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# FRONTIERS 2017 REPORT

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# TOPICS

**Subduing Sand and Dust Storms**

**Understanding the Environmental Dimension of Antimicrobial Resistance**

**Exodus: humans in the Anthropocene**

**Marine Protected Areas: flowing through the heart of sustainable development**

**Off-grid solar solution**

**Nano-X: a risk to society and the environment or a growing opportunity?**

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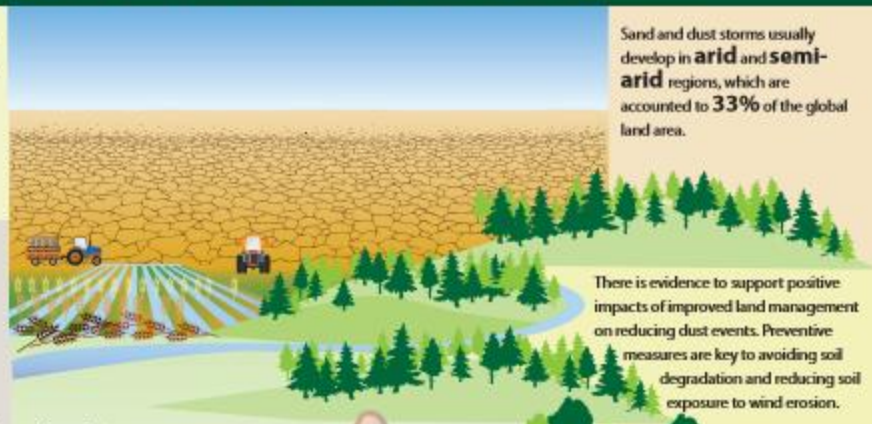
# Sources and impacts of sand and dust storms

**25% of dust emissions** are a result of human activities, e.g. unsustainable use of land and water, agricultural intensification, deforestation, water diversion for irrigation, human intervention in the hydrological cycle.



Sand and dust storms usually develop in **arid** and **semi-arid** regions, which are accounted to **33%** of the global land area.

There is evidence to support positive impacts of improved land management on reducing dust events. Preventive measures are key to avoiding soil degradation and reducing soil exposure to wind erosion.

Sand and dust storms contain particles in a wide range of sizes

Particles smaller than **10 microns** are of significant health concern as they cause respiratory and cardiovascular illnesses when inhaled.

**Sandstorms** are dominated by particles larger than **60 microns** in diameter

**Dust storms** are the result of surface winds raising large quantities of dust into the air, reducing visibility at eye level to less than 1 000 m. Dominant particles are smaller than **60 microns**

**Climate change**, especially increasing climate variability and frequency of extreme events, is an important risk factor for increased sand and dust storms.

Dust storms damage crops, kill livestock and erode fertile soil

Typical concentration of particulate matter during dust storms in **hundreds of µg/m³**

Over **10,000 µg/m³** detected in a dust event over Iran in January 2017

Air quality guideline set by the World Health Organization is below **50 µg/m³**

Infections by airborne fungi, such as **Aspergillosis**, **Valley Fever**, and bacteria such as **Meningitis** are found to correlate with dust events

Dusty regions are likely to become drier and face greater risk of dust storms, such as most of the **Mediterranean areas of Europe** and **Africa**, **northern Sahara**, **central** and **west Asia**, **southwest USA**, and **southern Australia**.

**US$ 964 million** of economic losses due to dust storms in China from 2010-2013

A dust storm in northwest China in 1993 killed nearly **120 000 livestock**; destroyed **373 333 million** hectares of crops; and buried over 2 000 km of irrigation ditches


# Antimicrobial resistance and the environment

The environment is key to antibiotic resistance. Bacteria in soil, rivers and seawater can develop resistance through contact with resistant bacteria, antibiotics, and disinfectant agents released by human activity. People and livestock can then be exposed to more resistant bacteria through food, water, and air.

**Human antibiotic use** jumped **36%** in the **2000s.**

Up to **75% of antibiotics** used in aquaculture may be lost into the surrounding environment.

**70% of antibiotics** are used by **animals**

Manure fertilizers cause antibiotic contamination in surface runoff, groundwater and drainage networks.

**Anti microbial use** for livestock will jump **67% by 2030.**

Antibiotics can be absorbed by plants and crops.

Antibiotics are increasingly used to boost animal growth in intensive farming, especially in developing countries.

Wastewater treatment plants cannot remove all antibiotics and resistant bacteria.

**30%** of antibiotics are used by humans

**Up to 80% of consumed antibiotics** are excreted through urine and faeces.

Indian industrial estate was found to release enough **antibiotics to treat 44,000 people.**

**More than 50%** of **municipal solid waste** ends up in landfills and open dumps. This can indude unused or expired drugs.

Man-made antibiotic resistant bacteria have been found in fish, sea mammals and sea birds.


# Environmental Displacement

## Land Degradation, Desertification and Drought

Drought, a prolonged period of dryness with deficiency in precipitation, leads to water and food shortages, and causes long-term environmental, economic and health impact on population. It often forces people to leave their lands in search of water, pasture, or better economic and social opportunities. Drought is projected to become longer and more intense due to climate change.

By 2020, between **75** and **250 million Africans** are likely to be exposed to increased water stress

Since 2016, insufficient rainfall and ongoing severe drought has led to crop failure, loss of livestock, and food insecurity in Somalia. At least **192,000 people** have been displaced since November 2016 as a result

## Infrastructure and Land grabbing

Infrastructure and Land Grabbing
Large scale infrastructure projects such as dams and roads can result in massive displacement of populations. Meanwhile, large-scale land purchases in developing countries by agribusiness for biofuels, food crops and palm oil plantations has become a highly contentious issue, often labelled land grabbing. It is difficult to determine how many people are displaced by these land purchases, but this is likely to more prominent cause of displacement in future.

Construction of the Three Gorges Dam on the Yangtze river in China is estimated to have displaced **1.3 million people**

In the 1980s and 1990s, **10 million people** worldwide were displaced each year by development projects, such as construction of large dams and transportation systems, transformation of urban areas

## Natural disasters

Over the past few decades, there is a marked increase in the number of weather-related disasters and the scale of impacts on societies, infrastructure, economies and the environment. Extreme weather events may make areas temporarily uninhabitable, and displace populations temporarily or permanently. Climate change has continued to influence the likelihood, frequency and intensity of extreme hydro-meteorological events, such as storms, floods, and extreme temperatures. Changes in the incidence of extreme events will amplify the challenges and risks of displacement.

Tropical cyclones making landfall in North and Central America; East Africa; West, East, South and Southeast Asia as well as in Australia and many Pacific Islands are expected to bring extreme rainfall more frequently

Average tropical cyclone maximum wind speed is likely to increase, according to the IPCC

From 2013-2015, **52.4 million people** were displaced due to weather-related disasters

Forced dispossessions of lands are increasingly common in Latin America due to the legal and illegal extraction of resources, e.g. oil palm plantation, crops for biofuels, logging.

Nearly **940 million people** or **11%** of the **global population** are projected to live in the low-lying coastal zone by 2030, and three quarters of them are in Asia and the Pacific

## Competition over Natural Resources

Mounting demands and competition over increasing scarce natural resources – land, water, timber, oil, minerals, gold, diamonds – can create tensions and ignite conflicts among users. Over the past 60 years, at least 40 per cent of all conflicts within national borders are associated with natural resources. In many cases, tensions can lead to violent conflicts and large-scale forced displacement. If unresolved, non-violent conflicts can also trigger forced displacement.

## Sea Level Rise

Sea level rise threatens coastal cities, coastlines and livelihood of hundreds of millions of people living in low-lying areas. Most of the world's megacities are located in the coastal zone including large deltas, and they continue grow. A study of migration patterns in developing countries suggests that from 1970 to 2000 people tended to move out of marginal drylands and drought-prone areas towards the coastal zone. Coastal population and infrastructure are vulnerable to flooding, inundation, coastal erosion and shoreline transformation and saltwater intrusion as a result of sea level rise.

## Industrial accidents

Serious industrial accidents can leave large areas so polluted that people are forced to abandon their homes and resettle elsewhere. Long-term health, social, economic and environmental impacts of industrial accidents often have implications for the permanent return and resettlement of residents. In Ukraine, the 1986 Chernobyl nuclear meltdown forced the resettlement of 350,000 people, while 150,000 were evacuated following the 2011 Fukushima meltdown following a devastating tsunami in Japan.

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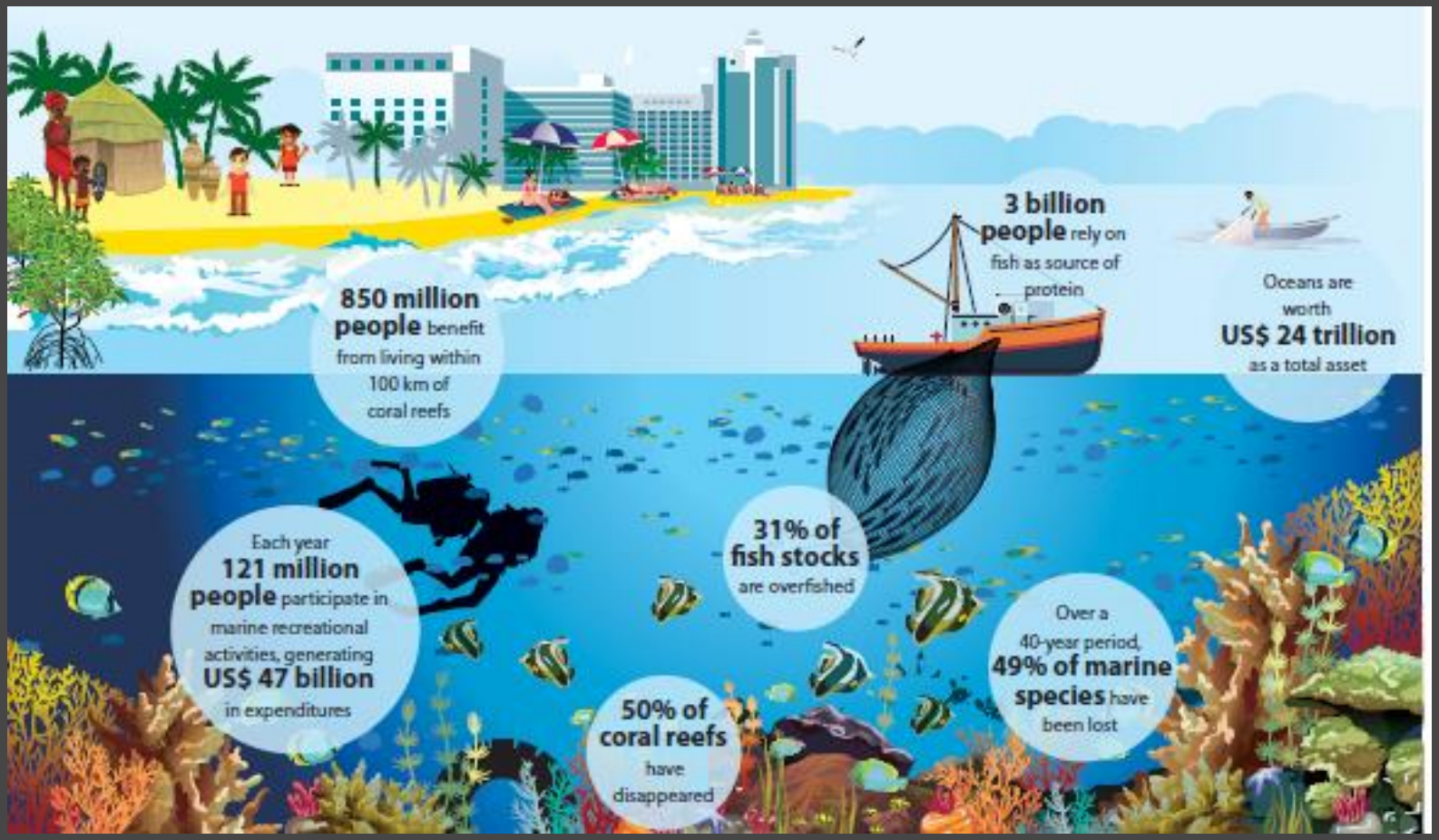


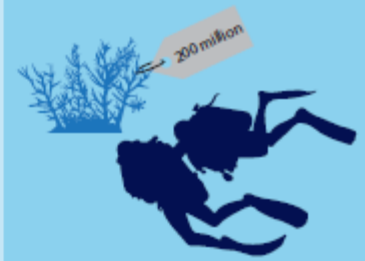

# Good Governance of Marine Protected Areas

## Top-down governance

Laws and regulations by the state needed to protect diversity of natural resources from degradation

## Bottom-up governance

People and local community are involved in decision-making




## Market-brand governance

Laws and regulations by the state needed to protect diversity of natural resources from degradation

### Chumbe Island Coral Park
### Tanzania

x

### Bluefield Bay
### Jamaica

Local community ___ and manages its own restirctions on how to use resources

### Great Barrier Reef
### Australia

x

## Did you know?

Oceans are worth **24 trillion** as a total

It is estimated that if **20-30%** of our oceans are protected areas

costing **$5-19** billion, Gross Value

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# The Rise of Off-grid Solar

## ACCESS TO ELECTRICITY

Nearly **1.1 billion people** worldwide have no access to electricity

- Southeast Asia **60 million**
- The rest of the world **76 million**
- South Asia **360 million**
- Sub-Saharan Africa **575 million**

**780 million people**
could still remain off-grid by 2030

## Solar or Photovoltaic (PV) systems

are becoming mainstream among off-grid populations in rural and urban settings particularly in Africa and Asia.

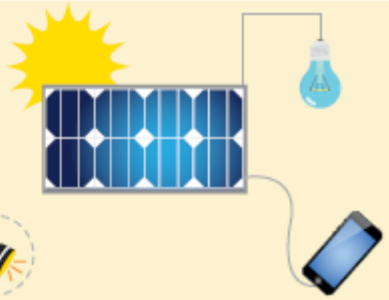
Globally **1** in **3** households is expected to use off-grid solar by 2020

**Solar home systems** are stand-alone photovoltaic systems that supply direct current electricity to power household lighting, electrical appliances or battery recharge.

Common sizes vary from a single solar lantern to a large system that can power TVs, small fridges and other household appliances.

**Pico-solar** or **pico-PV** is a small solar home system of up to 10 watt-peak, supporting household lighting and mobile phone charging.

Pico-solar is increasingly replacing traditional lighting sources.



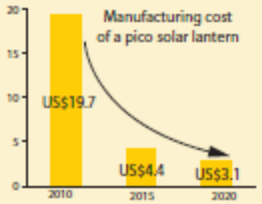
**Kerosene** burning emits black carbon, causing household air pollution and global warming.

**25 billion litres** of kerosene is used for lighting each year = **270 000 tons** of black carbon emitted

**1 kg of black carbon** causes as much warming as having **700 kg of $CO_2$** circulating in the atmosphere for 100 years

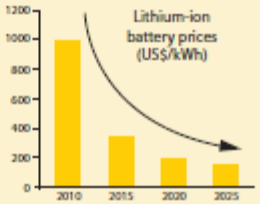
## TRENDS

### Prices are dropping




### Sales are rising


### Battery costs are falling




### Innovative business is emerging

Pay-as-you-go Payment schemes
To be added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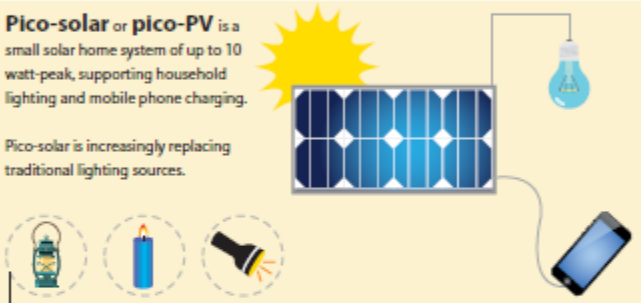

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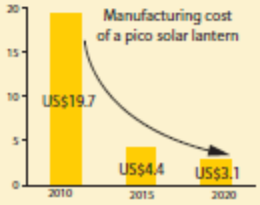


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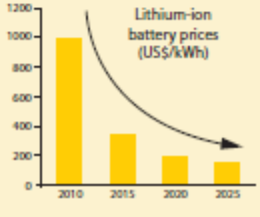


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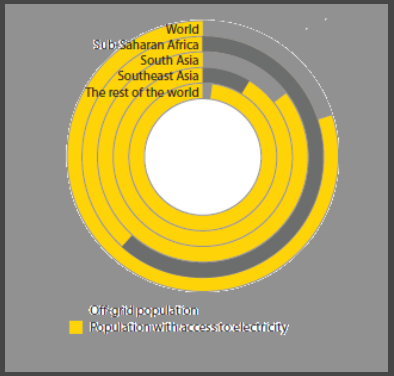


# NANO-X