN: 978-3-944152-33-2
Anandita Sengupta,
Debanjan Bandyopadhyay,
Nilanjan Paul,
Sreeja S. Nair and
Anil K. Gupta



Training Modules
Databases and Statistics for Disaster Risk Management

Databases and Statistics for Disaster Risk Management
(4 Modules)
ISBN: 978-3-944152-11-0
Sreeja S. Nair, Klaus Röder & Anil K. Gupta



Disaster Management and Risk Reduction

Role of Environmental Knowledge

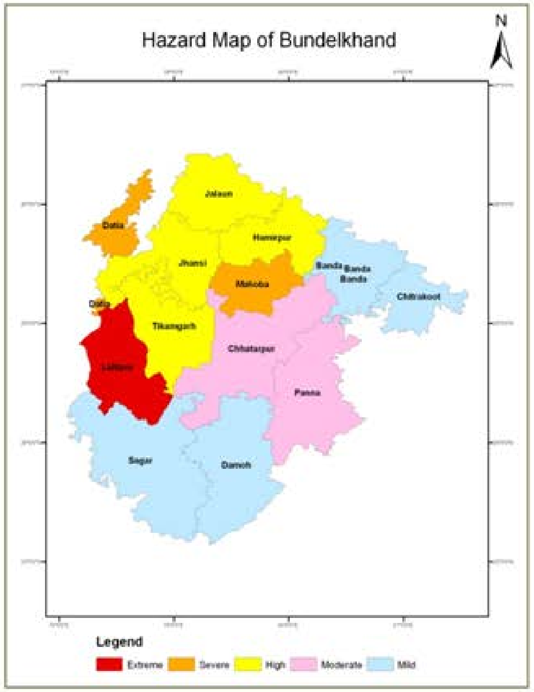
Editors
Anil K. Gupta
Sreeja S. Nair
Florian Bemmerlein-Lux
Sandhya Chatterji

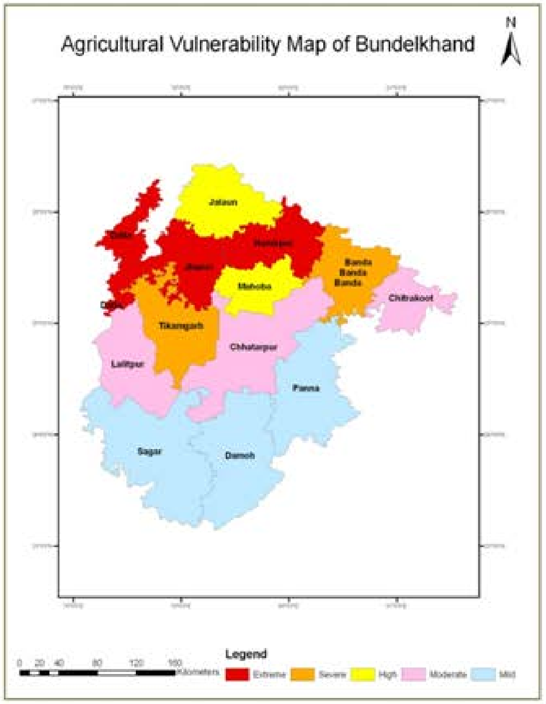
Narosa

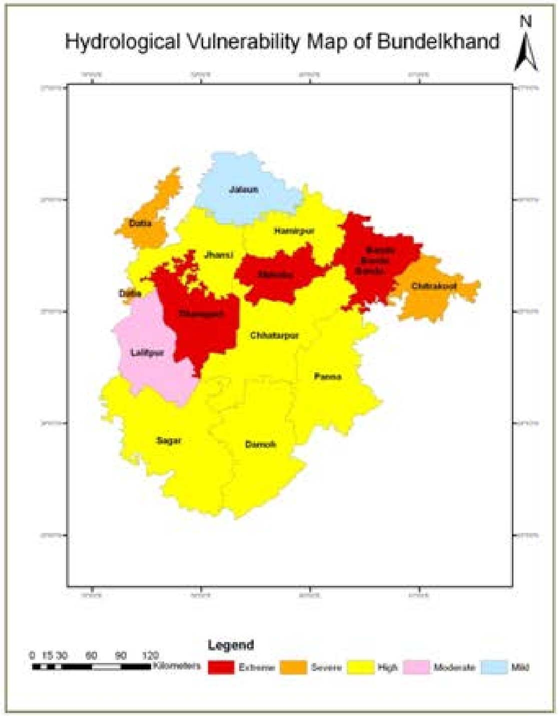
Bundelkhand Drought

(Indian Council of Social Science Research, Funded Project)

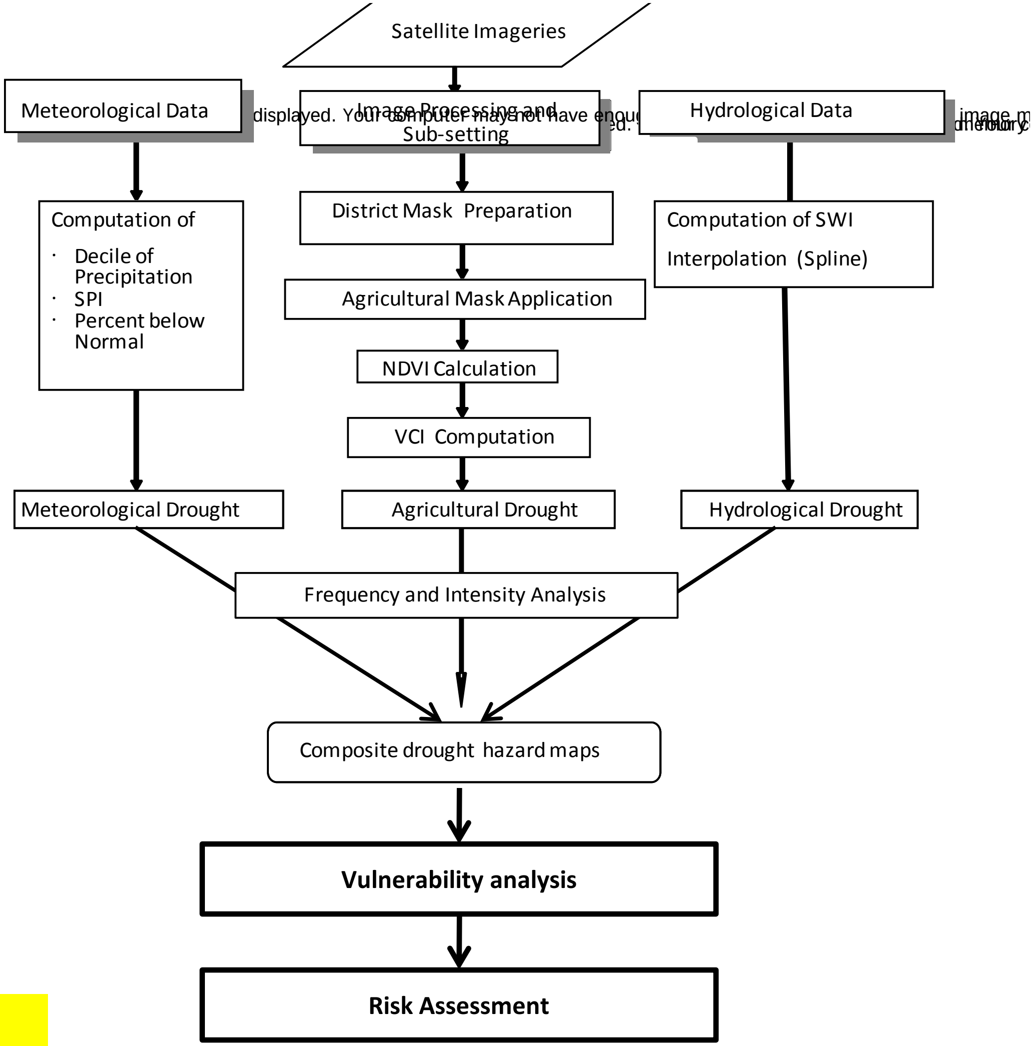
- ❑ Patterns of meteorological, hydrological and agricultural drought
- ❑ Spatial extent of environmental and socio-economic vulnerability
- ❑ Mitigation analysis (a new tool/approach) – spatial extent, effectiveness


Hazard Map of Bundelkhand


Agricultural Vulnerability Map of Bundelkhand


Hydrological Vulnerability Map of Bundelkhand

Risk Assessment



Satellite Imageries

Meteorological Data

Image Processing and Sub-setting

Hydrological Data

Computation of
- Decile of Precipitation
- SPI
- Percent below Normal

District Mask Preparation

Agricultural Mask Application

NDVI Calculation

VCI Computation

Computation of SWI

Interpolation (Spline)

Meteorological Drought

Agricultural Drought

Hydrological Drought

Frequency and Intensity Analysis

Composite drought hazard maps

Vulnerability analysis

Risk Assessment

Mitigation Analysis

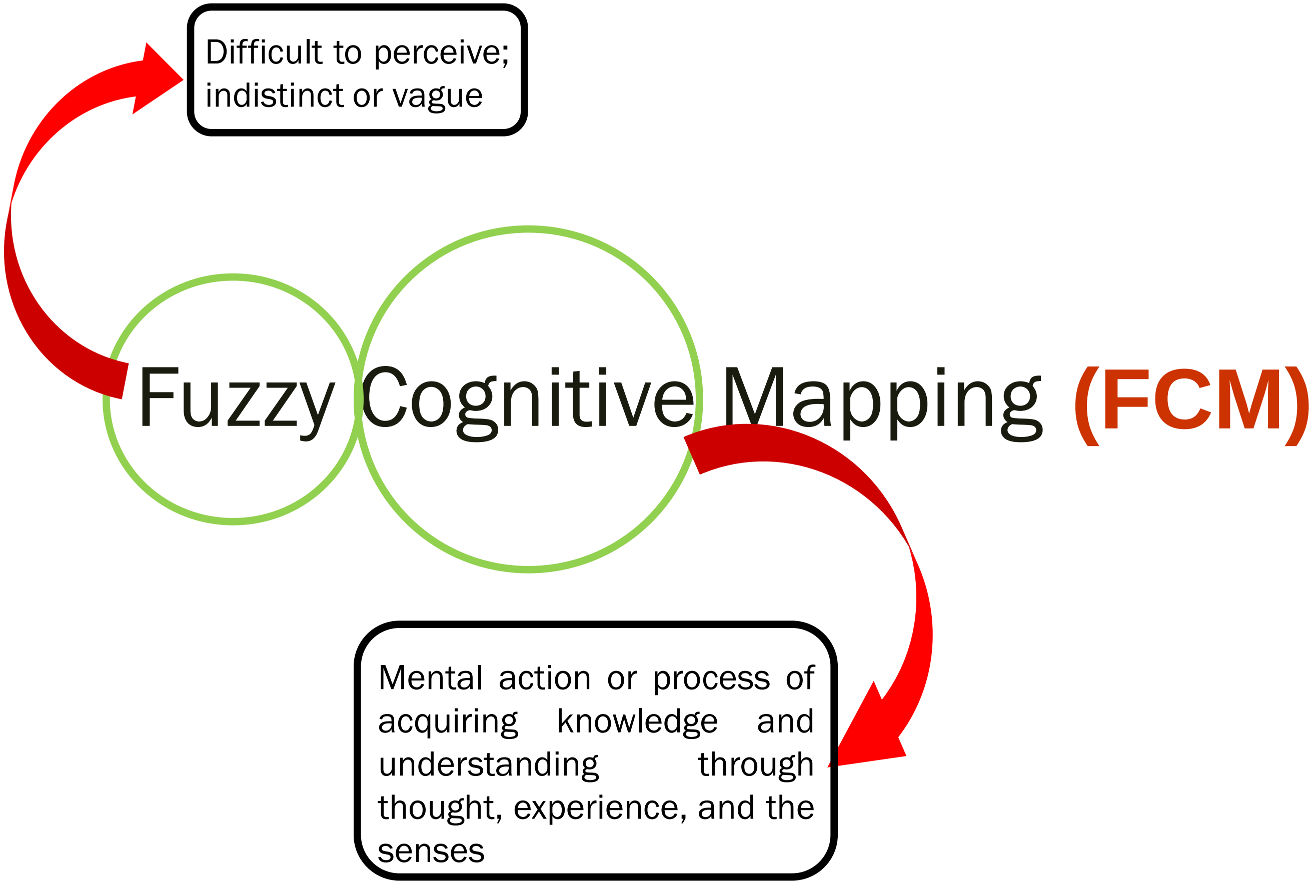
Identify the components of drought mitigation in the ongoing programmes

Typological, temporal and spatial distribution

Livelihood Analysis

Suggesting suitable measures based on the impact

STAKEHOLDER PERCEPTION MAPPING FOR SUSTAINABLE DEVELOPMENT



Difficult to perceive; indistinct or vague

Fuzzy Cognitive Mapping **(FCM)**

Mental action or process of acquiring knowledge and understanding through thought, experience, and the senses

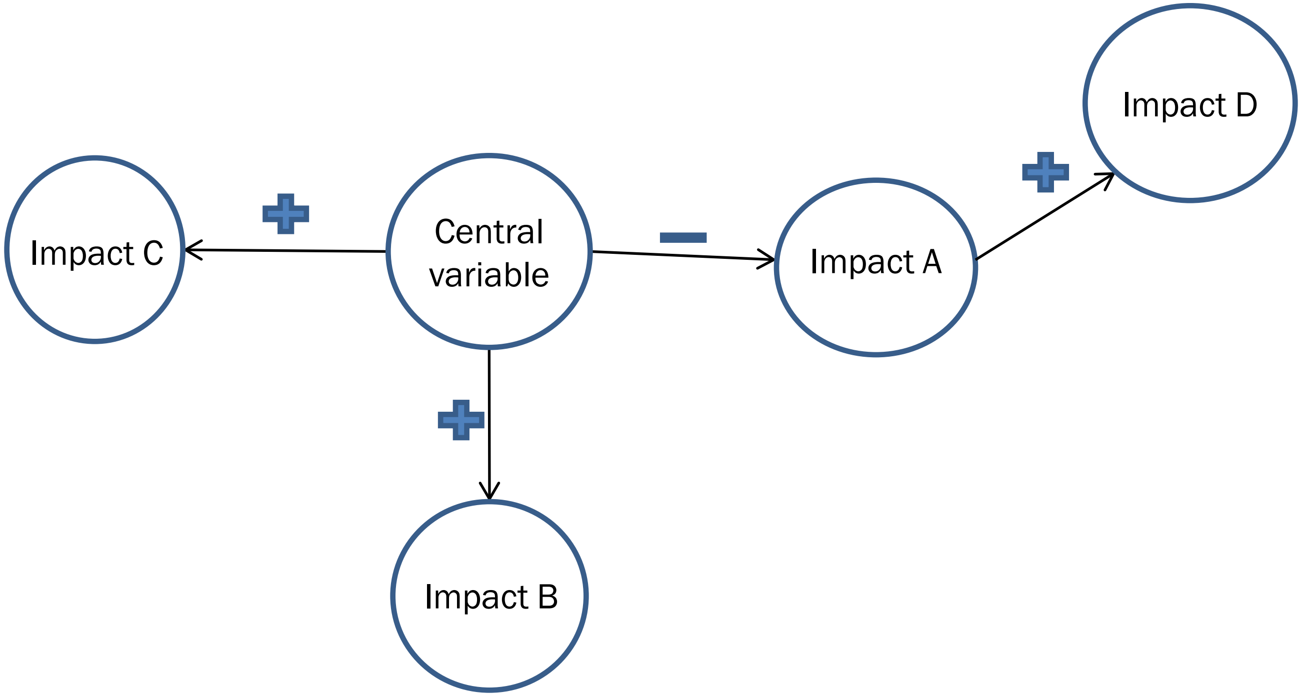
What is fuzzy cognitive mapping?

- A graphical representation of how a system operates.
- Based on the knowledge about or perception of a system.
- Enables representation of uncertain or vague or qualitative data.
- Causal relationships between variables as defined and described by the people rather than the researcher (Axelrod, 1976).

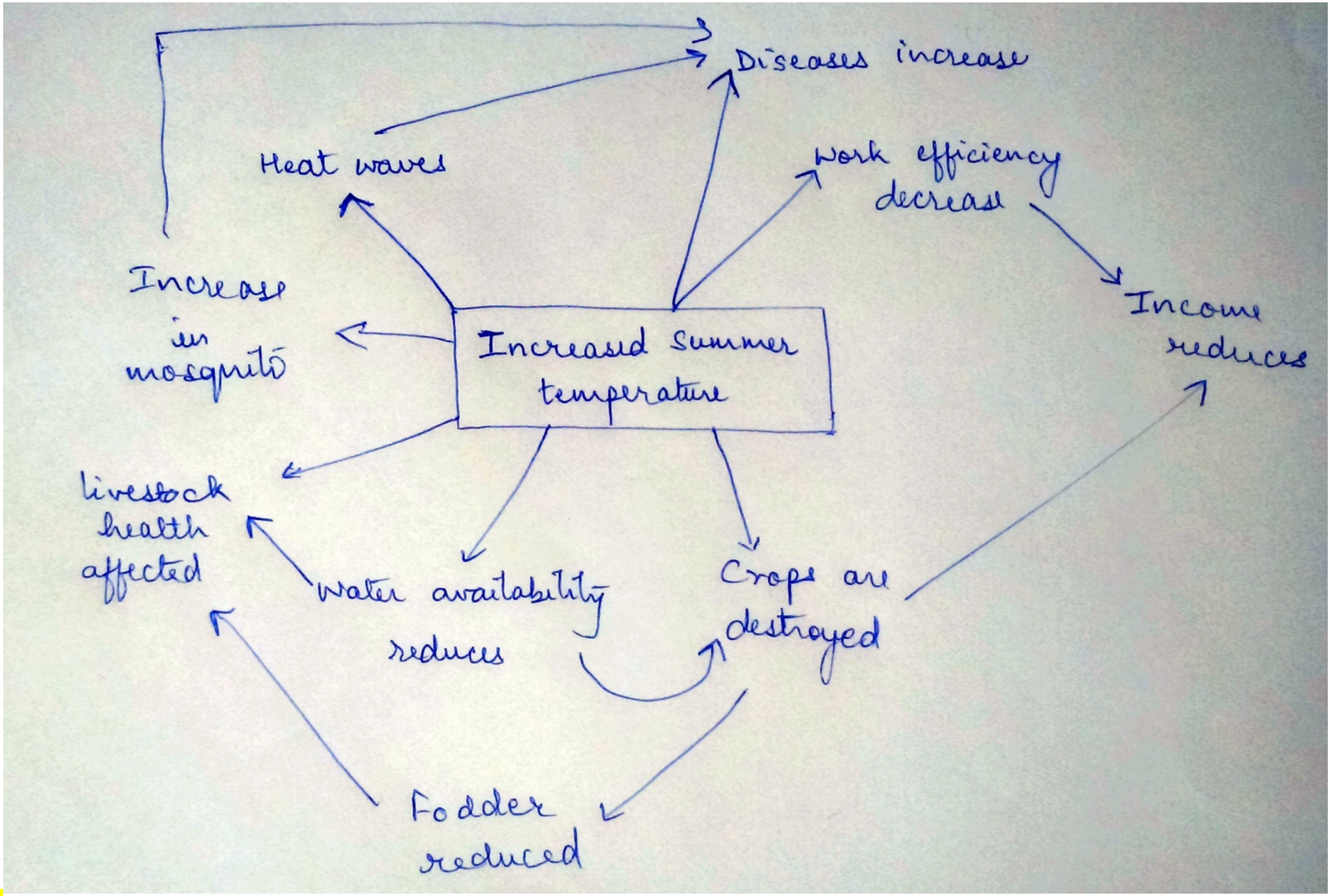
Fuzzy cognitive maps

- Visual representation of the variables and causal relationships between them.
- Used to show differences or similarities in perceptions between different stakeholders.
- They are directed graphs i.e. digraphs. Made up of variables (nodes) and links.
- Strength of causal relationships between variables are indicated with a number between -1 and 1.

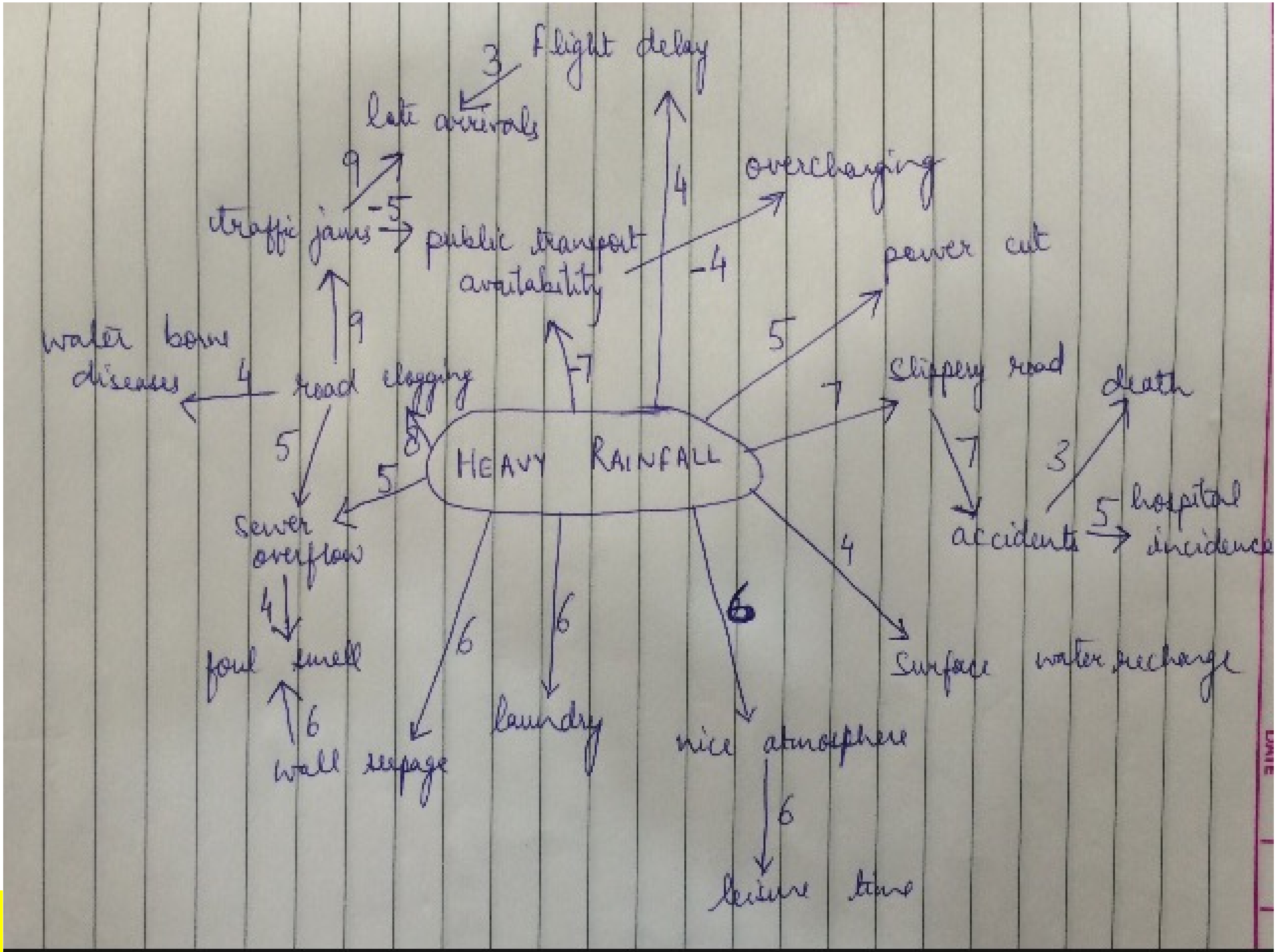
Cognitive Map

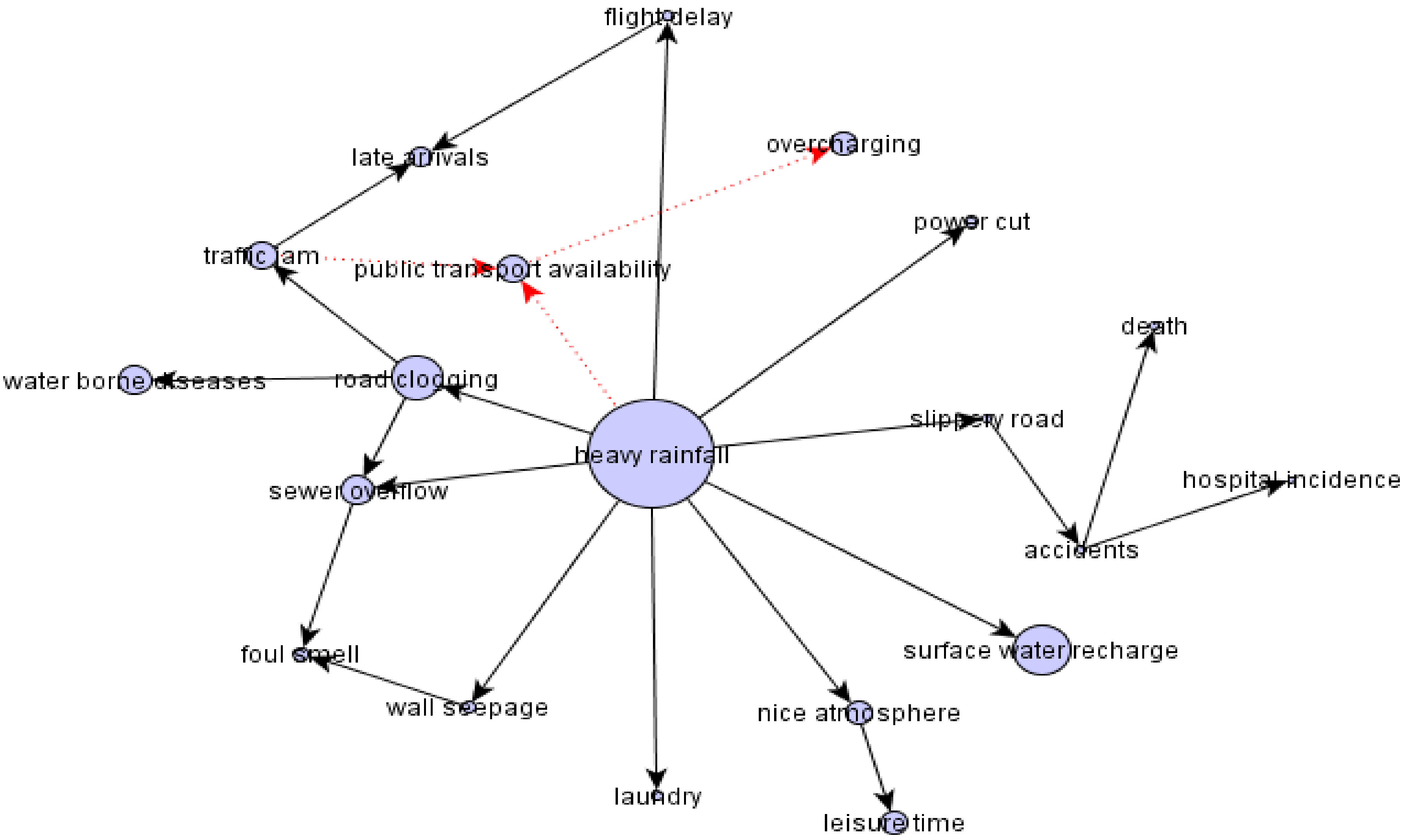


- Negative sign signifies an inversely proportional relationship while a positive sign signifies a directly proportional relationship. They do not signify increase or decrease.
- Can be used by both experts and local communities alike.
- Can be represented via
- *Cognitive Interpretative Diagram*
- *Adjacency vector matrix.*
- Can be carried out using specialised tools: FCMapper, FCMWizard, etc.


Diseases increase
Heat waves
work efficiency decrease
Increase in mosquito
Increased summer temperature
Income reduces
livestock health affected
water availability reduces
Crops are destroyed
Fodder reduced

Group activity


HEAVY RAINFALL
flight delay
3
late arrivals
9
traffic jams
-5
public transport availability
4
overcharging
-4
-7
power cut
5
slippery road
7
death
7
3
accidents
5
hospital incidence
4
surface water recharge
6
nice atmosphere
6
leisure time
6
laundry
6
wall seepage
6
foul smell
4
sewer overflow
5
5
road clogging
8
9
water borne diseases
4

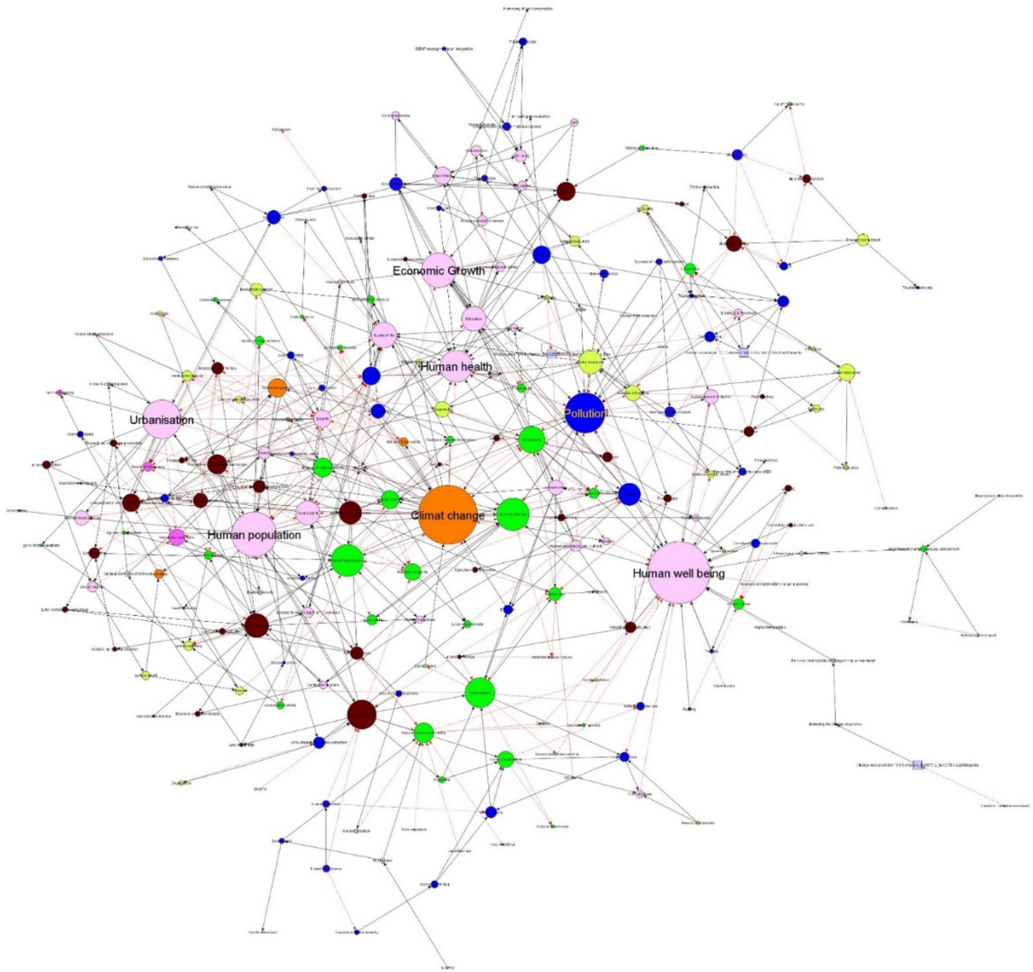

flight delay
late arrivals
overcharging
power cut
traffic jam
public transport availability
death
water borne diseases
road clogging
slippery road
heavy rainfall
hospital incidence
sewer overflow
accidents
foul smell
surface water recharge
wall seepage
nice atmosphere
laundry
leisure time

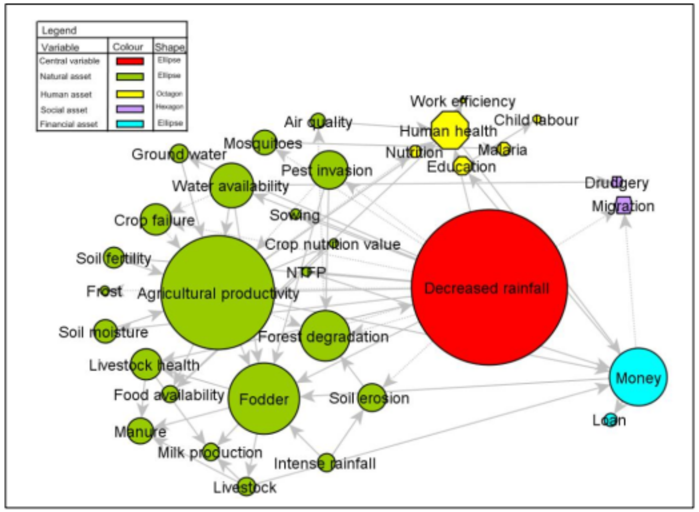
Advantages

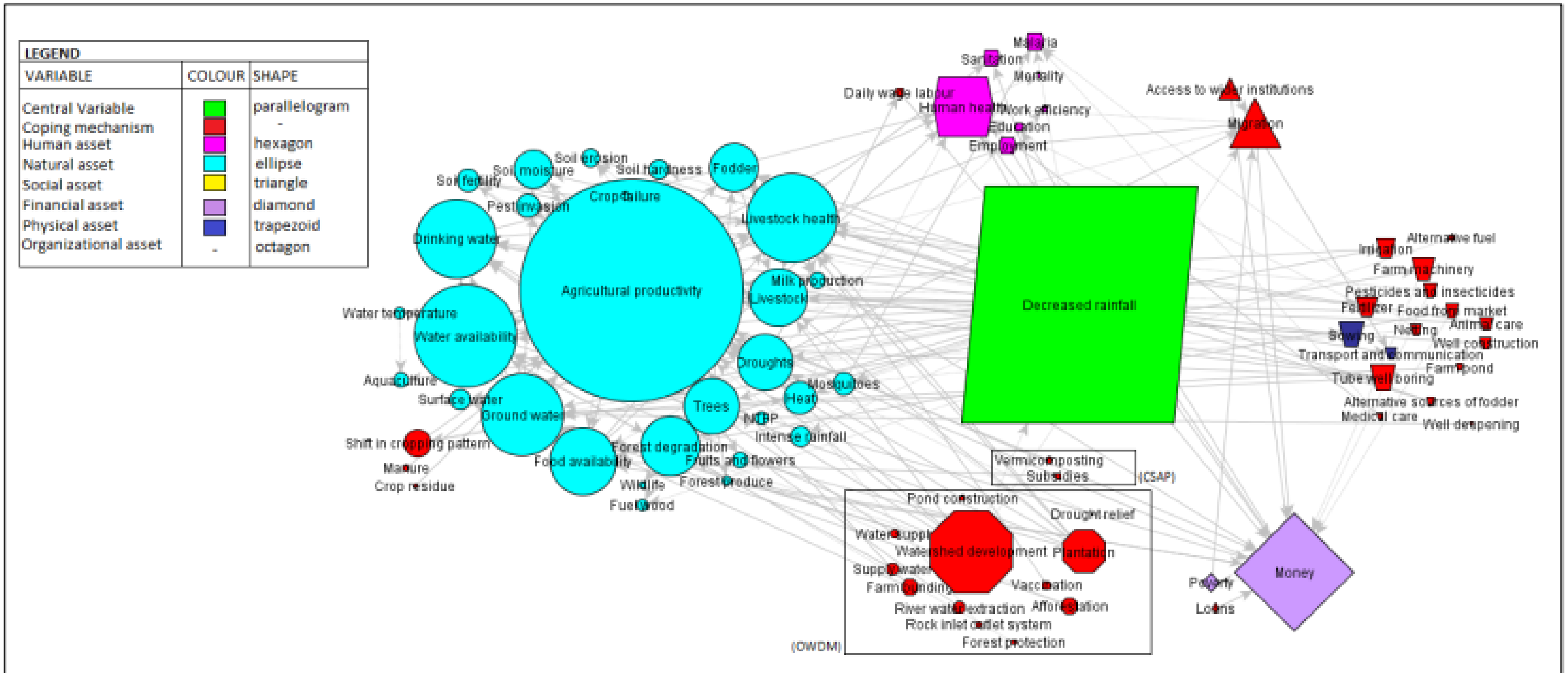
- Engages the stakeholders and utilises their perception.
- Complex systems can be modelled, even those with uncertainty.
- Independent of data availability.
- Reveals hidden important feedbacks in the system.
- Integrates data from multiple sources.
- Multiple policy simulations can be carried out.

Disadvantages

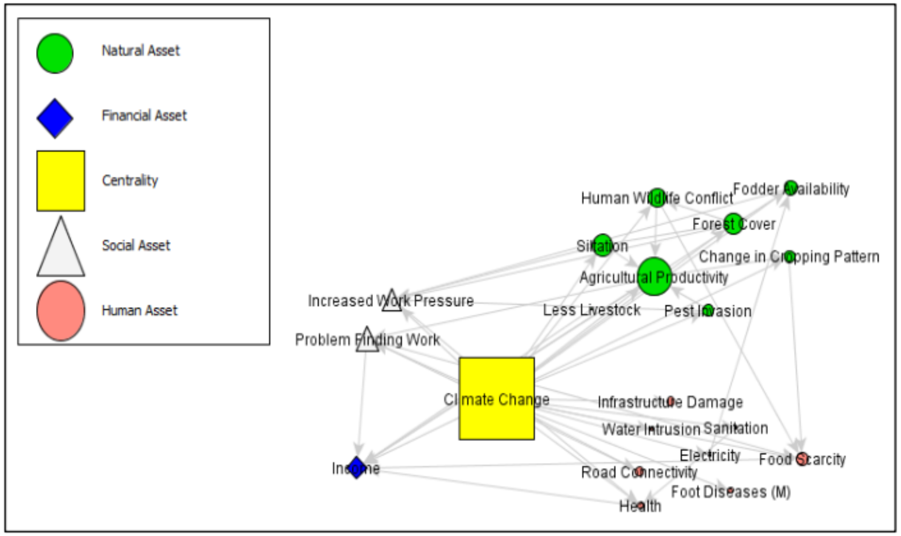
- Participants' misconceptions and biases get incorporated (Monte Carlo Simulation, Aggregation maps).
- Simulation results are relative not real-time.

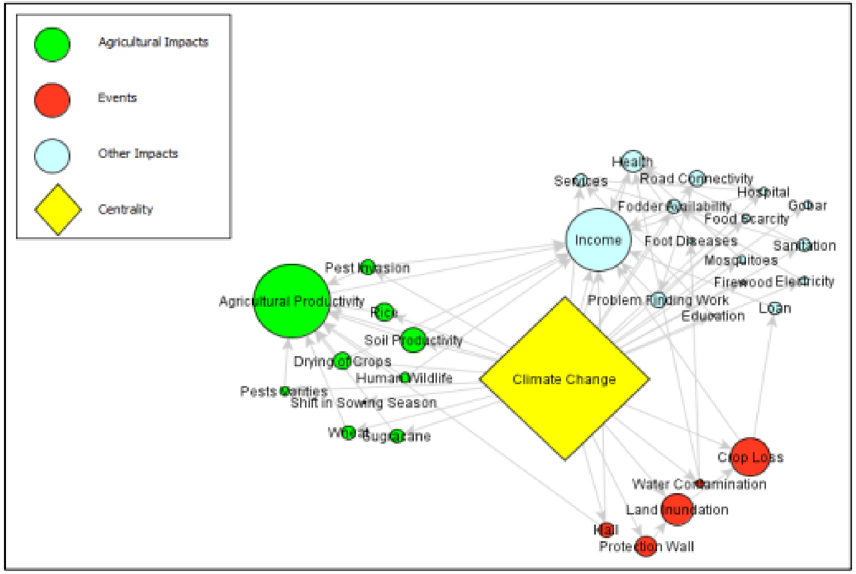

Economic Growth
Human health
Urbanisation
Pollution
Climat change
Human population
Human well being


Legend
Variable
Colour
Shape
Central variable
🟥
Ellipse
Natural asset
🟩
Ellipse
Human asset
🟨
Octagon
Social asset
🟪
Hexagon
Financial asset
🟦
Ellipse
Work efficiency
Air quality
Child labour
Human health
Mosquitoes
Ground water
Nutrition
Malaria
Education
Pest invasion
Water availability
Drudgery
Migration
Sowing
Crop failure
Crop nutrition value
Soil fertility
NTFP
Frost
Agricultural productivity
Decreased rainfall
Soil moisture
Forest degradation
Livestock health
Money
Food availability
Fodder
Soil erosion
Loan
Manure
Milk production
Intense rainfall
Livestock



BALANGIR: Decreased rainfall CID for all scales


Natural Asset
Financial Asset
Centrality
Social Asset
Human Asset
Human Wildlife Conflict
Fodder Availability
Forest Cover
Siltation
Change in Cropping Pattern
Agricultural Productivity
Increased Work Pressure
Less Livestock
Pest Invasion
Problem Finding Work
Climate Change
Infrastructure Damage
Water Intrusion
Sanitation
Electricity
Food Scarcity
Income
Road Connectivity
Foot Diseases (M)
Health


Agricultural Impacts
Events
Other Impacts
Centrality
Health
Services
Road Connectivity
Hospital
Fodder Availability
Gobar
Food Scarcity
Income
Foot Diseases
Sanitation
Mosquitoes
Firewood
Electricity
Pest Invasion
Agricultural Productivity
Problem Finding Work
Loan
Rice
Education
Soil Productivity
Drying of Crops
Human Wildlife
Climate Change
Pests Varities
Shift in Sowing Season
Wheat
Sugarcane
Crop Loss
Water Contamination
Land Inundation
Hail
Protection Wall

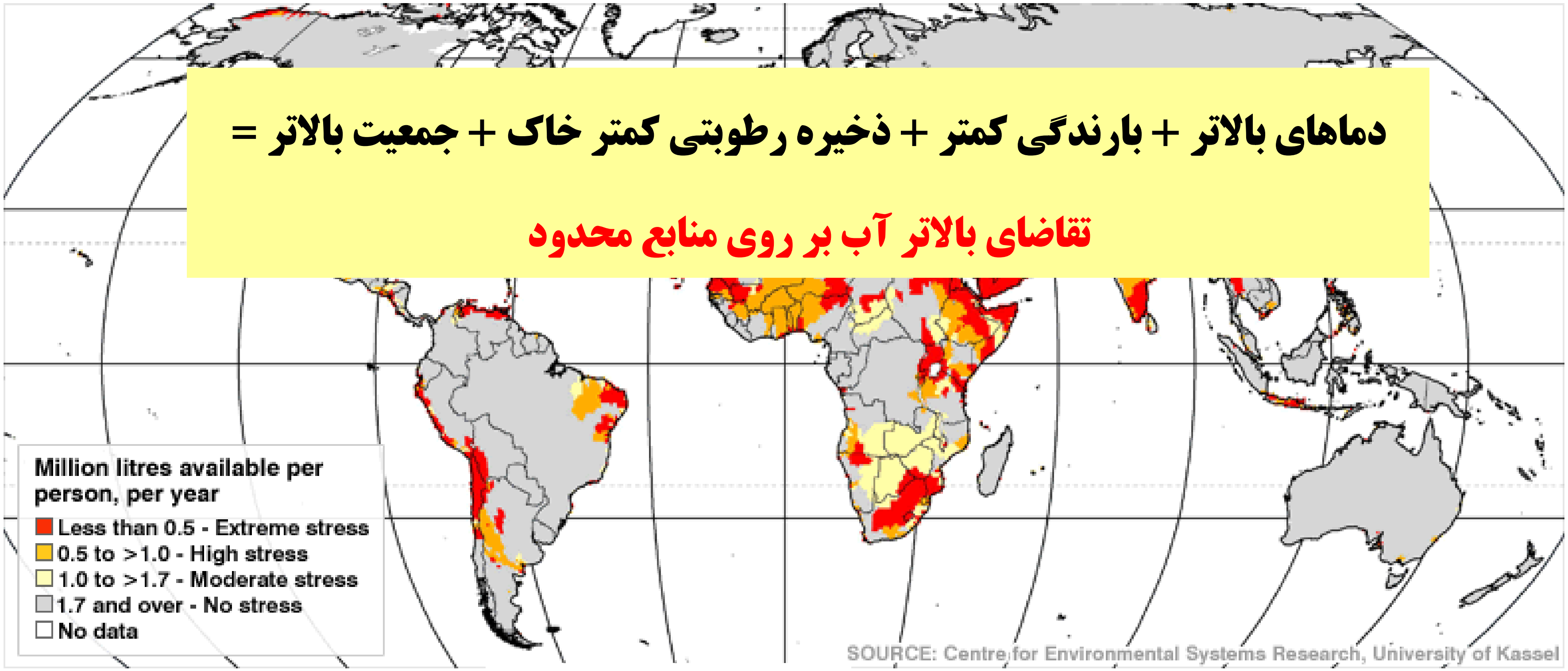
مدیریت منابع آب

مدیریت منابع آب

دماهای بالاتر + بارندگی کمتر + ذخیره رطوبتی کمتر خاک + جمعیت بالاتر =

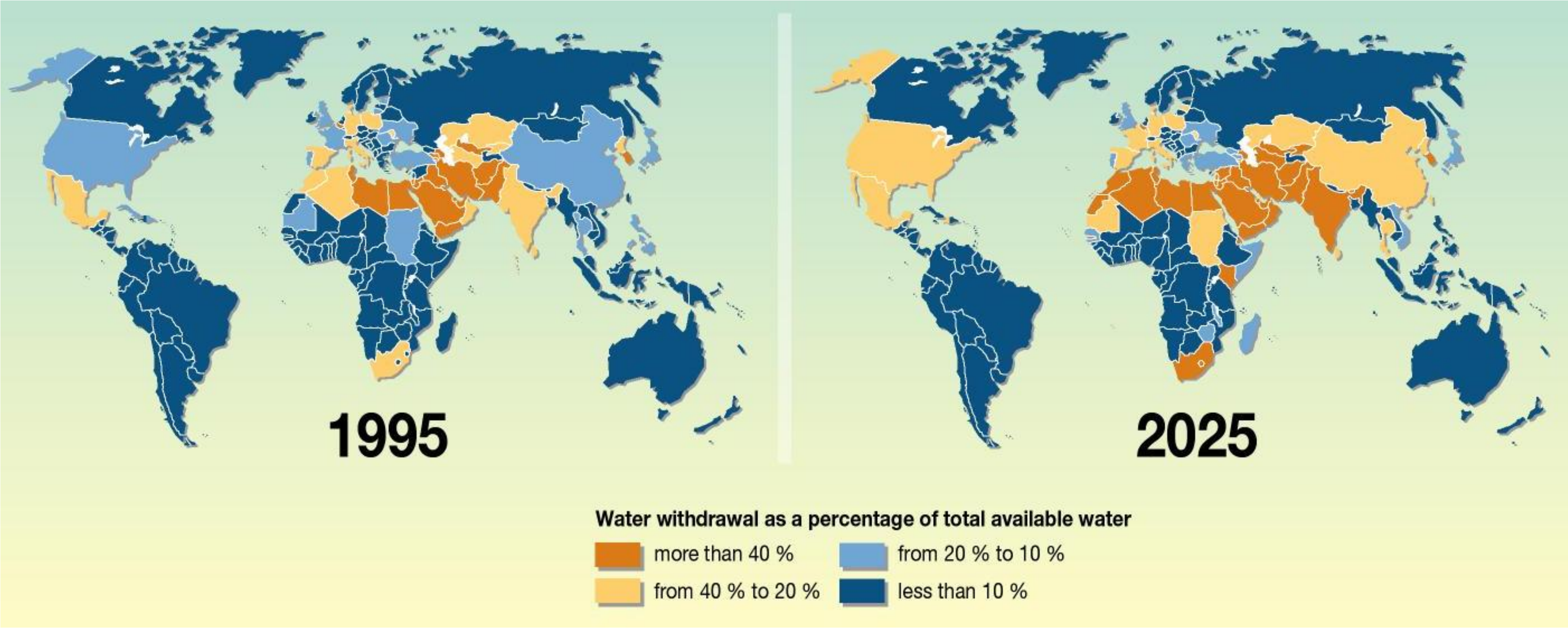
تقاضای بالاتر آب بر روی منابع محدود

2050s



SOURCE: Centre for Environmental Systems Research, University of Kassel

تنش جهانی آب

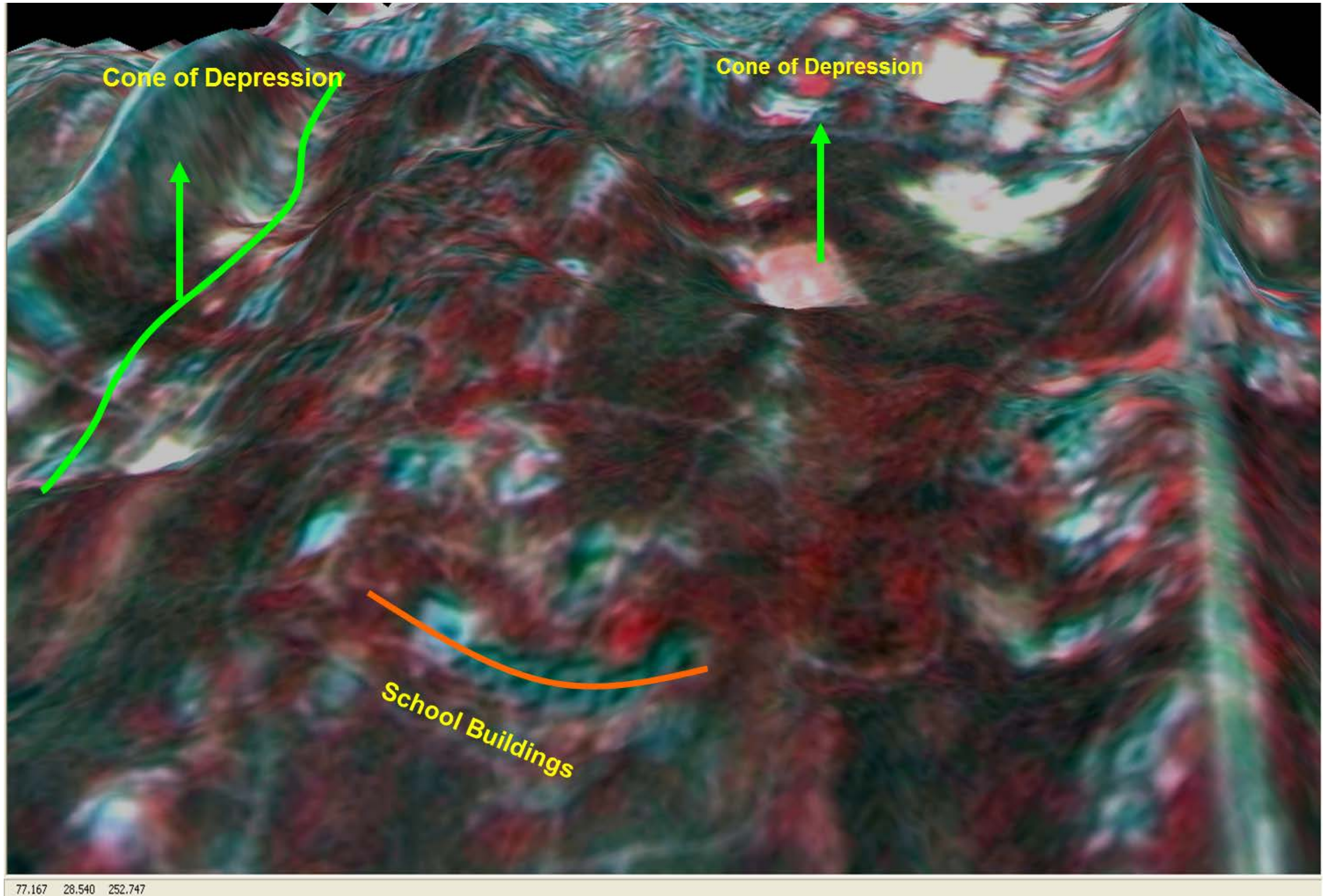

1995
2025
Water withdrawal as a percentage of total available water
more than 40 %
from 40 % to 20 %
from 20 % to 10 %
less than 10 %

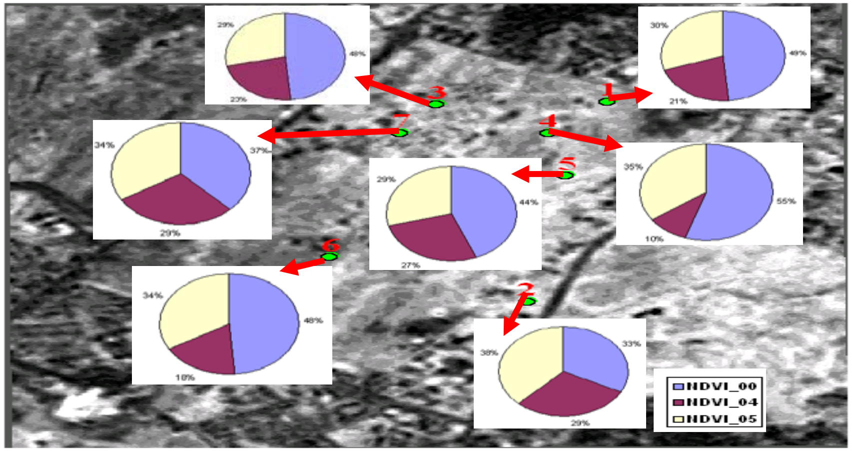
مدیریت منابع آب

- مدیریت منابع آب شامل مجموعه فعالیت های برنامه ریزی، توسعه، توزیع و مدیریت استفاده بهینه از منابع آب می باشد.
- در یک جهان ایده ال، برنامه ریزی مدیریت آب، کلیه مصرف کننده های متقاضی و رقیب را در نظر گرفته و تخصیص را به صورت عادلانه و با رضایتمندی همه ذینفعان انجام می دهد که البته به ندرت اینگونه عملیاتی نمودن ممکن می باشد.
- رویکردهای جدید در تامین آب شهرها معمولا عرضه محور است و این در حالی است که توسعه منابع جدید دارای محدودیت است.
- در حال حاضر، نیمی از جمعیت جهان در شهرها زندگی می کنند که انتظار می رود تا سال ۲۰۵۰ به دو سوم برسد.
- بنابراین، مدیریت منابع آب (WRM) یک مسأله و چالش اساسی شده است. لذا نیاز به دیدگاه جامع تری در مقوله مدیریت منابع آب نسبت به رویکردهای متعارف داریم.

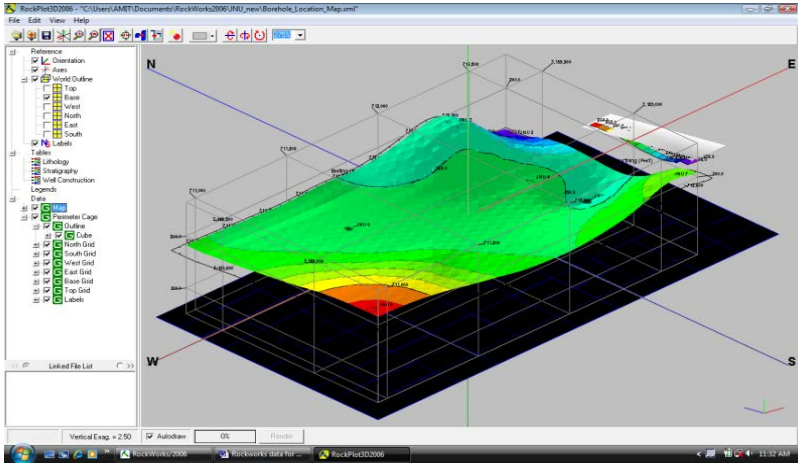
مدیریت کمی منابع آب با استفاده از تکنیک های cutting-edge

دید سه بعدی



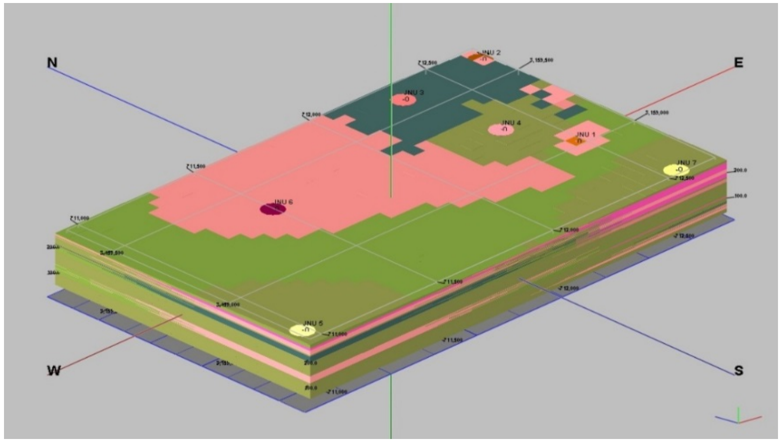


ANOMALOUS NDVI VALUES

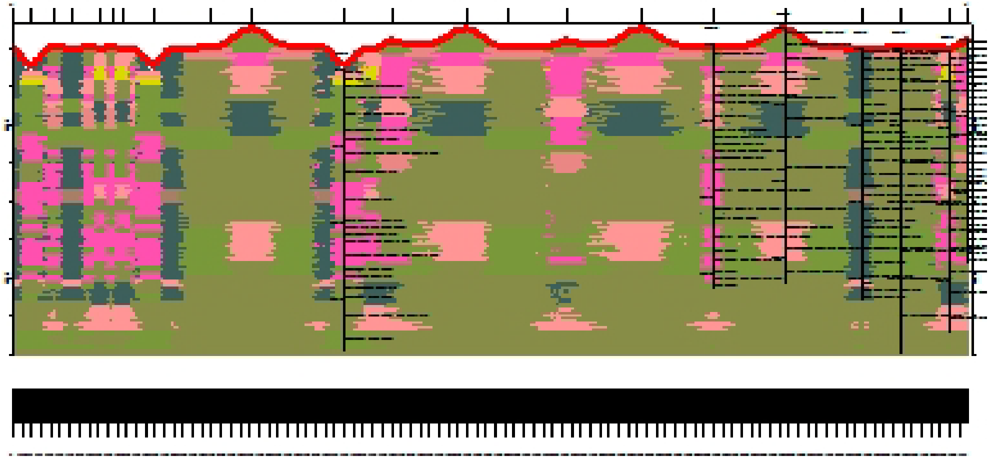


3D ELEVATION CONTOURS

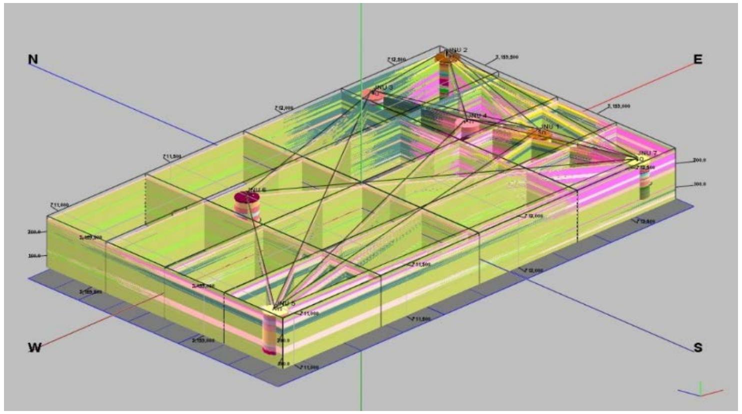
STRIPLOGS OF DRILLING SITE



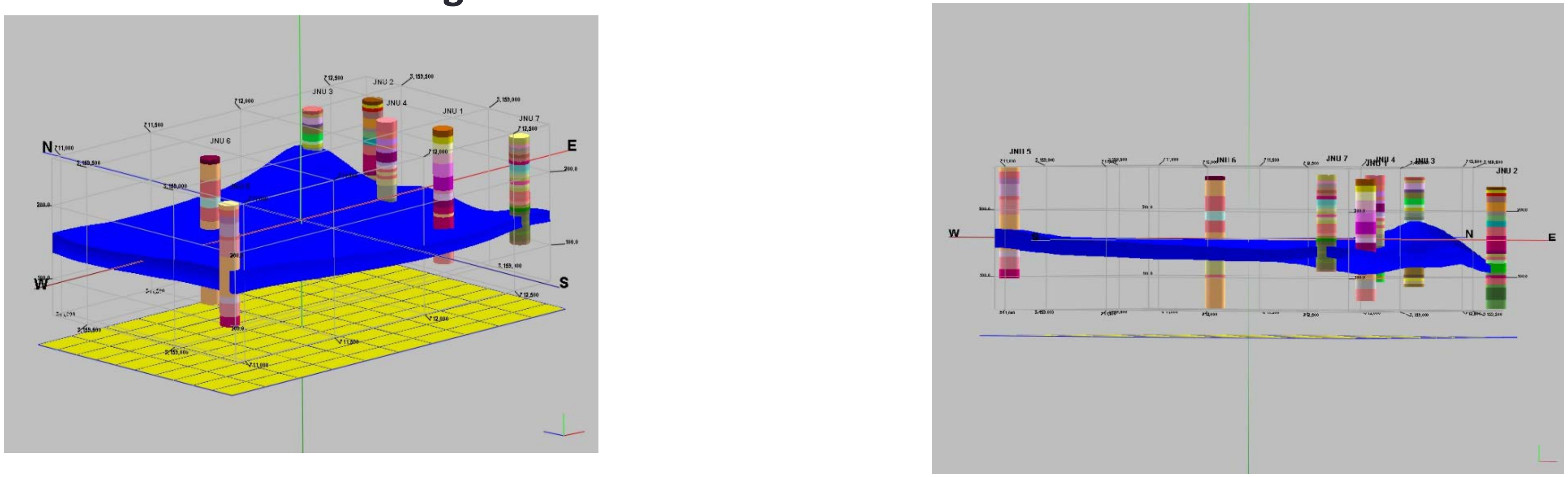
LITHOLOGY SOLID MODEL



Sliced panel from Lithology Solid Model across drilling sites

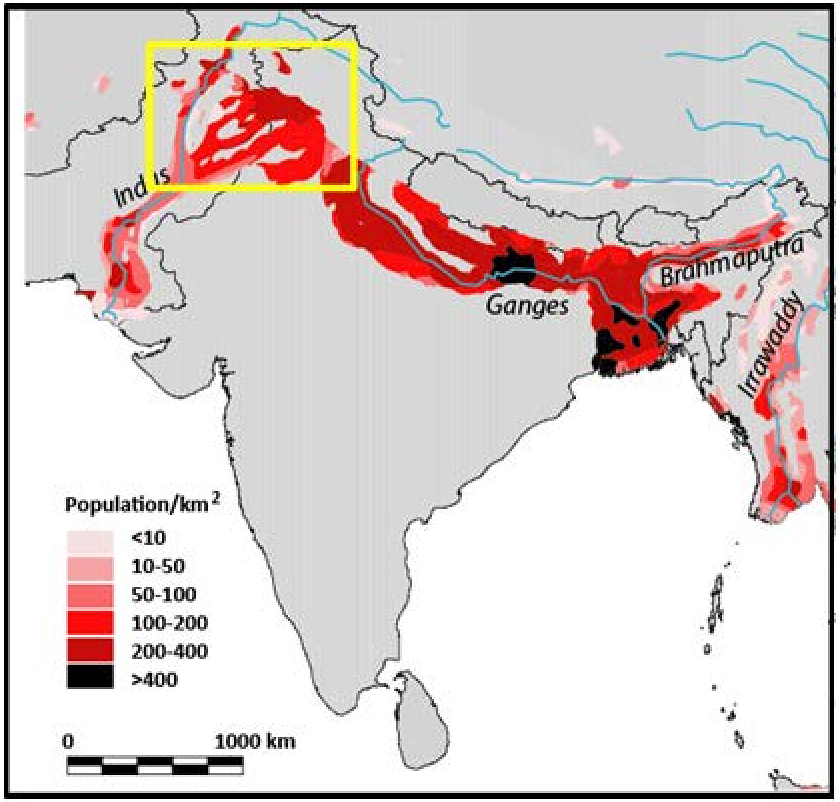


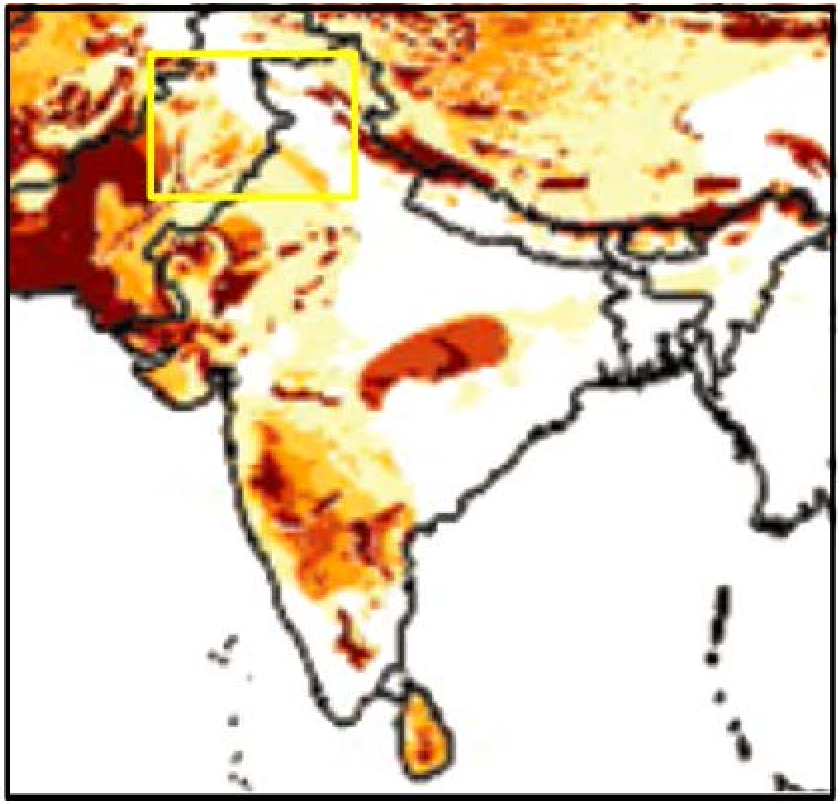
3-Dimensional Fence Diagram



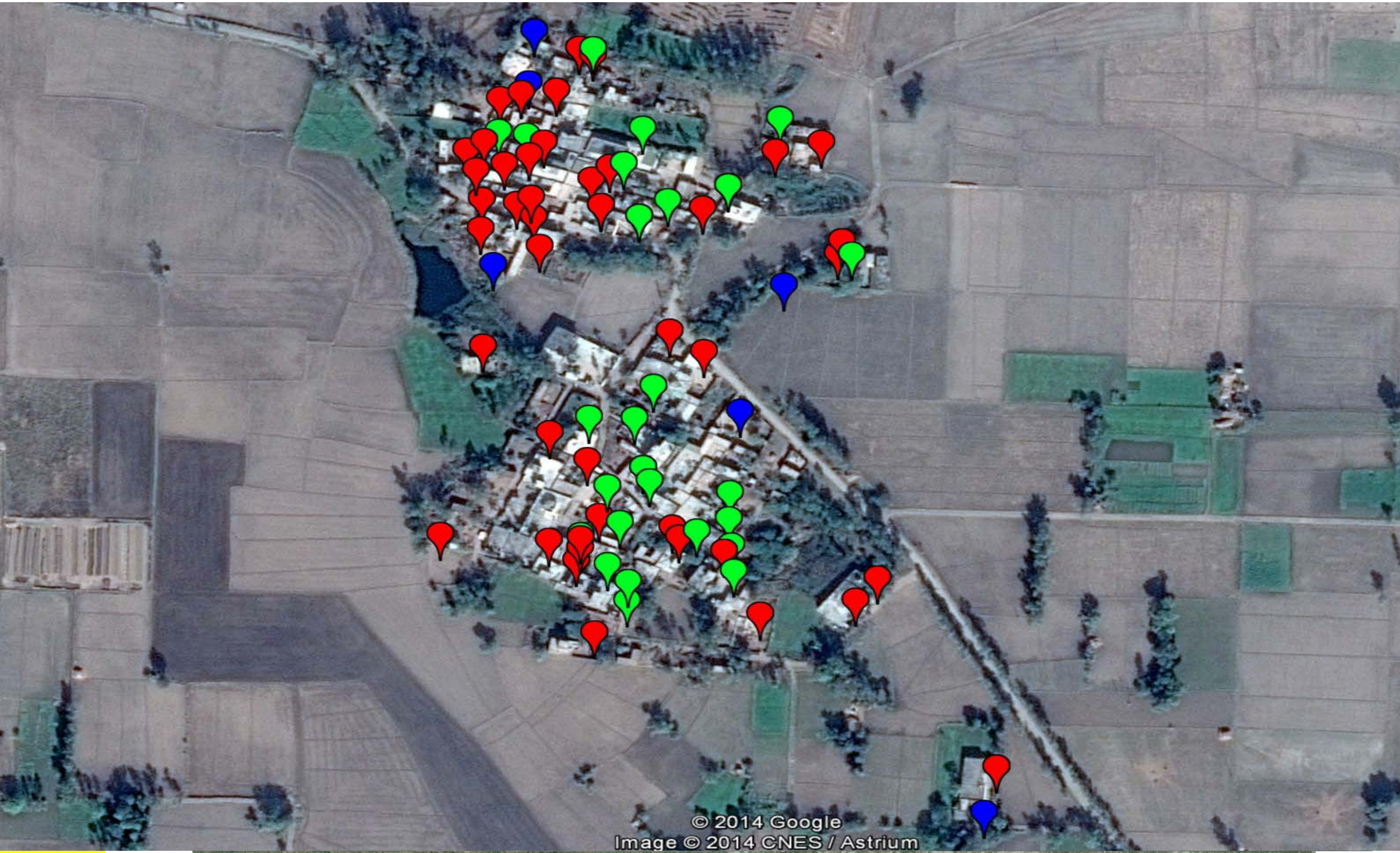
3-DIMENSIONAL AQUIFER MODEL

مدیریت کیفی منابع آب با استفاده از مشارکت عمومی





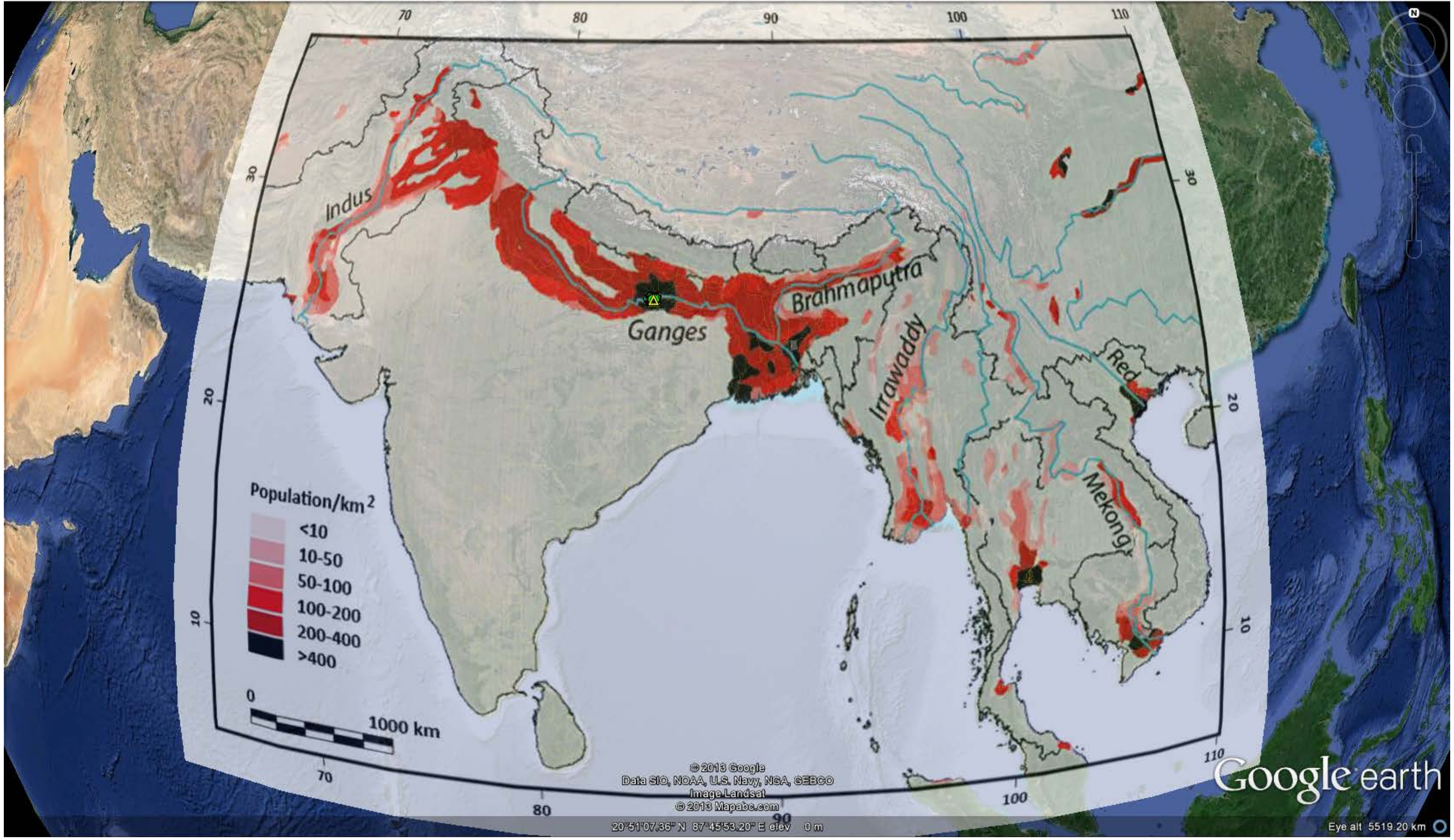
Ravenscroft (2007), modified by van Geen (2011)   Amini et al. (2008).
Yellow box outlines Punjab study area on the two sides of the Pakistan-India border.


© 2014 Google
Image © 2014 CNES / Astrium

Arsenic in Groundwater

- Doubled “all cause mortality” (Argos et al. 2010)
- Largest poisoning of a population in history (Smith et al. 2000)
- Impaired intellectual function in children (Wasserman et al. 2011), cancers (Chen et al. 2004), cardiovascular disease (Chen et al. 2011)
- Spatially heterogeneous distribution of arsenic occurrence
- Difficult to treat groundwater
- Little change over time; opportunity for well sharing
- Failure of public health services: testing and provision of safe drinking water
- Demand preferences can be assessed through contingent valuation or willingness to pay studies and can provide important guidance to decision makers (World Bank Report, 2012).

Floodplains across S/SE Asia with potentially high arsenic

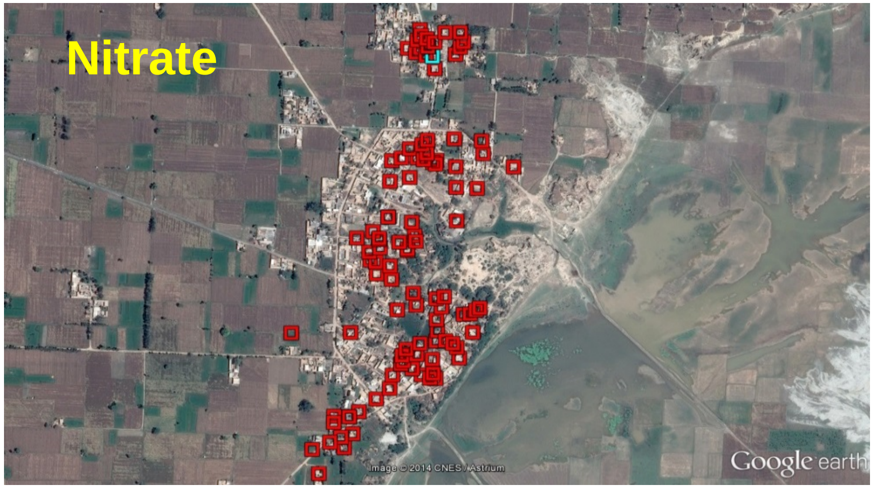


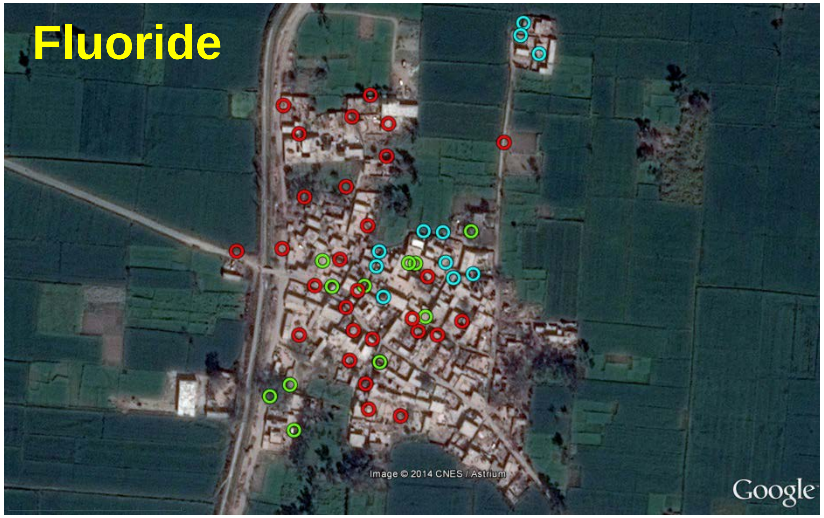
Ravenscroft, 2009

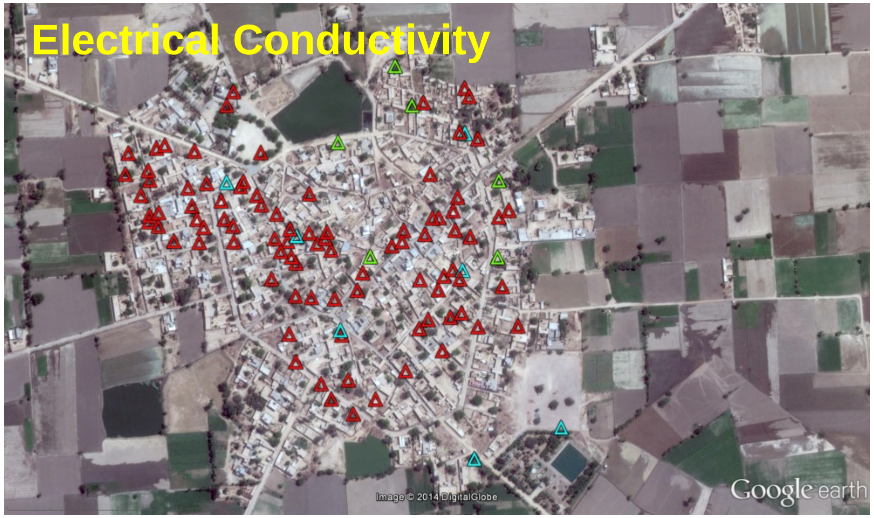
- Estimated 100 million exposed to arsenic >10 ug/L (WHO)
- Main obstacle to exposure reduction: lack of testing

Close-up of Villages


Arsenic


Nitrate


Fluoride


Electrical Conductivity

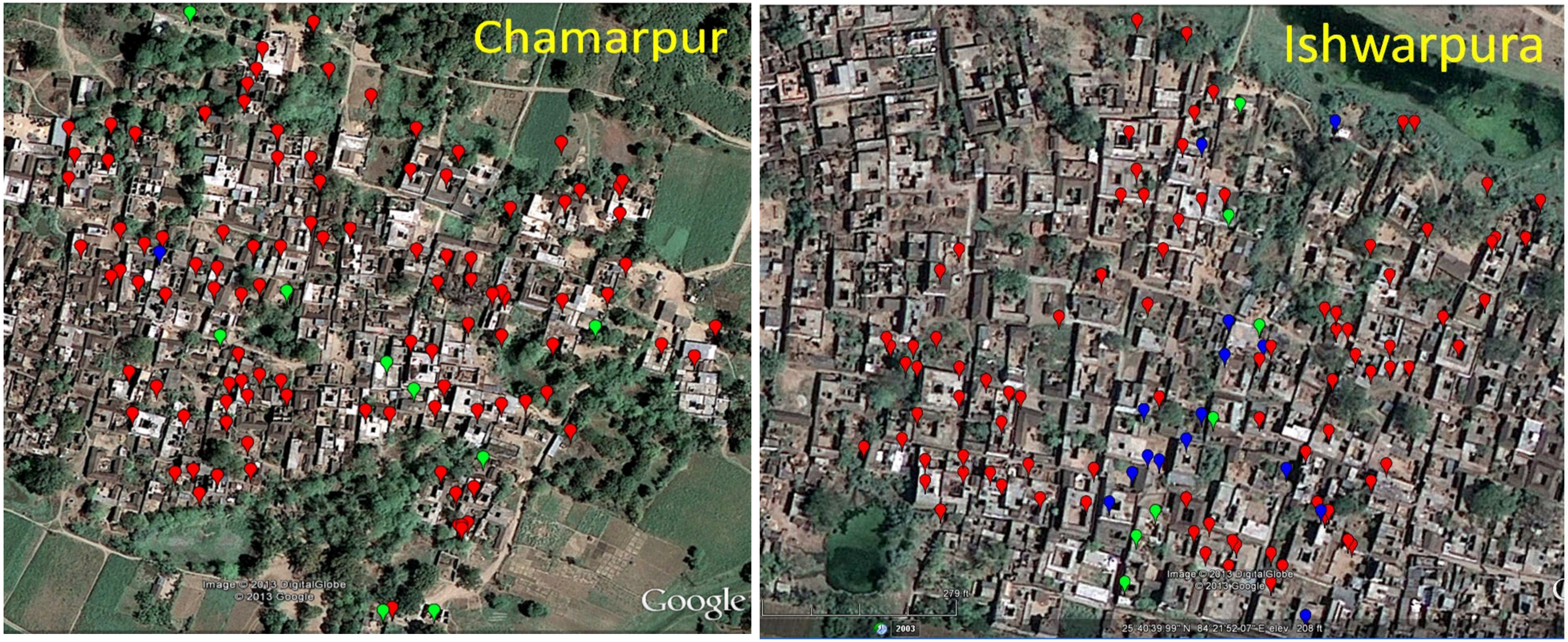
Research Objectives

- **Are households willing to get their wells tested for a fee?**
- **Is there a market for arsenic testing?**
- **What determines the household’s decision to switch to a safer well?**
- **How could more switching to safer wells be encouraged?**

Study design

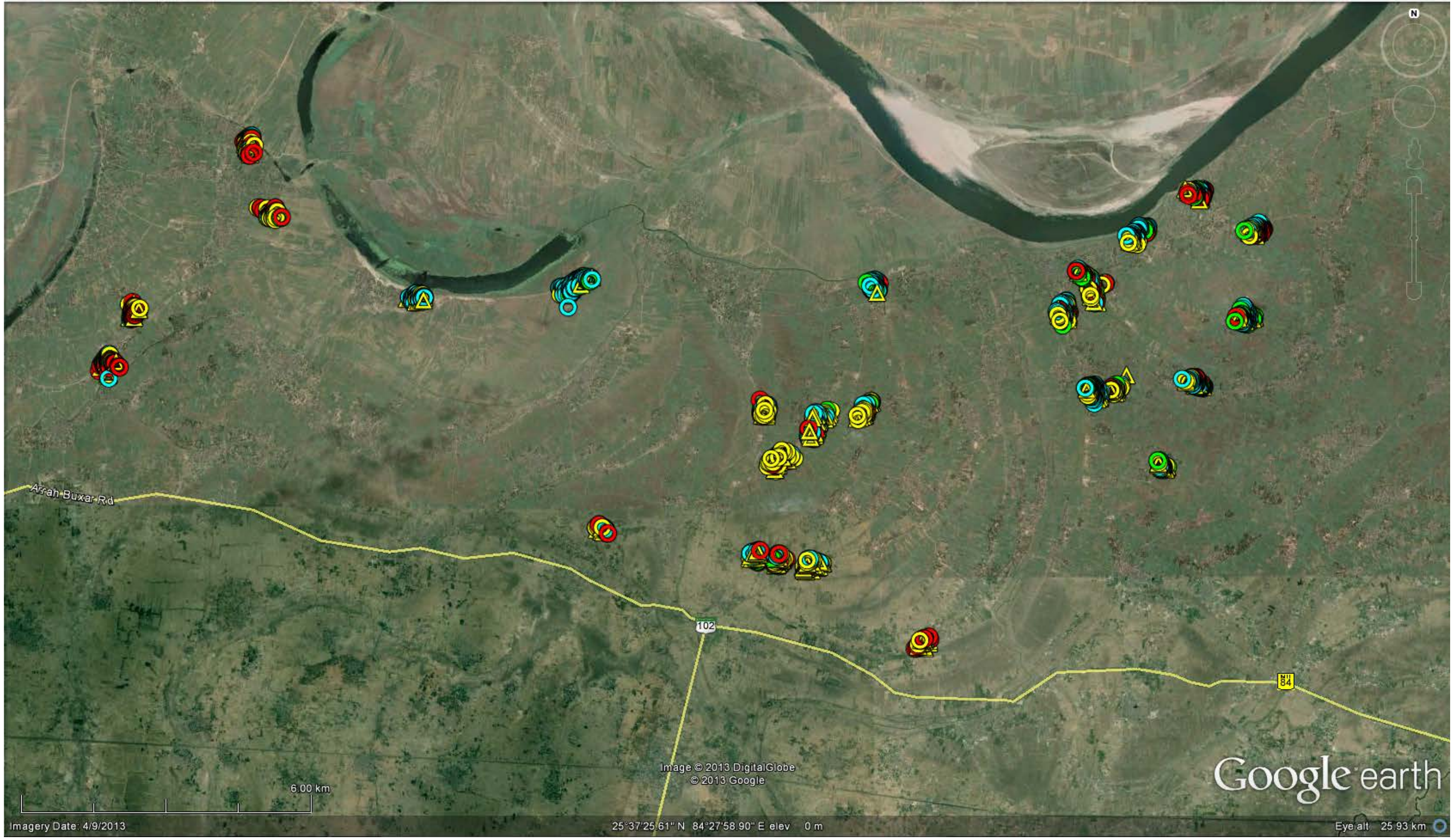
- **Background:**
  - Bhojpur district in Bihar, 26 villages selected ~arsenic occurrence, household numbers, satellite image availability
  - Recruitment of testers, training on testing kits
- **Intervention:**
  - Arsenic test prices (in five groups- Rs 10 to Rs 50) randomly assigned to 5 villages each.
  - Door to door campaign to sell tests to all the households (N~ 1800). Placard: Blue (< 10 ug/L), Green (10- 50 ug/L), and Red (> 50 ug/L) are placed after tests.
  - After testing (N~1200), map of all Blue, Green and Red wells put on display. Red well owners were encouraged to switch to a safer well.
- **Response survey:**
  - Follow up survey after 3-4 months covering all the households (N~1100) with red, green, and blue wells asking for the status of the well they currently draw their water from.

Extent of Arsenic Contamination



Results for two Villages (Chamarpur, Ishwarpura) in Bihar

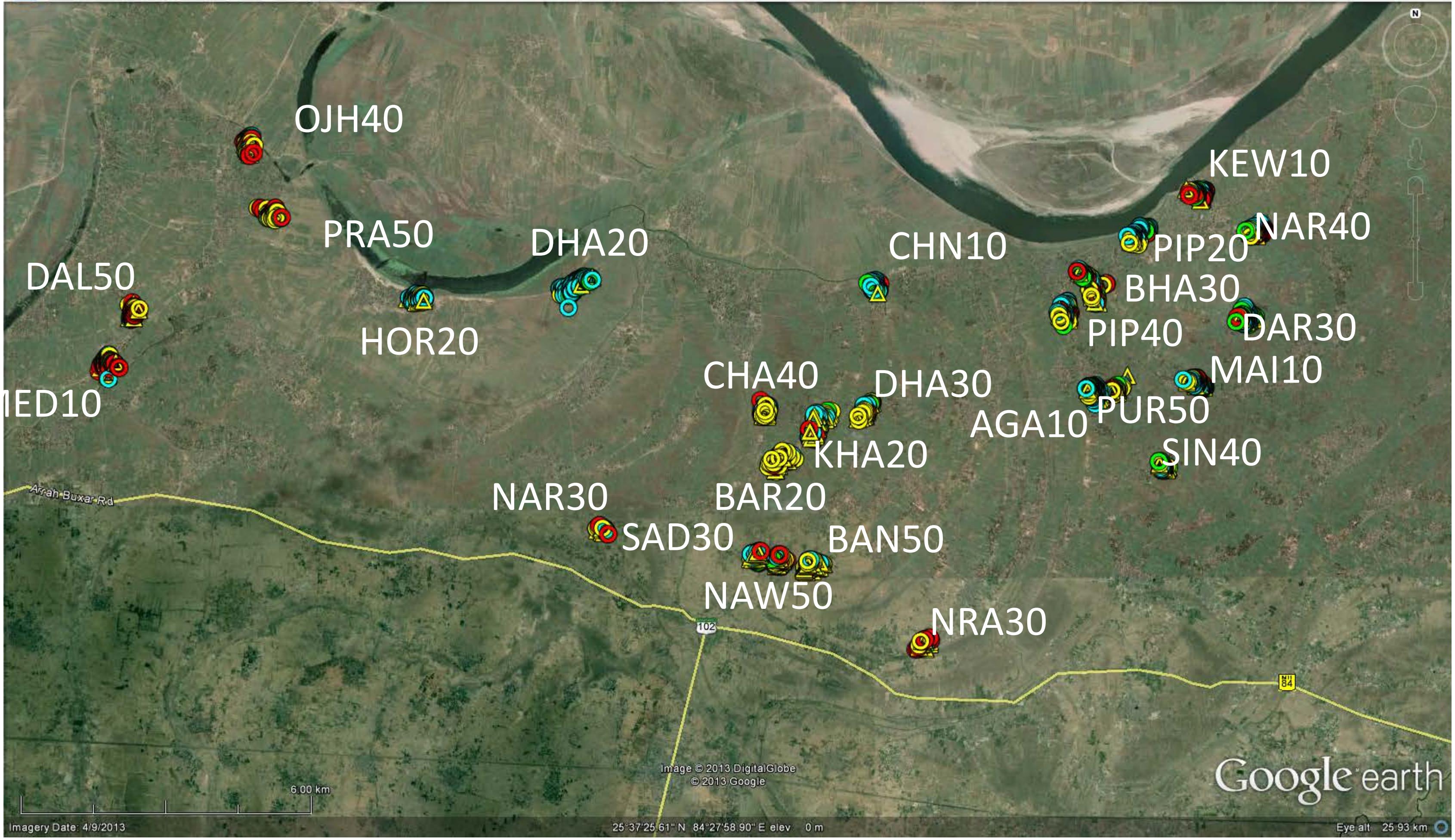
Intervention in Bihar to explore semi-commercial testing



Selected 26 villages in Bihar
Test offered to 1,833 households Oct-Dec 2012
Response survey Feb-Jun 2013

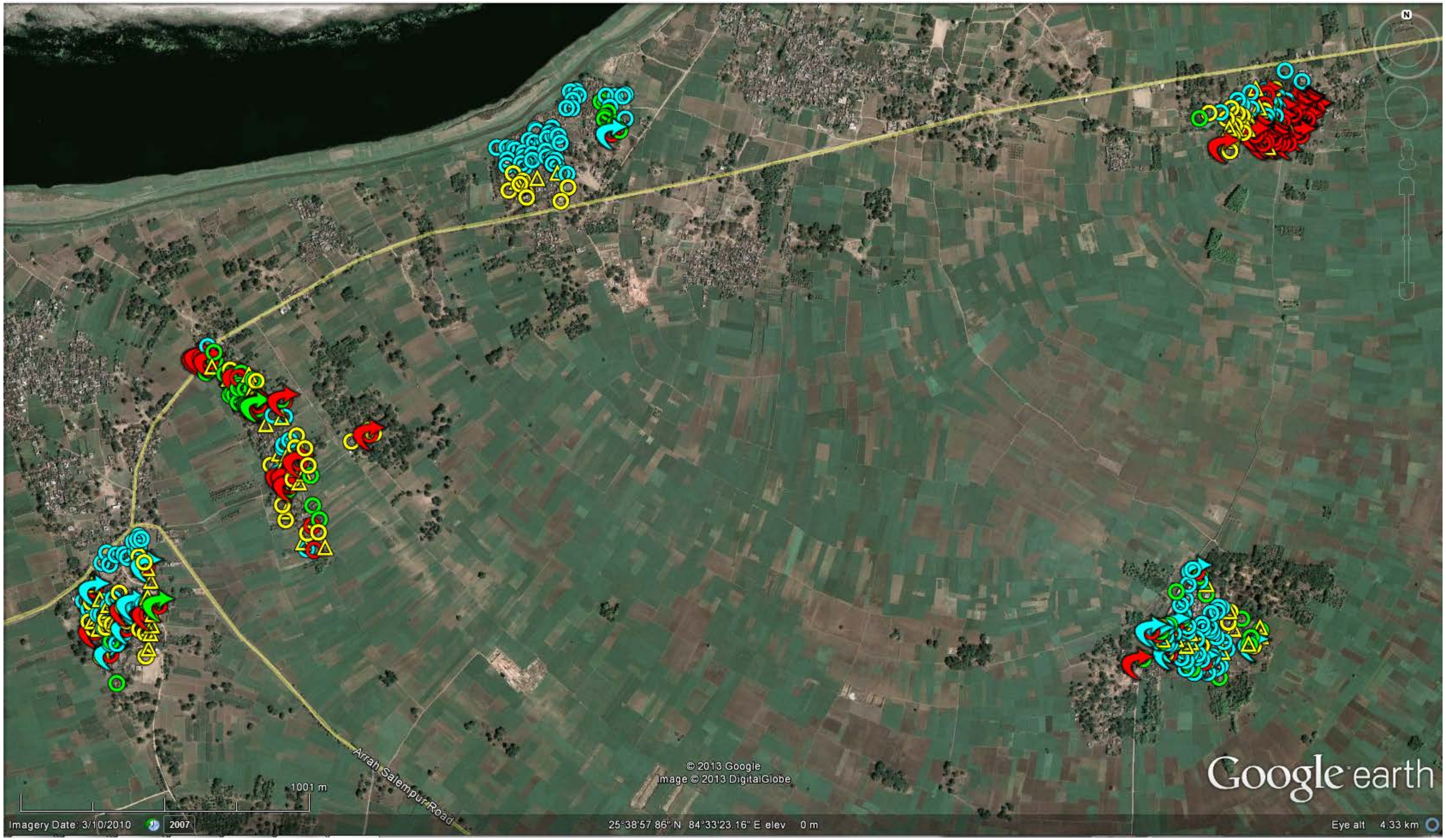
Google Earth map of village to generate interest and disseminate results

Testing offered door-to-door in each village

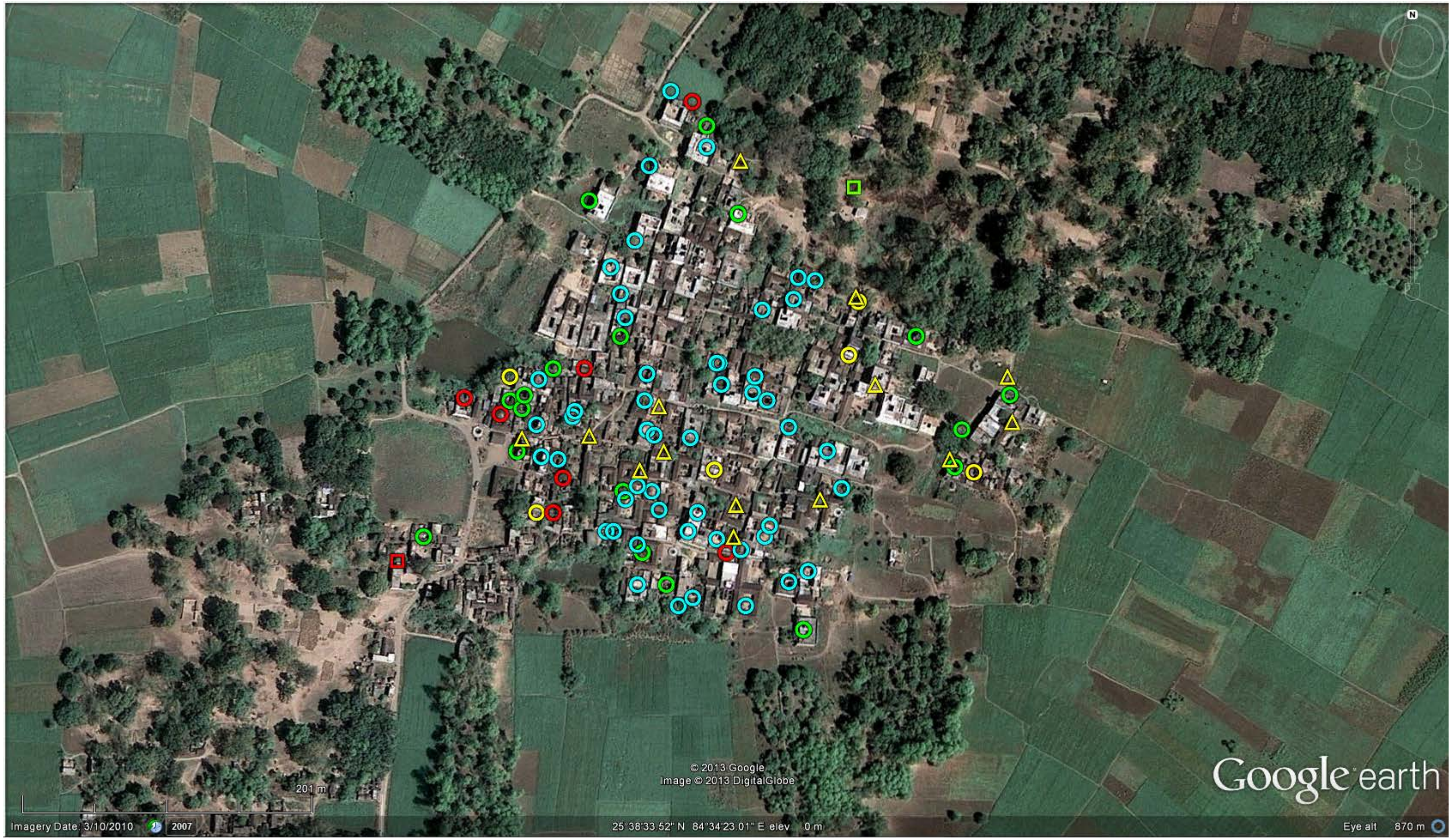


Rs. 10, 20, 30, 40, and 50 per test randomly assigned to each village

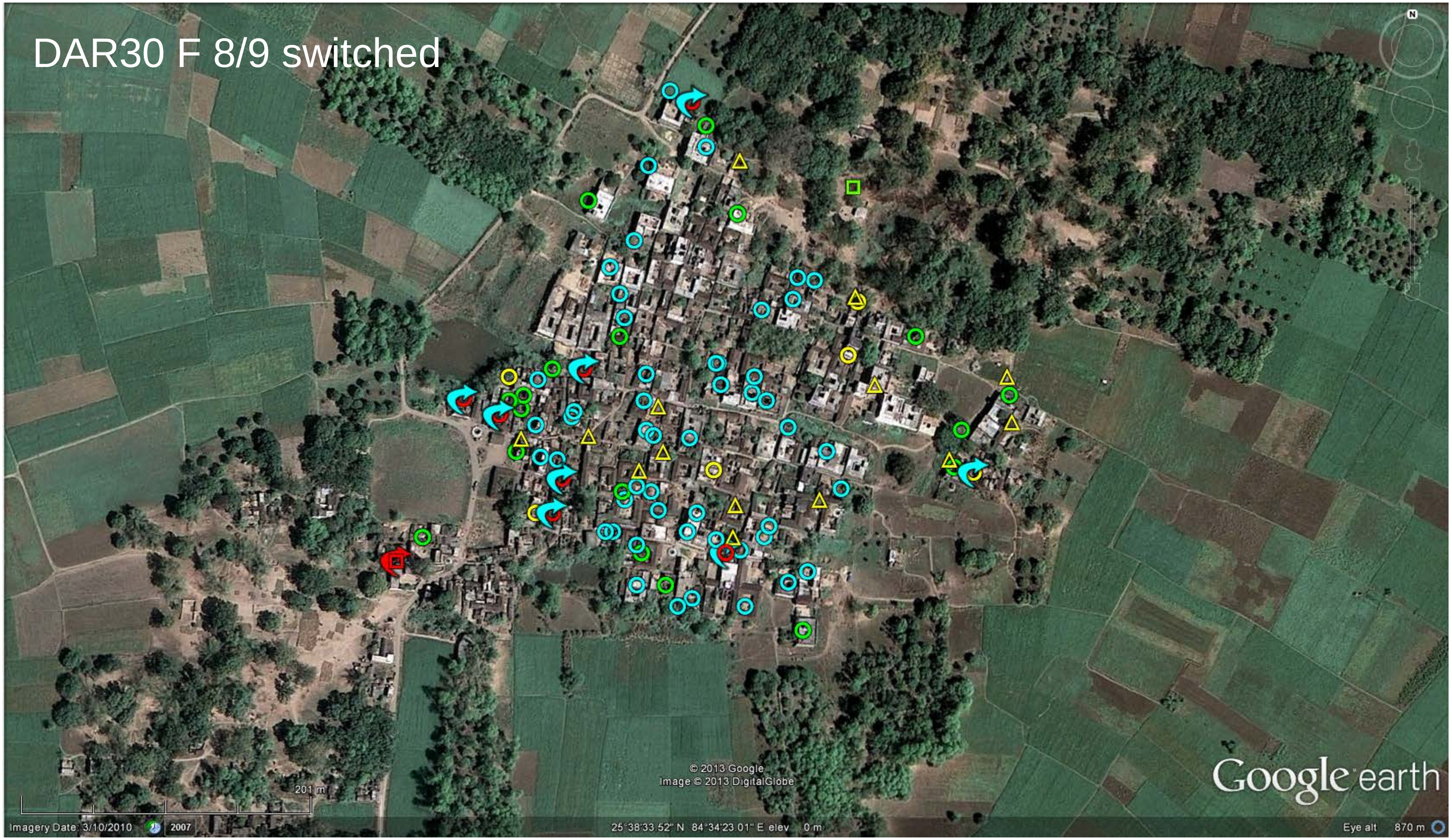
Spatial distribution of test results



Spatial distribution of test results



Household response to testing


DAR30 F 8/9 switched

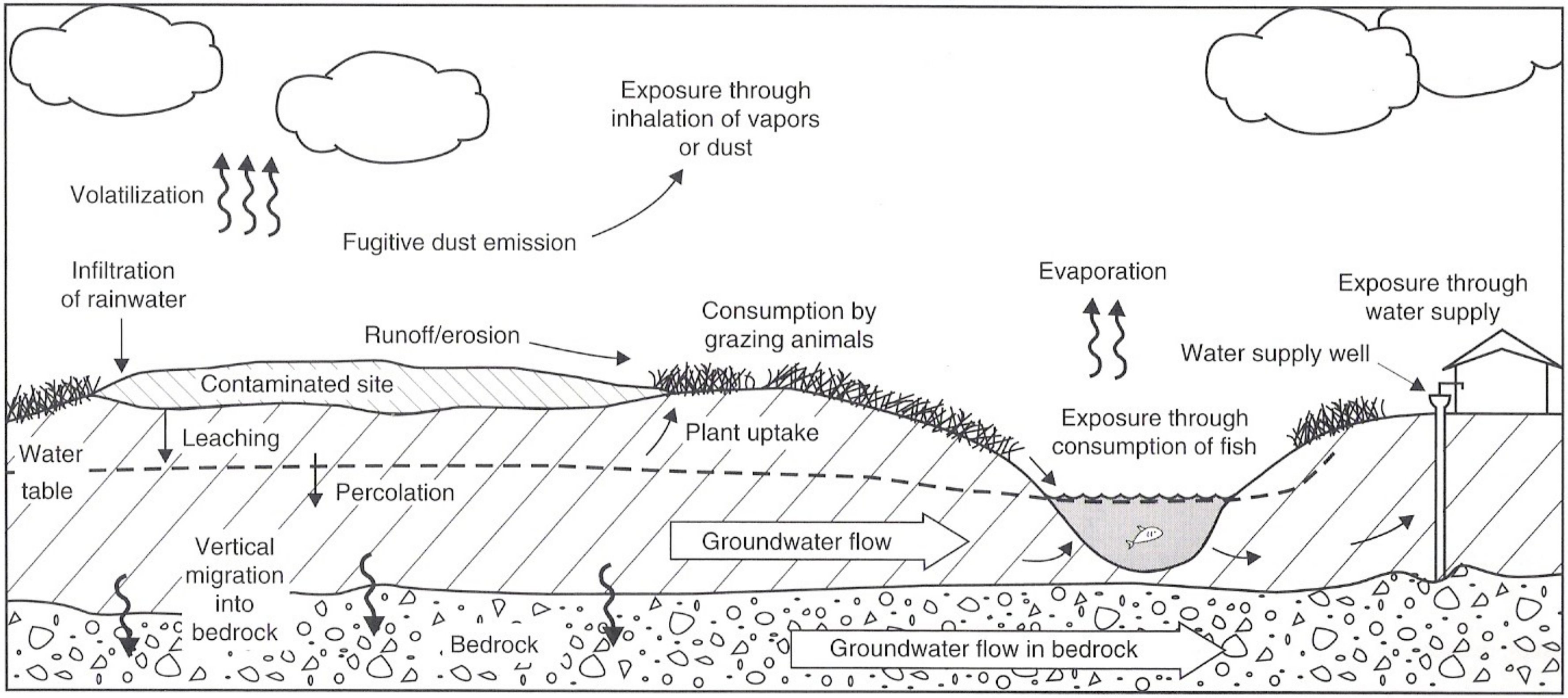
Policy implications

- Possibility of a subsidized market for arsenic well-testing
- Importance of information and awareness campaign
- Need additional effort in poor neighborhoods and backward caste villages
- Community wells at strategic locations may encourage switching

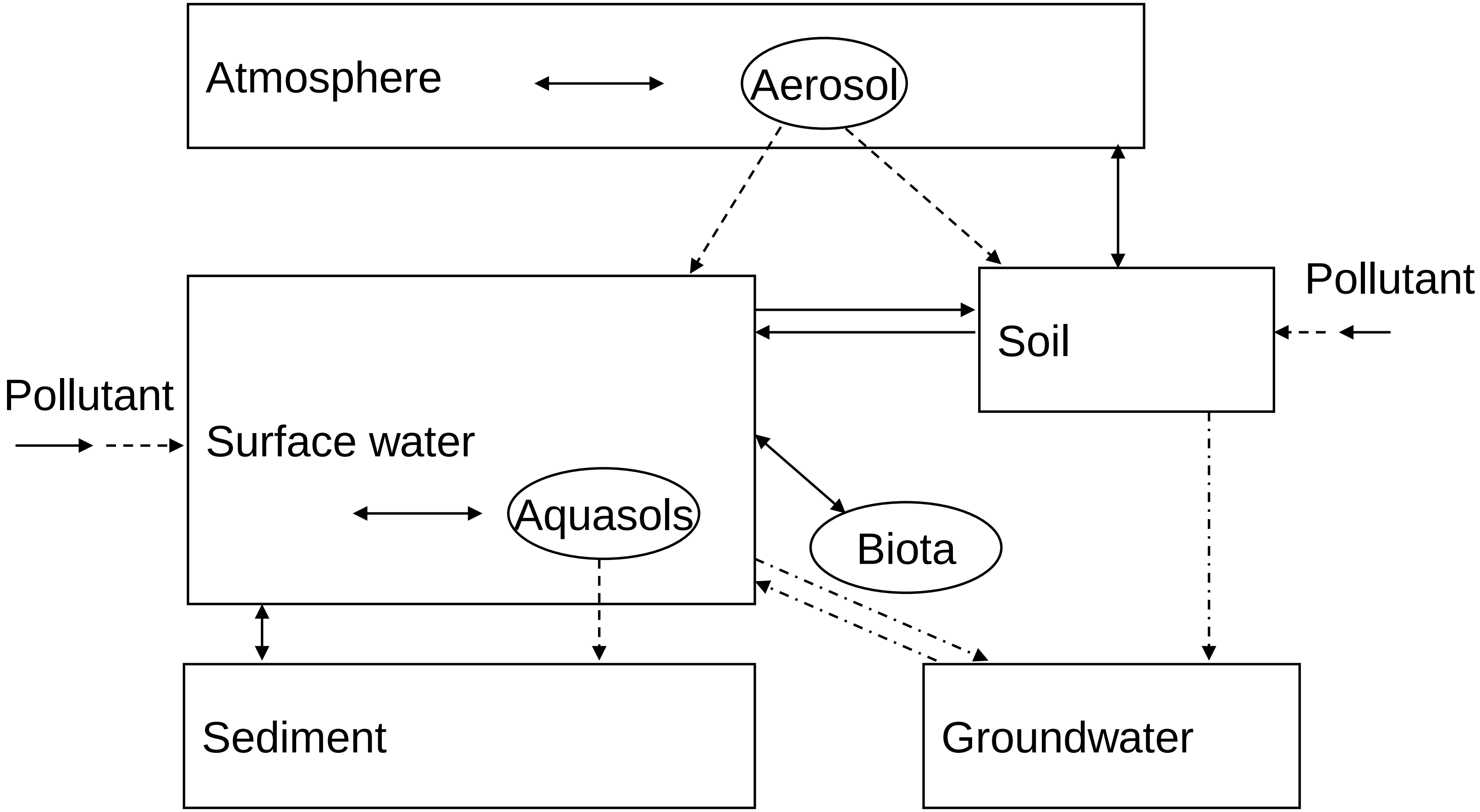
تعریف سناریو با استفاده از مدلسازی ریاضی

تعریف سناریو با استفاده از مدلسازی ریاضی

یک مسأله نمونه چند وجهی آلودگی محیط زیست



مسیر آلودگی از طریق محیط زیست



Atmosphere

Aerosol

Pollutant

Soil

Surface water

Aquasols

Biota

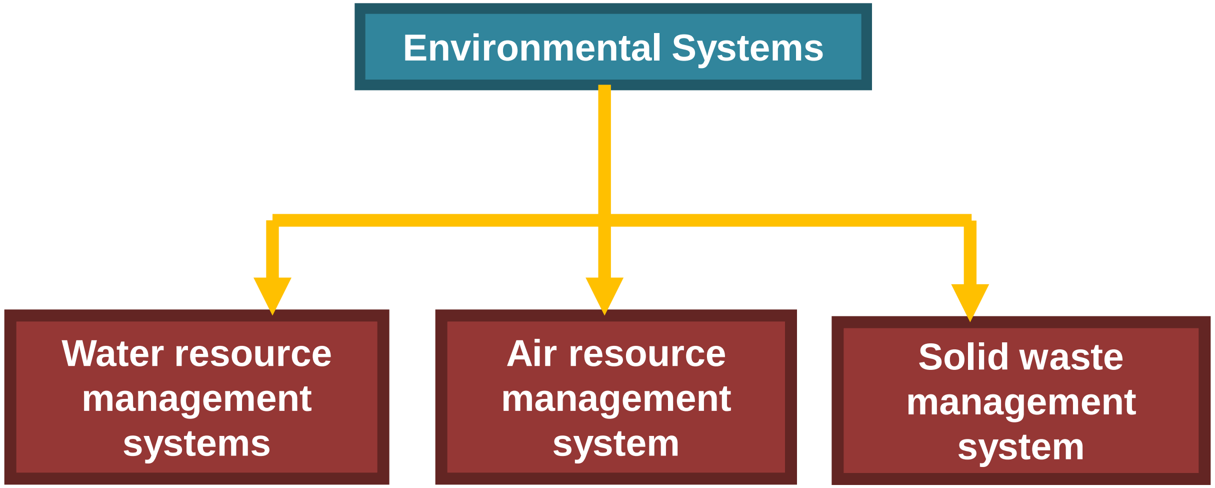
Sediment

Groundwater

معرفی سیستم های زیست محیطی

- مسایل محیط زیستی شامل منابع آب، خاک، هوا و انرژی که شدیدا متأثر از فعالیت های بشری هستند. یک موضوع مهم در این زمینه، کارکرد توآمان بخش های منفرد سیستم بوده که در نهایت ممکن است به نتایج ناخواسته ای منجر شود.

- رویکرد یافتن بخش هایی که با یکدیگر ارتباط درونی داشته و از یکدیگر تأثیر می پذیرند، رویکرد سیستمی نامیده می شود.
- سیستم ها، مجموعه ای از موجودیت ها بوده که کارکردشان در ارتباط با یکدیگر است. مطالعه ترکیب و کارکرد متقابل آنها، تحلیل سیستم نامیده می شود.



Environmental Systems

Water resource management systems

Air resource management system

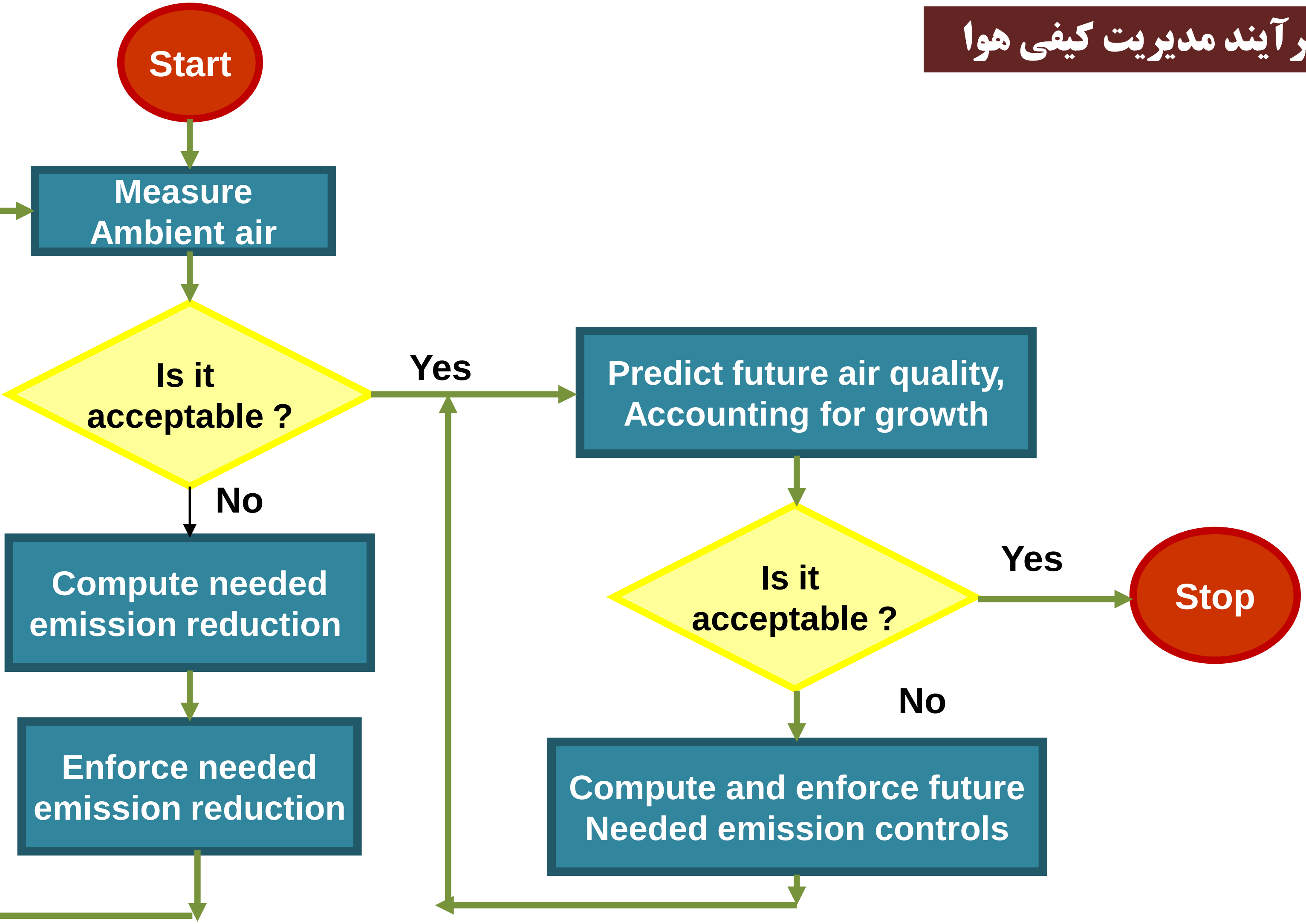
Solid waste management system

سیستم مدیریت هوا

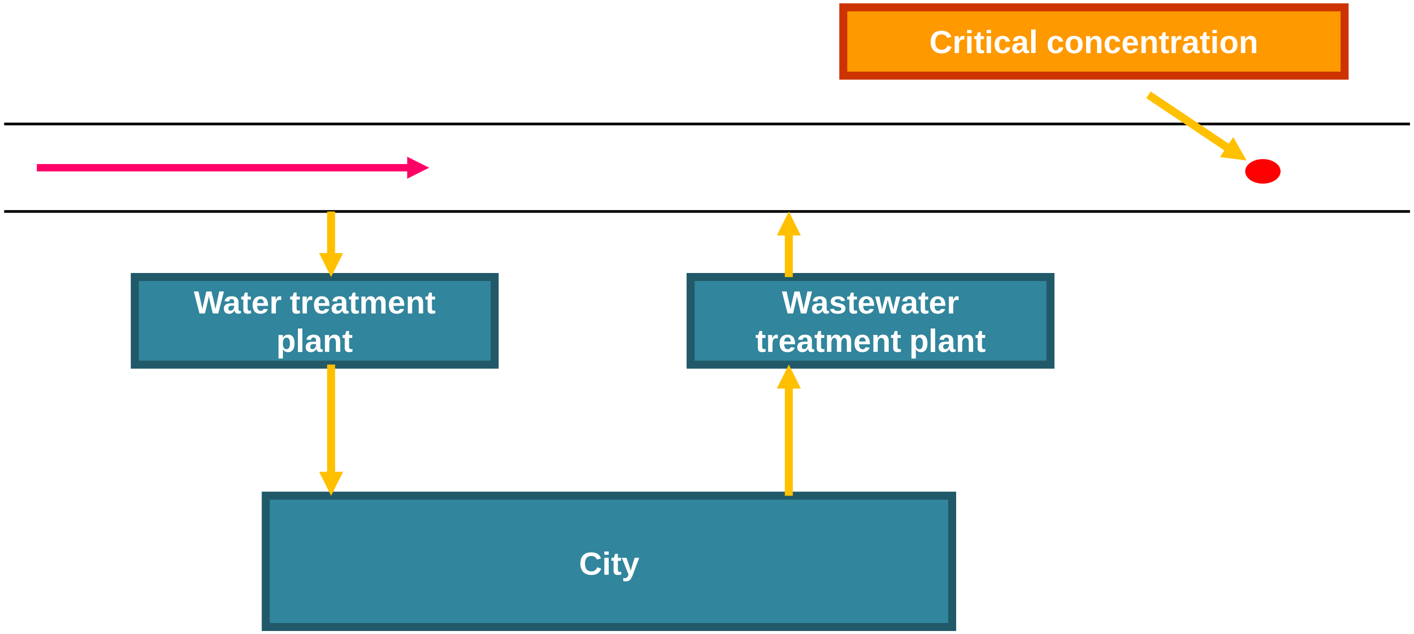
مؤلفه های یک سیستم مدیریت هوای شهری می تواند شامل مؤلفه های ذیل باشد:

- ❖ شبکه پایش کیفی هوا
- ❖ فهرست مواد منتشره
- ❖ مدل های پیش بینی
- ❖ استانداردهای کیفی هوا
- ❖ مطالعات انجام اقدامات کاهش مواد آلوده کننده (**Emission Reduction**) منتشره مقرون به صرفه و کارآمد (**Cost-effective**)
- ❖ مجموعه اقدامات و استراتژی ها همراه با سیستم اجرایی موردنیاز

فرآیند مدیریت کیفی هوا



یک سیستم فاضلاب شهری



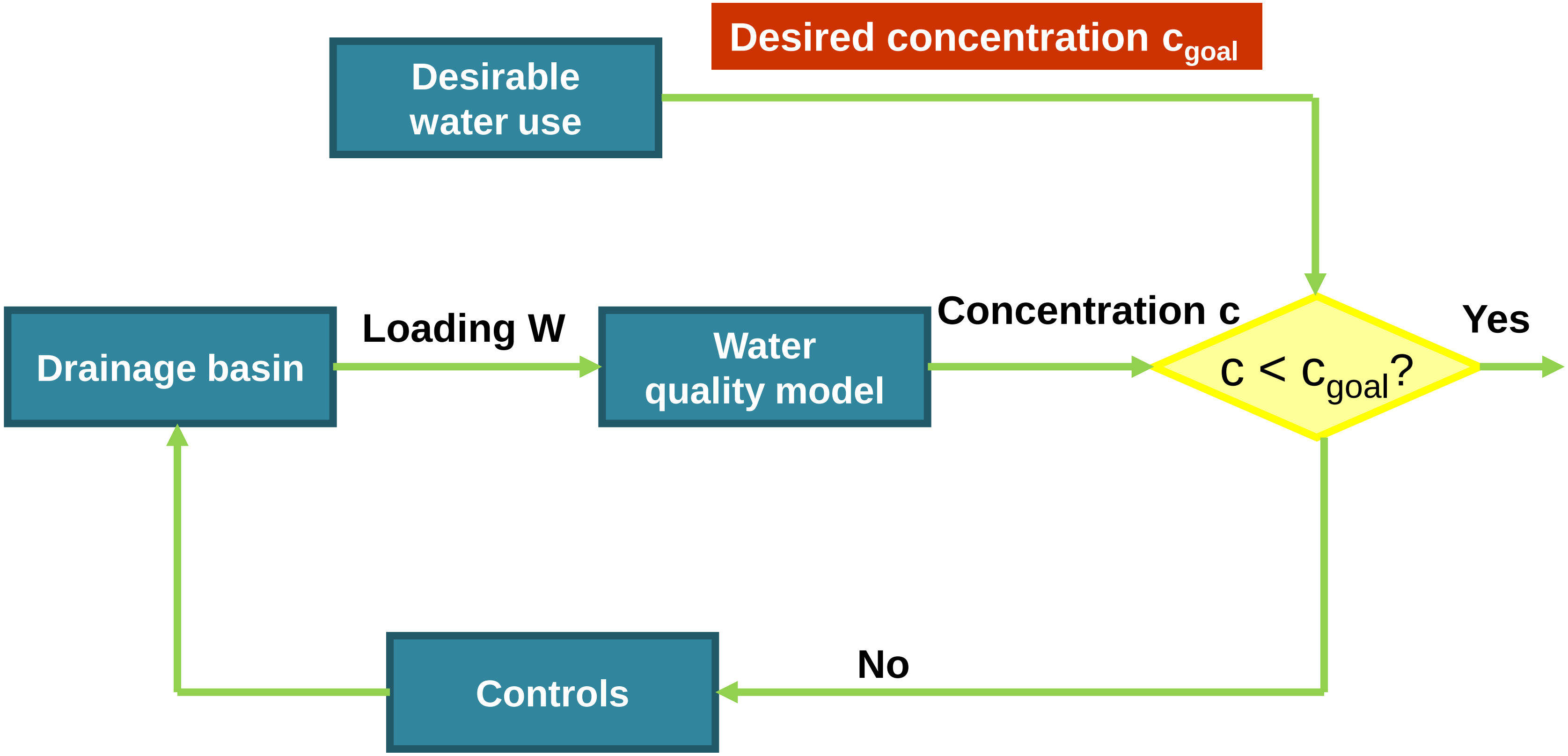
Critical concentration

Water treatment plant

Wastewater treatment plant

City

فرآیند مدل کیفی آب



تعریف مسأله و محدوده آن

❖ برای محاسبه چند نوع مشخص از آلودگی در زمان و مکان معین در اتمسفر، می بایست سیستمی را تعریف نمود که غلظت آلودگی های موردنظر را به غلظت دیگر پارامترها به وسیله روش های ریاضی، فیزیکی و آماری ارتباط دهد. چنین شیوه ای مدل نامیده می شود.

رویکرد مدلسازی

❖ مسأله اساسی کلیه مطالعات مدلسازی سیستم های زیست محیطی، شناسایی تابع ”F“ ای است که بتواند غلظت آلودگی $C(x, y, z, t)$ را در هر نقطه مکانی (x, y, z) و در زمان (t) با شرط معلوم بودن بار آلودگی و دیگر متغیرهای فیزیکی سیستم ارایه دهد.

سه رویکرد مختلف برای شناسایی F وجود دارد:

- ❑ مدلسازی ریاضی معین و قطعی
  - ➢ مدلهای تحلیلی
  - ➢ مدلهای عددی
- ❑ مدل های آماری
- ❑ مدل های فیزیکی

Typical (General) Uses of Environmental Models

Environmental Medium	Issues/Concern	Use of Models in
Atmosphere	•Hazardous air pollutants •Air emissions •Toxic releases •Acid rain •Smog •Health concerns	•Concentration profiles •Exposure •Design and analysis of control processes •Evaluation of management action plans •EIA of new projects •Compliance with regulations
Surface water	•Wastewater treatment plant discharges •Industrial discharges •Agricultural/urban runoff •Storm water discharges •Potable water source	•Fate and transport of pollutants •Concentration plumes •Design and analysis of control processes and equipment •Waste load allocations •Evaluation of management actions •EIA of new projects •Compliance with regulations
Ground water	•Leaking underground storage tanks •Leachates from landfills and agriculture •Injection •Potable water source	•Fate and transport of pollutants •Design and analysis of remedial actions •Draw downs •Compliance with regulations

تعریف مسأله و محدوده آن

- برای محاسبه چند نوع مشخص از آلودگی در زمان و مکان معین در اتمسفر، می بایست سیستمی را تعریف نمود که غلظت آلودگی های موردنظر را به غلظت دیگر پارامترها به وسیله روش های ریاضی، فیزیکی و آماری ارتباط دهد. چنین شیوه ای مدل نامیده می شود.

رویکرد مدلسازی

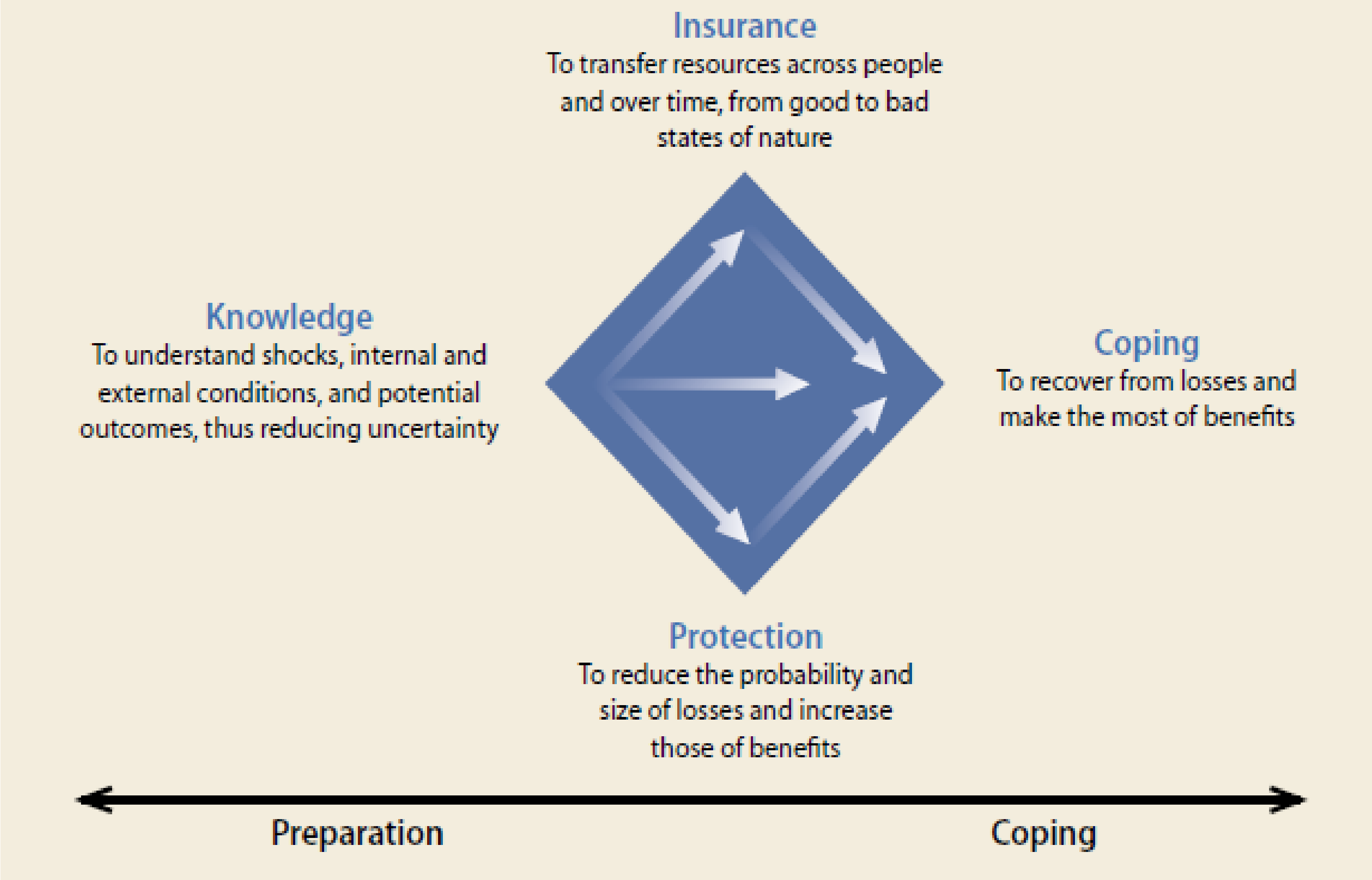
- مسأله اساسی کلیه مطالعات مدلسازی سیستم های زیست محیطی، شناسایی تابع “F” ای است که بتواند غلظت آلودگی $C(x, y, z, t)$ را در هر نقطه مکانی (x, y, z) و در زمان (t) با شرط معلوم بودن بار آلودگی و دیگر متغیرهای فیزیکی سیستم ارایه دهد.

سه رویکرد مختلف برای شناسایی F وجود دارد:

- مدلسازی ریاضی معین و قطعی
  - مدلهای تحلیلی
  - مدلهای عددی
- مدل های آماری
- مدل های فیزیکی

ریسک و فرصت ها در یک محیط زیست در حال تغییر

teri university



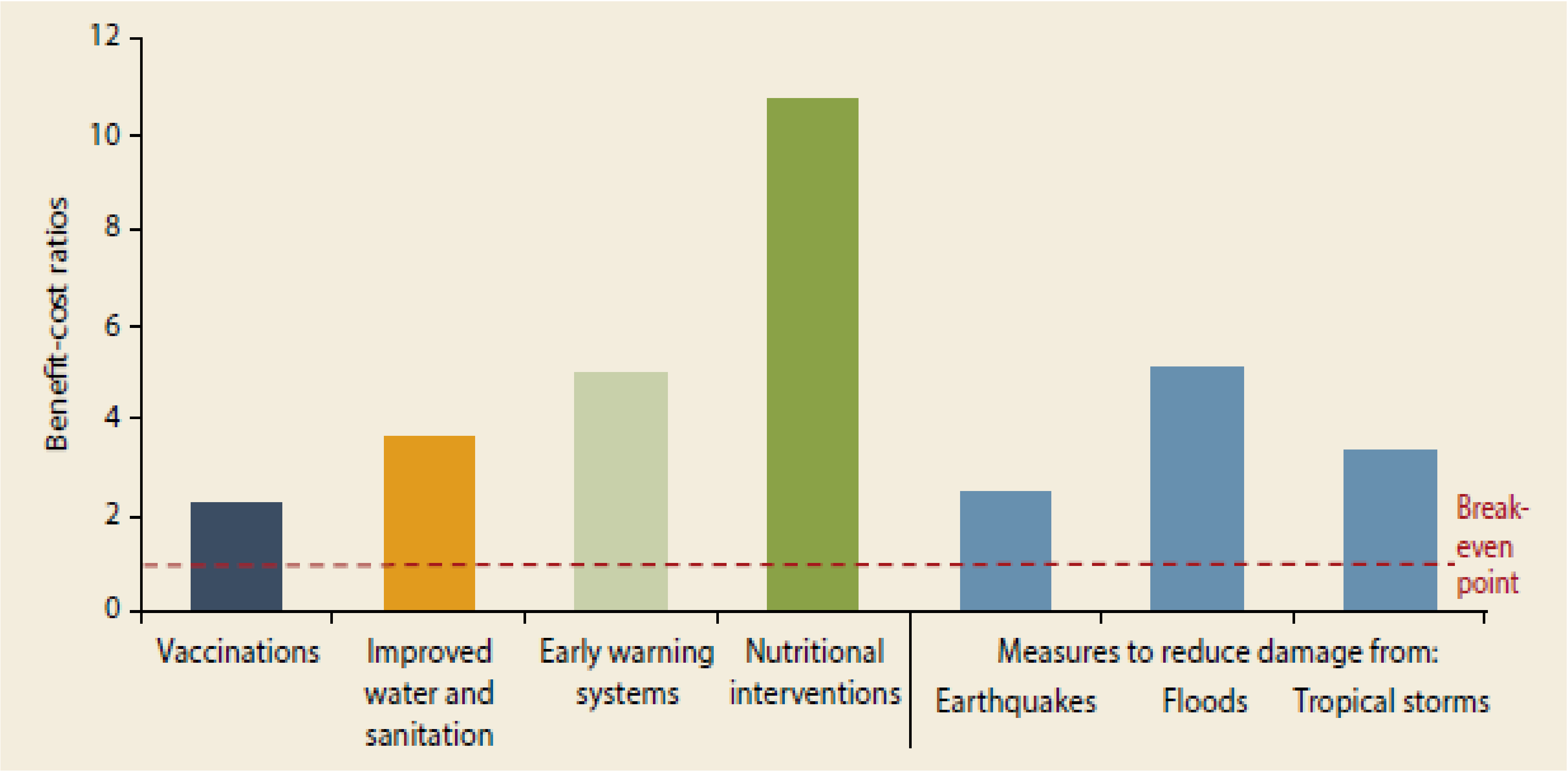
Insurance
To transfer resources across people and over time, from good to bad states of nature

Knowledge
To understand shocks, internal and external conditions, and potential outcomes, thus reducing uncertainty

Coping
To recover from losses and make the most of benefits

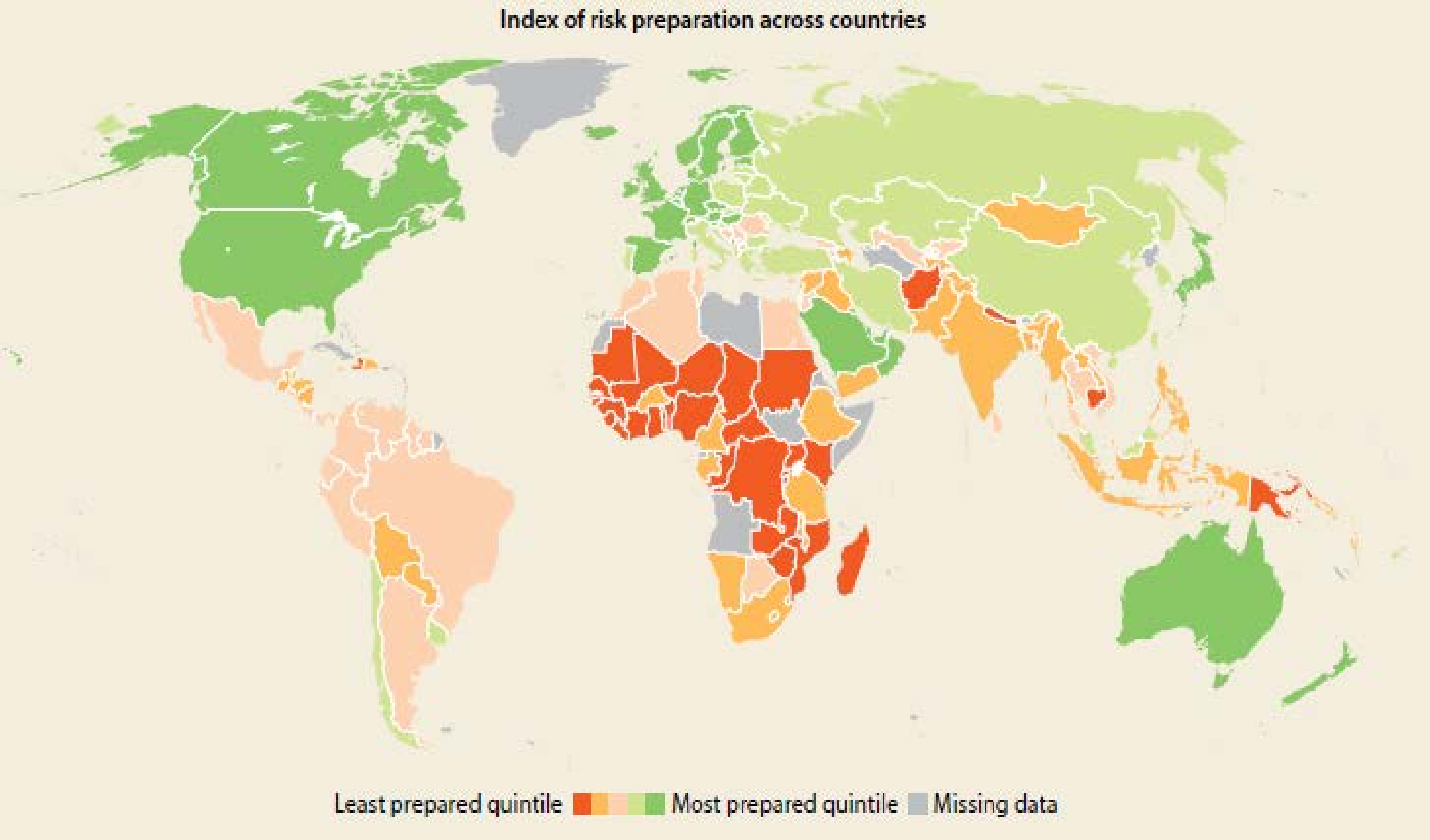
Protection
To reduce the probability and size of losses and increase those of benefits

The interlinked components of Risk Management



The benefits of risk management often outweigh the costs

Source: World Development Report 2014



Index of risk preparation across countries

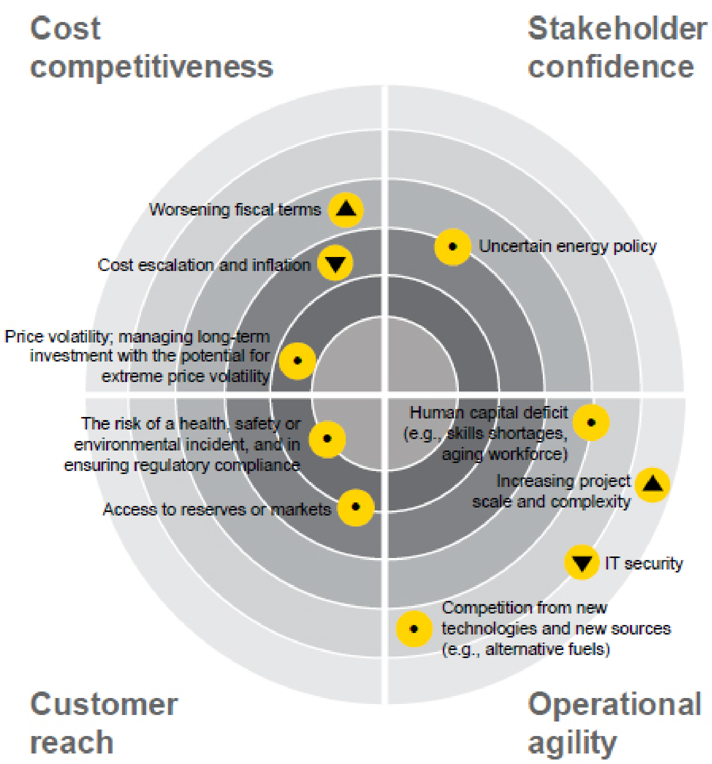
- Investing for both the present and the future in our fast changing world requires fresh thinking and comprehensive, foresighted analysis.
- This means accounting for risks, some of which are unprecedented, many of which are not identified in financial statements, and all of which are here for the foreseeable future.
- Today, rapidly accelerating climate change, dwindling water supplies, energy demands, supply chain breakdowns, population growth and other sustainability challenges pose enormous, unprecedented risks to the global economy.
- These sustainability-related risks will continue to have far-reaching implications for businesses, consumers and investors throughout the 21st century.

the silver lining ....

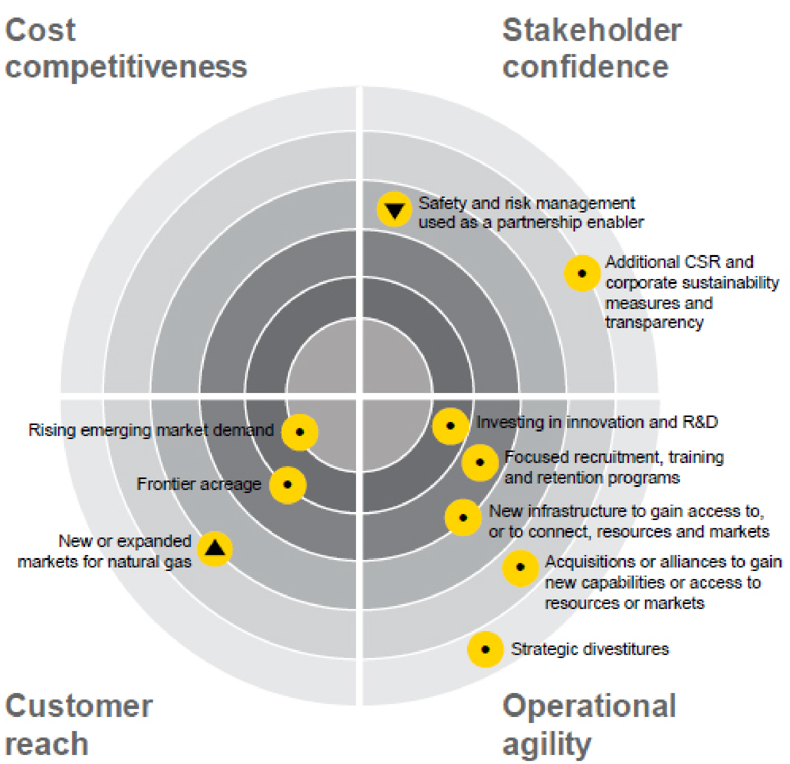
- “Risk is a burden, but also an opportunity…”

- These have also created enormous economic opportunities in renewable energy, efficiency technologies, resilient infrastructure and other solutions to these challenges.

Top 10 risks

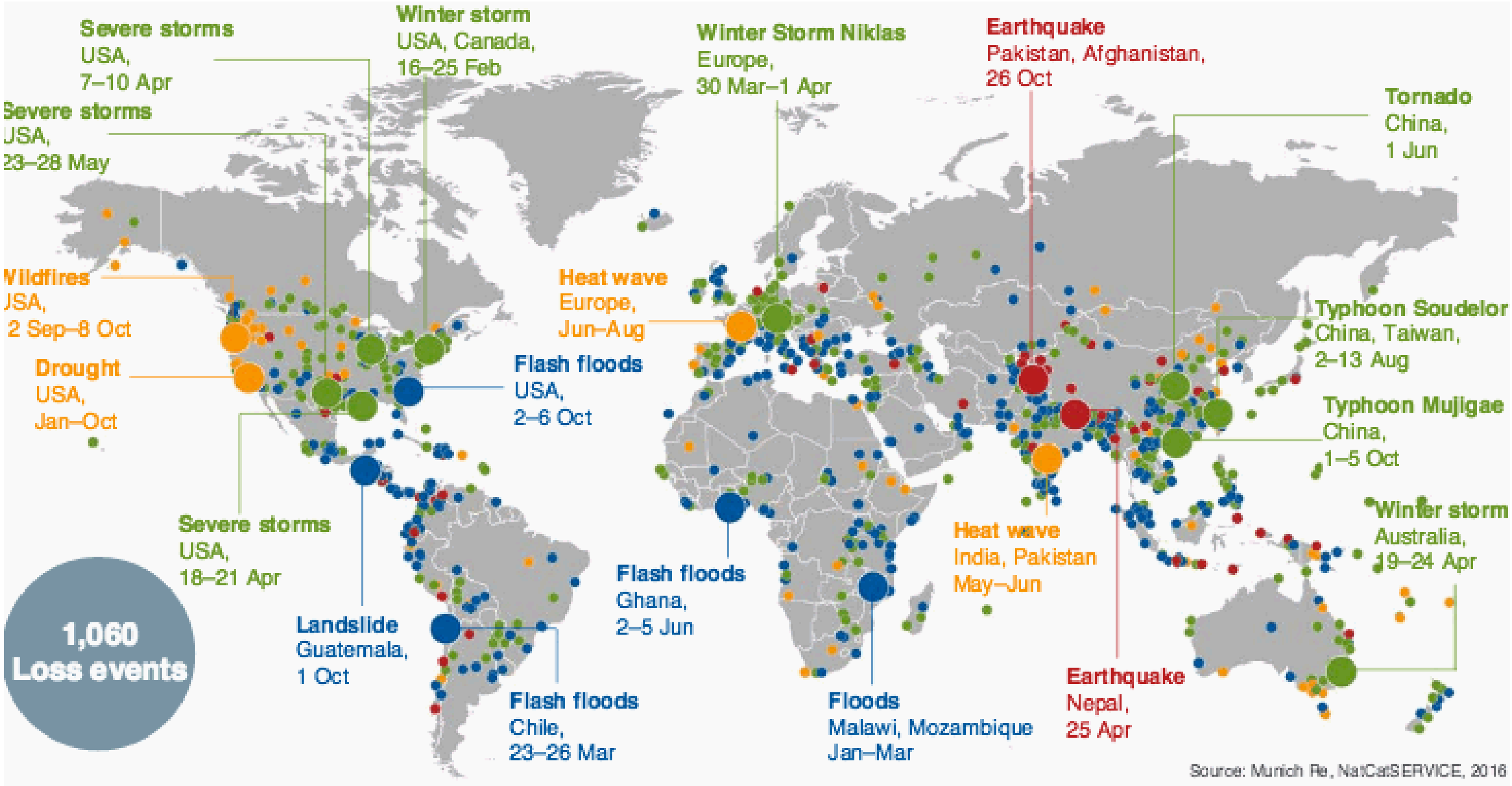


Top 10 opportunities



Source: Allianz Global Risks 2013

2013 ranking and expected 2015 ranking ▲ Up in 2015 ● Same in 2015 ▼ Less in 2015



Source: Munich Re, NatCatSERVICE, 2016

● **Geophysical events**
(Earthquake, tsunami, volcanic activity)

● **Meteorological events**
(Tropical storm, extratropical storm, convective storm, local storm)

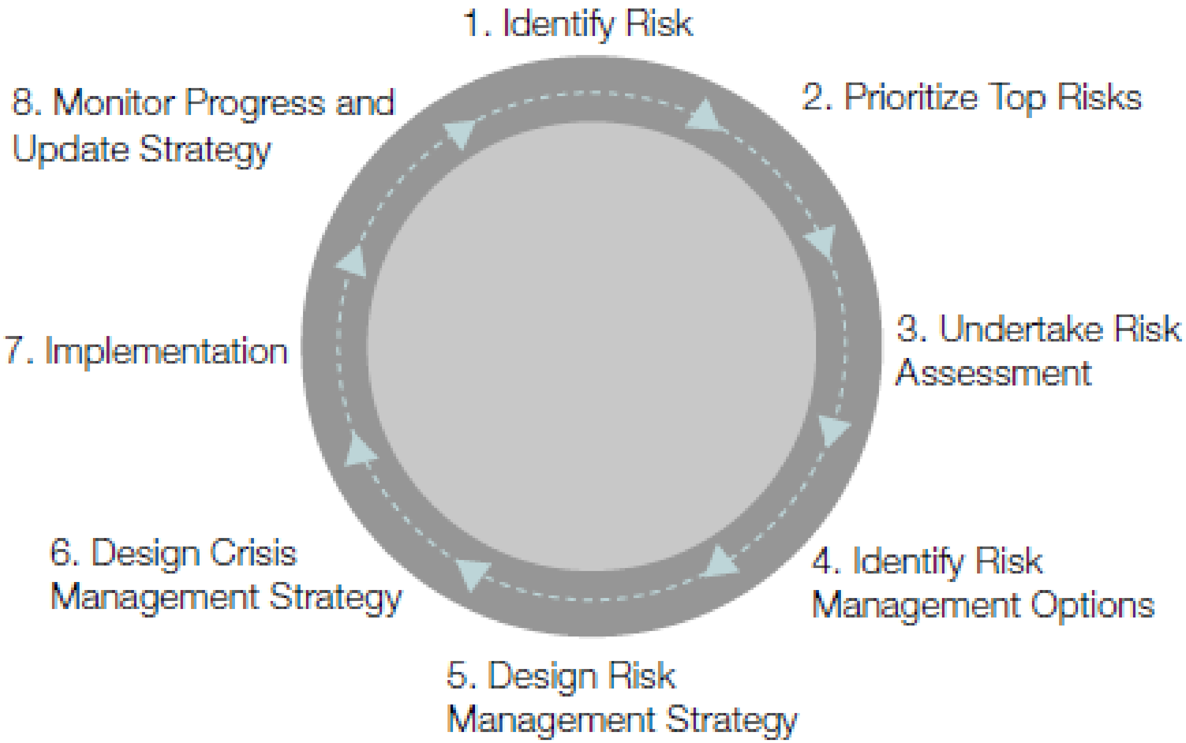
● **Hydrological events**
(Flood, mass movement)

● **Climatological events**
(Extreme temperature, drought, forest fire)

○ **Loss events**

○ **Selection of catastrophes**

The Risk Analysis and Management Process



1. Identify Risk
2. Prioritize Top Risks
3. Undertake Risk Assessment
4. Identify Risk Management Options
5. Design Risk Management Strategy
6. Design Crisis Management Strategy
7. Implementation
8. Monitor Progress and Update Strategy

Source: Kunreuther, Michel-Kerjan and Useem 2013.

- Many of the world's leading corporations are already integrating sustainability considerations into their business models.
- Rather than be at the mercy of sustainability pressures that will continue to reshape the global economy, companies are mitigating social and environmental risks and seizing opportunities to invest in solutions, enhance their brands and help assure sustainable earnings.

- As Daniel Kahneman put it in his 2011 book Thinking, Fast and Slow, humans suffer from the 'what you see is all there is' (WYSIATI) phenomenon. WYSIATI theory suggests that human decision-making is based primarily on Known Knowns, namely phenomena we have already observed, and rarely considers Known Unknowns. Most importantly, human decision-making appears almost oblivious to the possibility of Unknown Unknowns, - that's what risk recognition and risk management is all about !

بازدید از سایت تحقیقاتی دانشگاه تری پیرامون توسعه پایدار

- **Location:** Saliakot, Mukteshwar, India

- **Description:**

a. Agricultural village

b. Climatic Conditions – Very cold “7ºC – 10ºC”

c. Topography: High altitude

d. Precipitation: Low rainfall (3 to 4 months each year)

e. Accessibility to basic amenities: 3 to 4 hours

The Interview

1. SOCIAL CAPITAL

a. Integration of the Village - Interviewed Family
b. Roles of the Family
c. Education: Minimum/Basic
d. Closely Knit Families

The Interview

- **2. HUMAN CAPITAL**

a. Health: Access to medical facilities – 5 Km.
b. Food and nutrition: 2 – 3 Km.
c. Knowledge and Skills: limited skills

The Interview

- **3. NATURAL CAPITAL**

a. Sources of energy: Biomass
b. Water availability: scarce resource
c. Disasters: Floods and landslides

The Interview

4. FINANCIAL CAPITAL

a. Source of Income: Agriculture + “Other sources”
b. Annual Income: 30,000 – 35,000 Rp.
c. Debts & Loans: Multiple loans

The Interview

5. PHYSICAL CAPITAL

Access to services: phone, road, transportation, satellite T.V.

Facilities by TERI

- **Social:** Community Radio
- **Human:** Vocational training
- **Natural:** Rainwater harvesting + Solar infrastructure
- **Financial:** provide markets and packaging

Learning Outcomes

1. Vocational training, value addition, packaging and marketing

2. Resource efficiency and management (solar energy, water)

3. Community Networks (e.g. radio, mobile phones)

Assessing Urban Sustainability

- **Location:** Connaught Place, Delhi

Sustainable Practices	Unsustainable Practices
Compact architecture (easily accessible location)	Absence of natural lighting and ventilation (shops)
Accessible through mass transit system	Air pollution (vehicles and dust)
Green spaces	Waste disposal (attracting stray dogs)

با تشکر از توجه شما