The Coastal Built Environment: A Source of Current and Future Marine Debris?

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The Coasts are Changing

The coastal urban environment is a rapidly growing. In the last century, coastal settlements have grown over a thousand times in population. This rapid growth in population and urban sprawl also led to a rapid growth in construction, built material, and consumer goods in the coastal zones. Not only are people moving closer to the ocean, but the anthropogenically produced chemical materials are moving with them. This poses a potentially global catastrophic risk (GCR) to both the urban coast and the ocean. The expanding coastal population and the growing built environment are exposed to a changing spectrum of natural hazards. The ocean is vulnerable to changes in the biogeochemical cycles and coastal disaster contribute to the flows of plastics, rubber, and other litter into the ocean. Among others, the urban coasts are exposed to increasing flooding and inundation as sea-level continues to rise, tropical cyclones and other storms that are expected to increase with climate change, and tsunamis. It is expected that the growth of the urban environment will continue and this will worsen the GCR. Governance and reduction of this risk requires a fundamental rethinking of the design of the urban coast. This process needs to be informed by scientific knowledge based on scenario studies.

Amount of People

Population increase since 1900:

- Figure 1 shows the most populated cities in 1900 with over 1,418,000 people.
- Figure 2 shows the most populated cities in 2005 with over 3,389,000 people.
- London, UK: 1 in 1900 went from 6,480,000 to the 22nd spot with 8,505,000 in 2005.
- About a 2,000,000 increase in population.
- Tokyo, Japan:
  - In 1900 it was 1,497,000 people, increased to 35,197,000 people by 2005.
- If this trend were to continue, in 2110, Tokyo would have a population size of 827,540,954.

Looking to 2025:

- It has been estimated that coastal populations are expected to reach 6,000,000,000 by 2025.
- Figure 2 has a total population of 325,829,000.
- Population increase since 1900:
  - Figure 1: This figure depicts population sizes in 1900. Note, almost all the cities studied are coastal cities that border the oceans and will be affected by the rise in sea levels. It came from the 19.20.21 organization, accessed in 2010 and now since has been archived.

Coastal Populations and Shorelines:

- There is an apparent correlation between the countries with many coastal cities of more than 1 million people and the alteration of the shoreline.
- Degrading shorelines have more impacts on both spheres than on just the increased population living closer to the shore.

Amount of Material

Plastic increase since 1950:

- Between 1950 and 2015, global plastic production has increased from near 0 to a total of 448 million tons.
- In 2015:
  - 72 million tons was used in construction and building materials.
  - 65 million tons in textiles.
  - 46 million tons in consumer products.
- 35% of the population live within 60 miles of a coast.
- If we estimate a 1:1 ratio, 35% plastic will be within 60 miles of a coast.
- 2.2 million tons of construction and building.
- 2.2 million tons of textiles.
- 16.1 million tons of consumer products.
- Increased amount near shorelines means increased probability of entering the ocean.

Increase in Material Production:

- The amount of materials extracted, harvested and consumed worldwide increased by 60%.
- Global metal extraction increased by 8.7 Gt or 133% in 28 years.
- Construction increases by 8.7 Gt or 80% in 28 years.
- If the trend continues, metal increases 19.1 Gt construction increases 15.6 Gt in the next 28 years.
- Material is projected to reach 100 Gt by 2030, potentially 35% of this material production staying within 60 miles of the shore.

Toxic Building Materials:

- Toxic to the environment:
  - During production by releasing fumes.
  - During use by releasing fumes.
  - After discarding into land and water.
- Toxic to humans:
  - By poisoning drinkable water.
  - Through off-gassing during use.
- Toxicity increased in building materials due to the release of industrial-by-products and some industrial wastes.

Hazardos

There are two separate entities at risk of harmful hazards due to the increase in population and built material in coastal zones:

1. Hazards to the Ocean
   - Plastics
   - Heavy metals
   - Concrete
   - Lumber
   - Waste
   - Cloths and other materials inside of the building

2. Hazards to People
   - Tsunamis
   - Cyclones (hurricanes, typhoons)
   - Strong storms
   - Floods
   - Sea-level rise

References


Figure 1: This figure depicts population sizes in 1900. Note, almost all the cities studied are coastal cities that border the oceans and will be affected by the rise in sea levels. It came from the 19.20.21 organization, accessed in 2010 and now since has been archived.

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Figure 3: Coastal Population and Soil Degradation from UNEP 2002b. This map shows the percent of population living within 100km of the coast by country compared to the shoreline alteration (Kok et al., 2007).

Figure 4: This figure shows the percent increase in material resource extraction percent increase since 1980 to 2008 by material type (OECD, 2015).

Figure 5: A graph depicting the material resource extraction percent increase since 1980 to 2008 by material type (OECD, 2015).

Figure 6: Global plastic production by industry between 1950 and 2015 (Geyer, 2018).

Table 1: A list of toxic building materials. (Geyer, 2018)