

The Future of our Oceans – How to Fight Marine Plastic Pollution



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**MAR SEM LIXO.
MAR DA GENTE.**

Biblioteca Parque Estadual, 10 – 11 November 2015
Rio de Janeiro



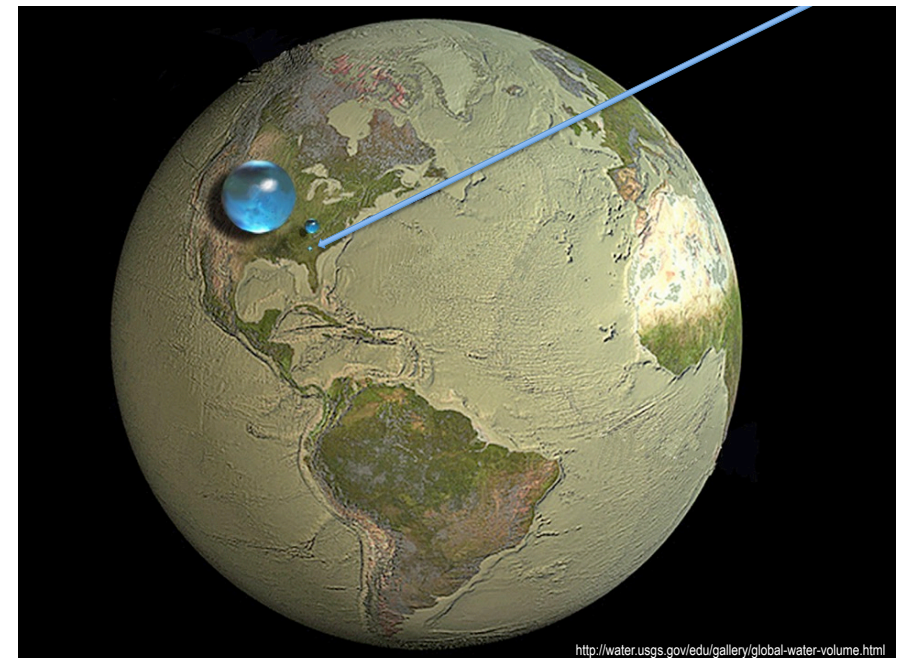
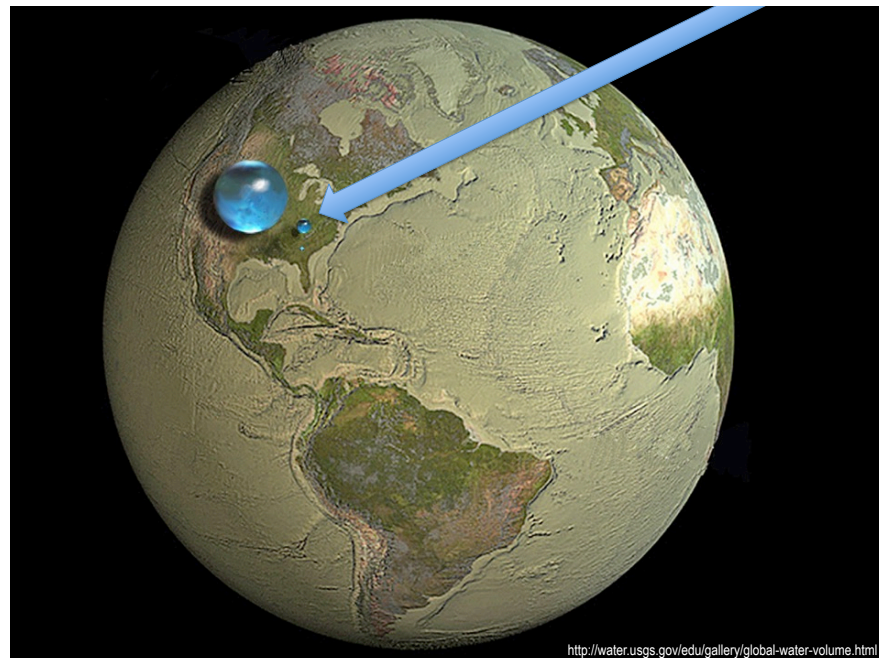
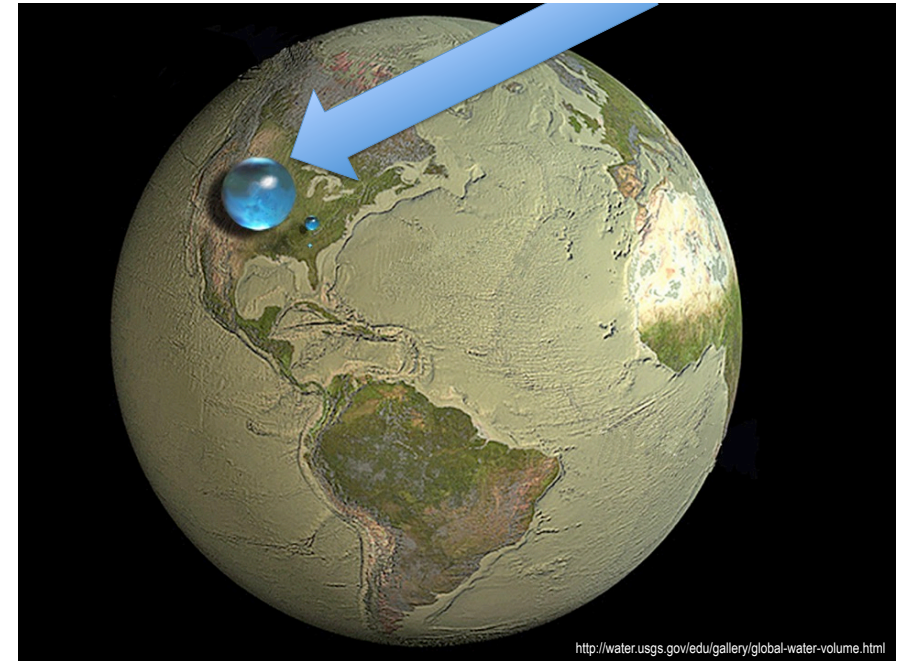
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Overview

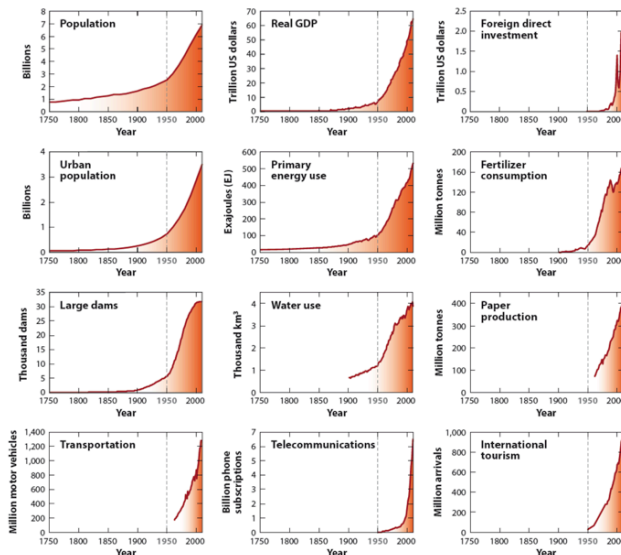
- 1) Global challenges and priorities
- 2) Science response – Future Earth
- 3) Water challenges
- 4) Marine plastic debris – analysis and solution paths
- 5) Implementation of change – transformation
- 6) Conclusion

1.

Global challenges and priorities

The great acceleration (I)

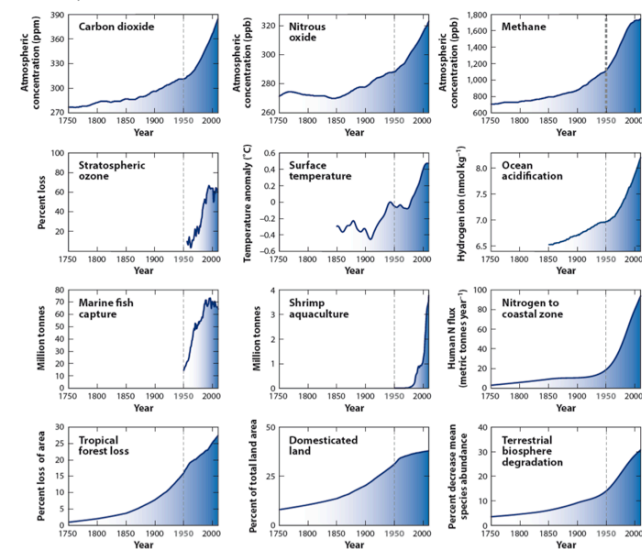
a Socioeconomic trends



O'Rourke & Lollo (2015).
Transforming consumption: From
decoupling, to behavior change,
to system changes for
sustainable consumption. Annual
Review of Environment and
Resources, 40, 10.1-10.27.

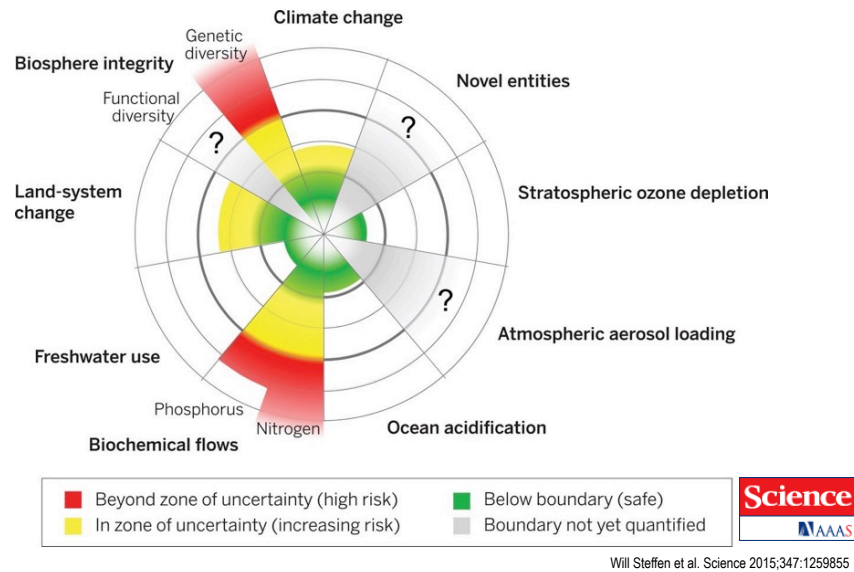
The great acceleration (II)

b Earth system trends

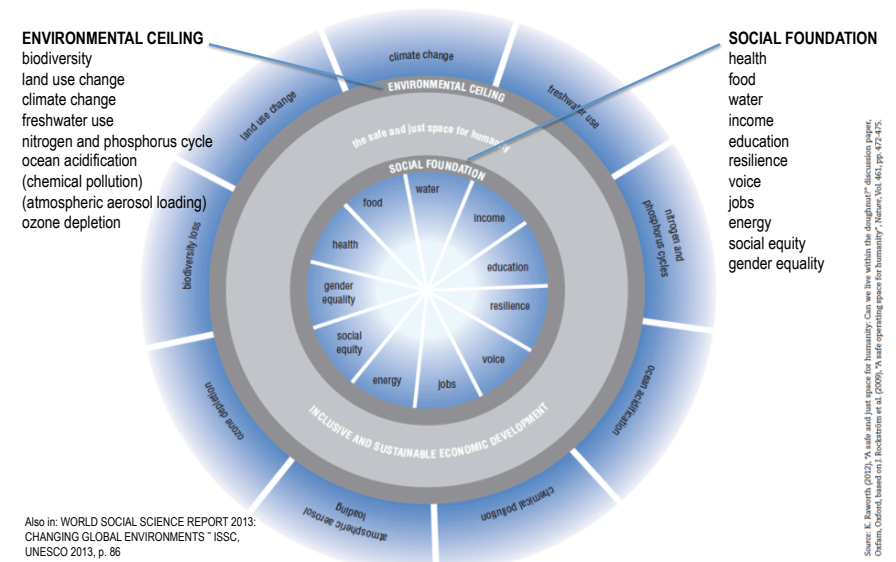


O'Rourke & Lollo (2015).
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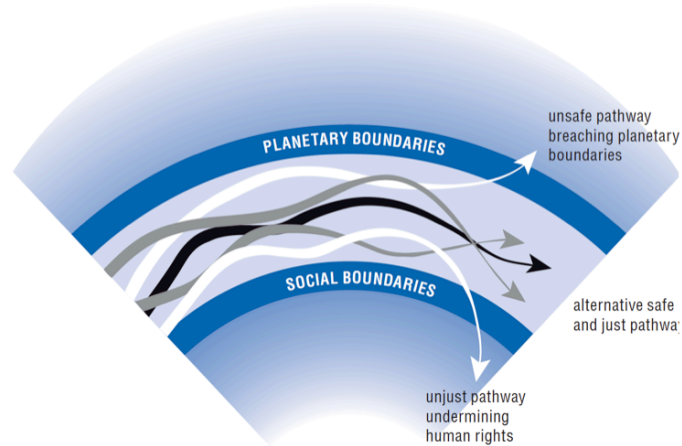
Planetary boundaries (I)



Planetary boundaries (II)



Complex challenges in the Anthropocene: navigating within multidimensional boundaries



Also in: WORLD SOCIAL SCIENCE REPORT 2013: CHANGING GLOBAL ENVIRONMENTS "ISSC, UNESCO 2013, p. 87

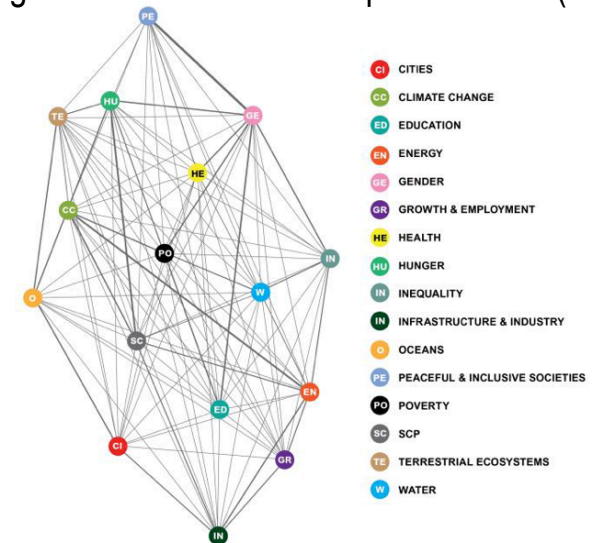
Source: K. Raworth (2012), "A safe and just space for humanity: Can we live within the doughnut?" discussion paper, Oxfam, Oxford, based on J. Rockström et al. (2009), "A safe operating space for humanity", Nature, Vol. 461, pp. 472-475.



Targeting the Sustainable Development Goals (SDG's)



Targeting the Sustainable Development Goals (SDG's)



2.

Science responses – Future Earth

What did we get after more than 30 years
of scientific investment in global environmental
change research (GEC)?

(1) A enormous amount of systems knowledge about our planet ...

...and (2) a pile of high-level publications some of it policy relevant,...



...but (3) the total investment all in all had a very limited impact!

[at the global emergent scale at which it really counts]



The Problem:
**Policy relevance of
scientific results is
not enough...!**

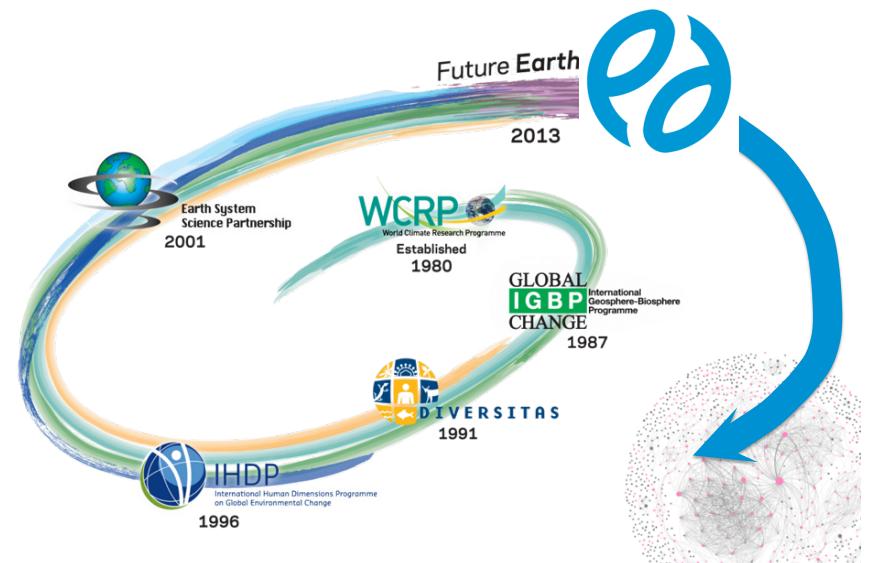
One reason: Policy
relevance **doesn't**
translate itself into
policies!!!

Thus:
New approaches
are needed:
Another science...?

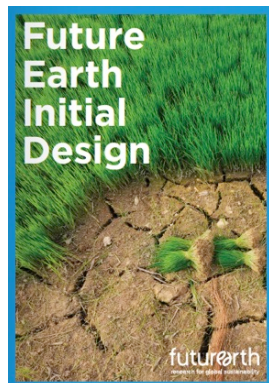
The wake-up call to GEC science...

- Build and *connect* global knowledge!
- Intensify the *impact* of research!
- Find *new* ways to accelerate sustainable development!

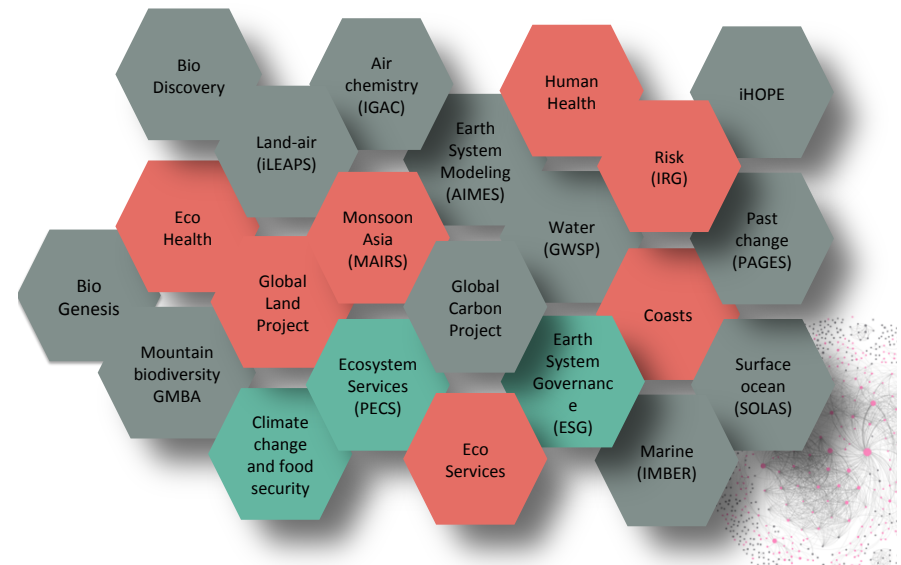
The Future Earth narrative



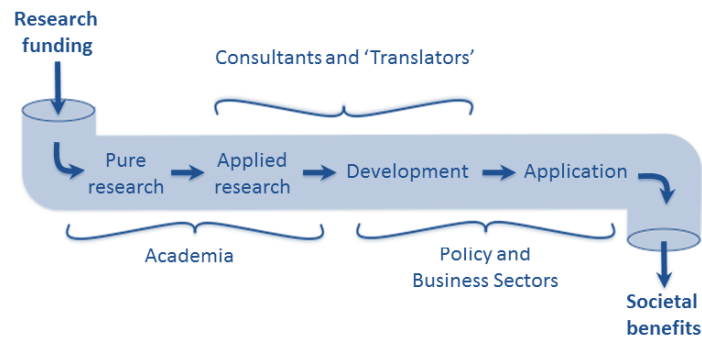
Future Earth was created by the Science and Technology Alliance for Global Sustainability



Projects (50'000 - 70'000 scientists at work...)



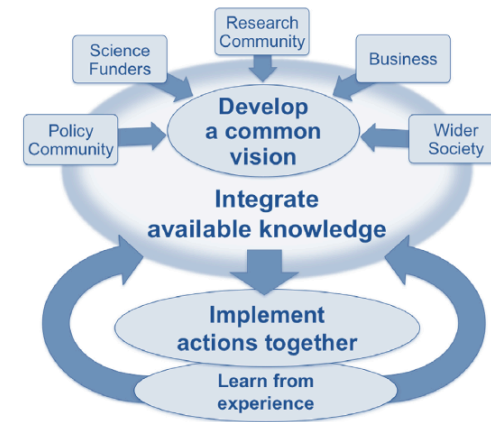
Models of knowledge production and implementation (1)



The 'linear pipe model'

Stafford-Smith, Moser et al. (forthcoming)

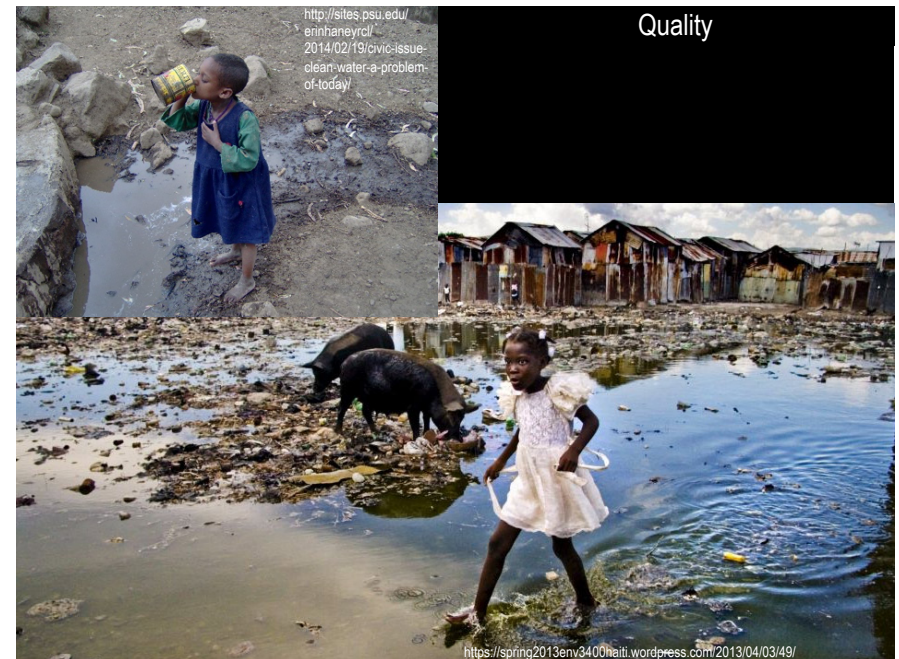
Models of knowledge production and implementation (2)

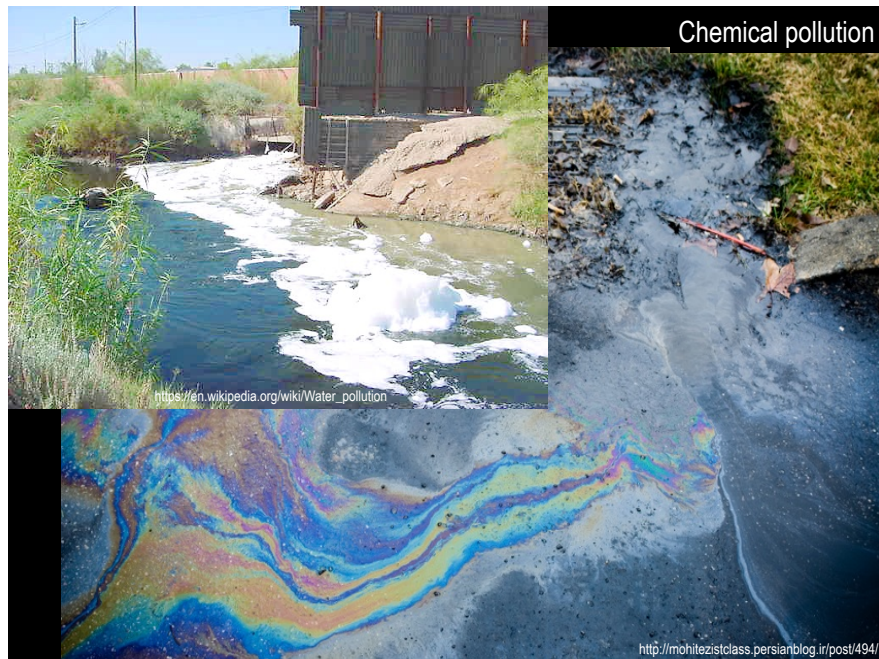


The "co-design and co-production" model –
The knowledge arena: sustainability science as a collective learning process

Cornell et al. (2013). Opening up knowledge systems for better responses to global environmental change. *Environmental Science & Policy*, 28, 60-70.

3. Water challenges





Eutrophication



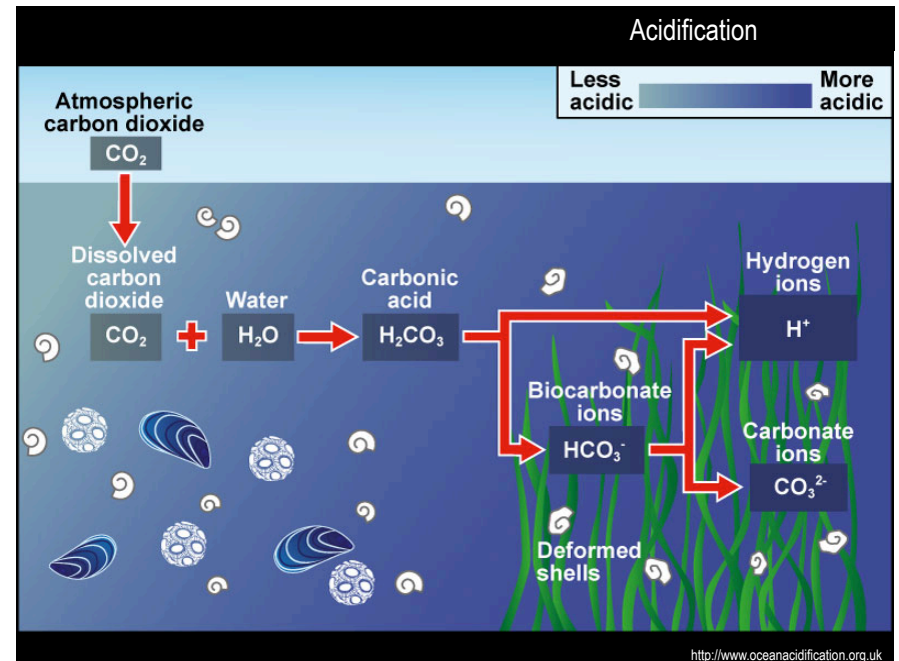
Eutrophication

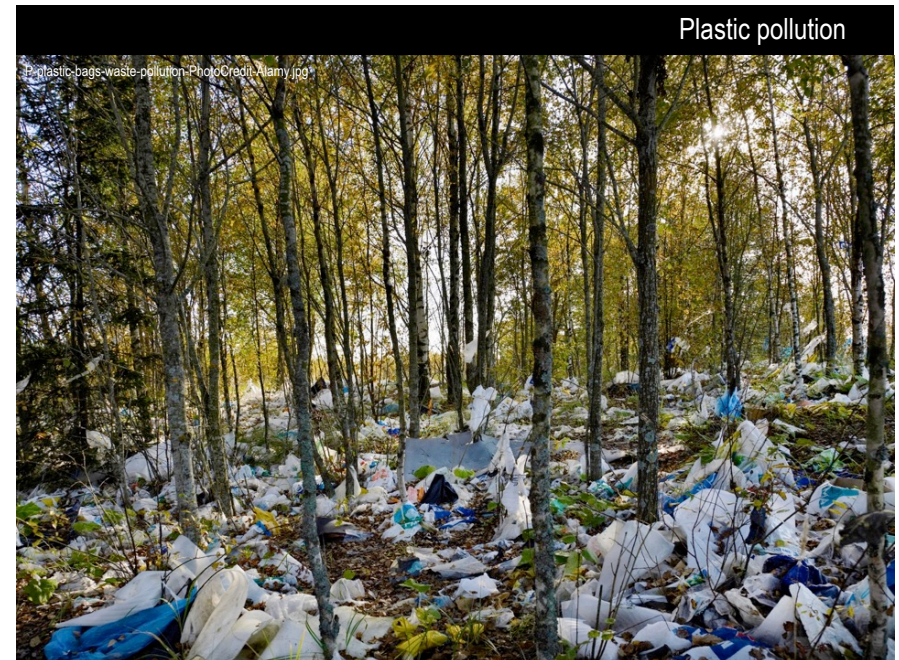


Eutrophication

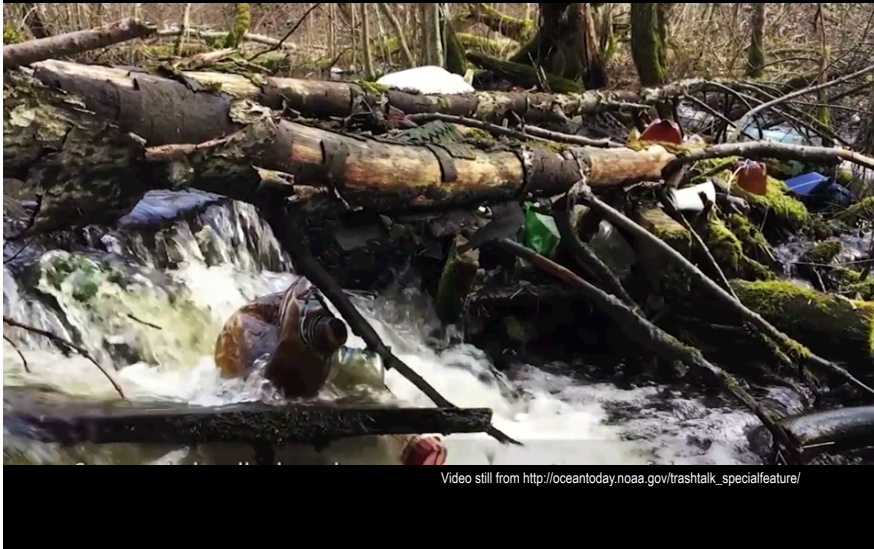


Acidification





Plastic pollution



Video still from http://oceanoday.noaa.gov/trashtalk_specialfeature/

Plastic pollution



<https://www.pinterest.com/pin/149955862563019120/>

Plastic pollution



Video still from http://oceanoday.noaa.gov/trashtalk_specialfeature/

Plastic pollution



Sometimes fishers lose their gear, like fishing traps, nets, or fishing line,

http://oceanoday.noaa.gov/trashtalk_specialfeature/



Plastic pollution



Plastic pollution



4.

Marine plastic debris – analysis and solution paths

Plastic waste input from land into the ocean

- Estimated total **production of plastic waste** in 192 costal countries (2010): **275 million metric tons (MT)**
- Estimated **1.7- 4.6%** of total plastic waste production is **leaked** into the ocean.
- Estimated production of plastic waste within 50km distance to ocean is **99.5 million MT** , of this, **31.9 million MT** are classified as **mismanaged**, of this estimated 15-40% is leaked to the ocean.
- Estimated **leakage to the ocean** in 2015: **5.5 to 14.6 million MT**
- Without drastic waste management infrastructure improvements this amount is predicted to increase by **an order of magnitude** by 2025.

Year	Mismanaged plastic waste [MMT/year]	15% marine debris (MMT)	25% marine debris (MMT)	40% marine debris (MMT)
2010	31.9	4.8	8.0	12.7
2015	36.5	5.5	9.1	14.6
2020	41.3	6.2	10.3	16.5
2025	69.9	10.5	17.5	28.0
Cumulative	618.7	92.8	154.7	247.5

J. R. Jambeck, R. Geyer, C. Wilcox, T. R. Siegler, M. Perryman, A. Andrady, R. Narayan, and K. L. Law, "Plastic waste inputs from land into the ocean," *Science*, 2015, Volume 347, Issue 6223, 768-771.

Sources, drivers, solutions (1)

- 80% of leakage originates from land-based sources, 20% comes from fisheries, fishing vessels, ocean liners, offshore platforms etc.
- Over 50% of land-based plastic-waste leakage originates in just five countries:
 - China,
 - Indonesia,
 - the Philippines,
 - Thailand,
 - and Vietnam

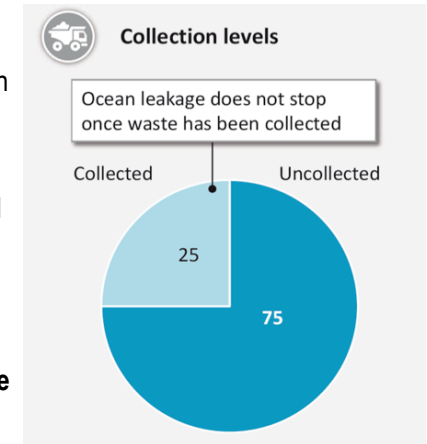


- These are the five focus countries for action
(Source: Ocean Conservancy & McKinsey Center for Business and Environment (2015). Stemming the Tide: Land-based strategies for a plastic-free ocean, p. 7)

Ocean Conservancy & McKinsey Center for Business and Environment (2015). Stemming the Tide: Land-based strategies for a plastic-free ocean, p. 7.

Sources, drivers, solutions (2)

- Of all land-based leakage 75% comes from uncollected waste and 25% leaks from within the waste-management system itself (!): Causes are improper dumping, poorly located or uncontrolled formal and informal dump sites.
- Two solution paths:
Increase collection rate and reduce post-collection leakage



Ocean Conservancy & McKinsey Center for Business and Environment (2015). Stemming the Tide: Land-based strategies for a plastic-free ocean, p. 7.

Sources, drivers, solutions (3)

- Reducing post-collection leakage** within the collection system is done by...
 - ...optimizing transport systems to eliminate illegal dumping,
 - ...and by closing or improving dump sites located near waterways.



Ocean Conservancy & McKinsey Center for Business and Environment (2015). Stemming the Tide: Land-based strategies for a plastic-free ocean, p. 8.

Coast near Lima, Peru. Photo H. Gutscher 2014

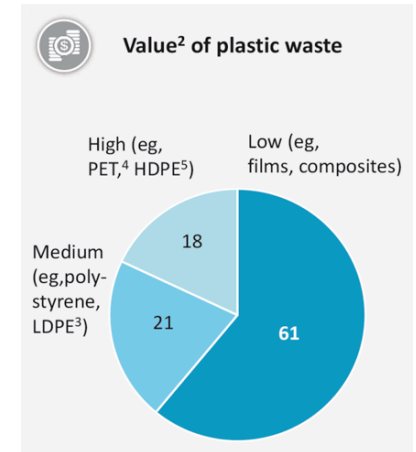
Sources, drivers, solutions (3)

- **Reducing post-collection leakage** within the collection system is done by...
...optimizing transport systems to eliminate illegal dumping,
...and by closing or improving dump sites located near waterways.
- **Increasing waste-collection rates** by expanding collection service.
The weighted average collection rate in the five focus countries should be doubled, from roughly 40 percent to nearly 80 percent.
- Using a variety of **waste-to-fuel** (e.g., gasification) or **waste-to-energy** (e.g., incineration with energy recovery) **technologies** to treat waste in areas with high waste density.
- **Manually sorting high-value plastic waste** in areas with low waste density and converting much of the remainder to refuse-derived fuel (RDF) for use in the cement industry. This RDF could replace 3 percent of total coal consumption.

Ocean Conservancy & McKinsey Center for Business and Environment (2015).
Stemming the Tide: Land-based strategies for a plastic-free ocean, p. 8.

Sources, drivers, solutions (4)

- In the five high priority countries there are no formal recycling systems.
- But there exist informal systems – waste picking by waste pickers.
- Waste picker focus their effort to high value plastic, about 20% of plastic waste-stream from cities.
- This – and their inclusion and empowerment – has to be considered in the design of any intervention.



Ocean Conservancy & McKinsey Center for Business and Environment (2015).
Stemming the Tide: Land-based strategies for a plastic-free ocean, p. 7.



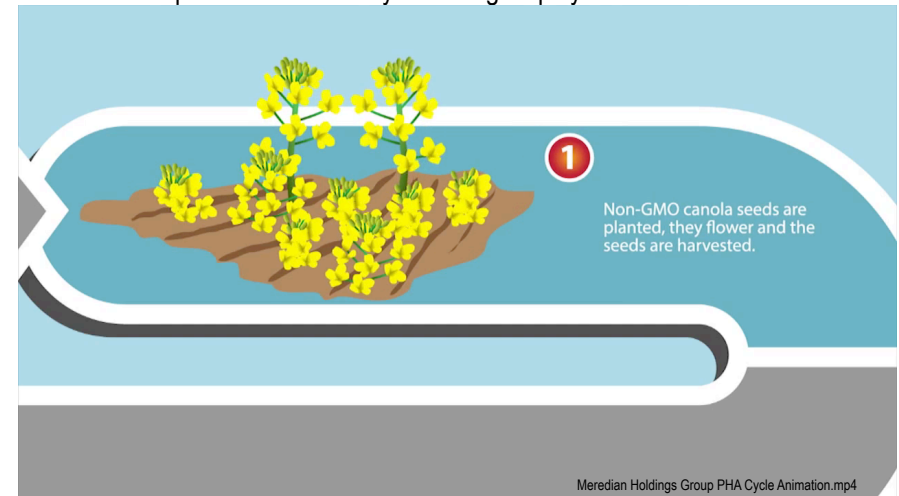
Sources, drivers, solutions (5)

- **Short term:** Accelerated development of collection infrastructure and plugging of postcollection leakage to create an almost 50 percent annual leakage reduction by 2020, which would also help ensure availability of sufficient waste feedstock to support waste treatment at scale.
- **Medium term:** Development and rollout of commercially viable treatment options to convert over 60 percent of plastic waste to material or energy, using technologies that are already viable or can be developed at an accelerated pace. This would reduce leakage by nearly 16 percent by 2025, for a total reduction of 65 percent by that year.
- **Long term:** Innovations in recovery and treatment technologies, development of new materials, product designs that better facilitate reuse or recycling, adoption of alternative food- and beverage-dispensing concepts, and adherence to the broader principles of circularity to ensure a more sustainable plastic life cycle.
- Together with the short- and medium-term initiatives, these longer-term actions have the potential to essentially eliminate plastic-waste leakage from the priority countries by 2035.

Ocean Conservancy & McKinsey Center for Business and Environment (2015).
Stemming the Tide: Land-based strategies for a plastic-free ocean, p. 9.

Sources, drivers, solutions (6)

→ New biodegradable materials example: Cold pressed Canola oil based bioplastics are naturally occurring biopolymers.



Action areas

1. **Ensure political leadership and commitment.** Obtain real and meaningful commitments from national governments, governors and mayors to set and achieve ambitious waste management targets.
2. **Secure on-the-ground wins.** Provide local “proofs of concept” for integrated waste management approaches in a number of carefully selected “beta” cities.
3. **Get critical mass.** Use lessons learned in beta cities to enable stakeholders to build a “best practice” transfer mechanism that can accelerate the transfer of global expertise to high priority cities.
4. **Pave the way for funding.** Ensure that required project investment conditions are in place in the private, public and multi-lateral sectors. Work with industry on an innovative mechanism to strategically reduce capital costs and investment risks.
5. **Facilitate technology implementation.** Equip state-of-the-art waste management technology providers with the detailed data on waste composition, volume, and pathways; local infrastructure; wage structure; scavenger systems; feedstock supply security; energy prices, feed-in tariffs and off-take agreements to enable implementation at scale.
6. **Intensify the priority.** Bring leadership and strategic focus on solutions to the ocean plastic challenge as part of the global policy agenda on the ocean.

Ocean Conservancy & McKinsey Center for Business and Environment (2015).
Stemming the Tide: Land-based strategies for a plastic-free ocean, 10.

Solid waste management in Rio de Janeiro

- COMLURB seems to strive to implement a state-of-the-art waste management system.
- Full waste collection services in parts of the city
- Problems in some high-density slum areas that do not receive full waste collection services because of the difficulty with traditional collecting processes → work in progress
- Recycling program in parts of the city, though recycling rate fairly low
- More than 1/3 of waste stream is organic, though quality issues in the composting program
- Pioneering use of landfill gas as energy source
- COMLURB Member of “Climate and Clean Air Coalition” (CCAC), a voluntary partnership uniting governments, intergovernmental and nongovernmental organizations, and representatives of civil society and the private sector in the first global effort to address emissions of short-lived climate pollutants, including methane and black carbon, as a collective challenge.
(<http://new.ccacoalition.org/en>)
- BUT: Brazil was ranked 16th among the top 20 countries by mass of mismanaged plastic waste in 2010. (J. R. Jambeck, R. Geyer, C. Wilcox, T. R. Siegler, M. Perryman, A. Andrady, R. Narayan, and K. L. Law, “Plastic waste inputs from land into the ocean,” *Science*, 2015, Volume 347, Issue 6223, 768-771. Supplementary material, Table S2.)

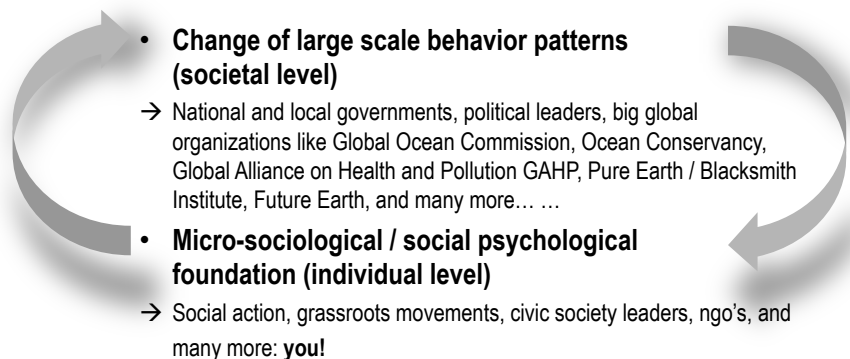


Littering

- Even if on a global scale littering accounts for mere 2 % of marine debris, it makes sense to invest some thinking into this problem.
- Rio Lixo Zero (2013)→ “One of the biggest problems we have in the city is that **bad habit of discarding waste incorrectly**, so we implemented a plan of action based on raising awareness and oversight,” Roriz told The Rio Times.
- “COMLURB spends over R\$600 million per year to collect the trash found on Rio's streets and beaches. Nearly 3,300 tons of trash are removed from public spaces every day, an amount equivalent to three Maracanã stadiums filled with litter over a year, according to O Globo.”
- “Cariocas must **change their behavior in relation to garbage...** ”

<http://riotimesonline.com/brazil-news/rio-politics/rio-lixo-zero-to-impose-fines-for-littering/>

Where does transformation start:
The chicken or egg question?



5. Implementation of change – transformation

Obtaining real and meaningful commitments from
national governments, governors and mayors

- Keep in mind: **Scientists run on truth and facts, politicians run on power, on votes.**
- If you want to gain support for your issues from politics it helps if you can demonstrate that there is voter support.
- And in the case of political support for large investments in waste-management measures “the proof of the pudding” would be a drastic change in littering behavior.

What are preconditions for transformation?

Three keys to behavior change



What is needed?

1. A sufficiently large discrepancy between **what is** and **what should be** → **No tension, no change**
2. A sufficient level of self-efficacy → **we can...solutions**
3. A sufficient sense of the **benefits of making the change** → potential for **social** and **political resonance**

S. also the discussion on climate narratives →
<http://www.yaleclimatemediaforum.org/2011/12/the-debate-over-climate-communication-heats-up/>

Where does the discrepancy arise from?

- It arises from individual perception and experience.
- In principle it's easy to see that plastic debris does not belong on the beach and in the water.
- Do "Cariocas" really see?

What do you see?



Perception needs top-down input into your brain,
a concept, a narrative...



...here comes your concept: See a dog?



Where does self-efficacy arise from?

From practising and/or being involved in new modes of knowledge production



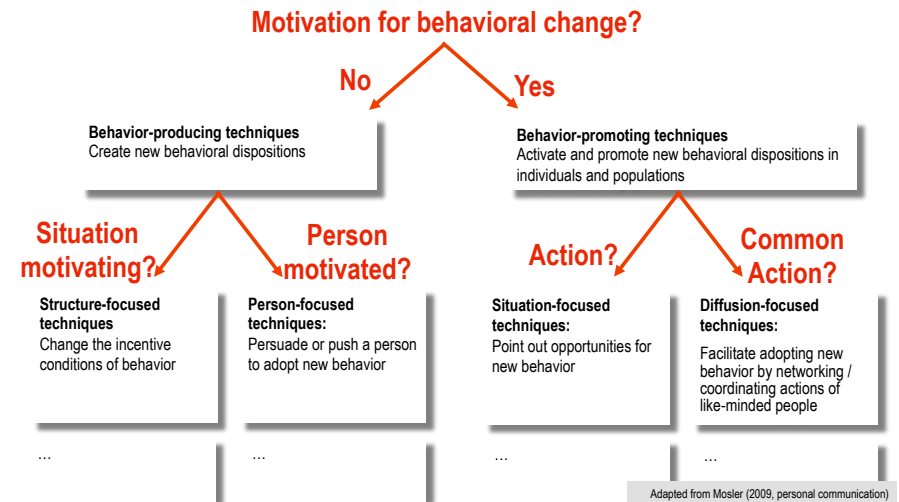
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Motives

- Waste is littered because people want to get rid of it, because it has become useless, has no value anymore...

Transformative knowledge: tools to promote individual and societal change



Adapted from Mosler (2009, personal communication)

Motives

Pro-Littering

Time costs
Cleaning costs
Brain effort
Social norm pressure
Arrogant base attitude
Ignorance / stupidity
Carelessness
Missing disposal option
Other priorities

...
...
...

Anti-Litering

Pride, reputation protection
Better business
Cleanness as a positive asset
Sense of ownership of public places
New social norm pressure
Better sense of security
Threat of cost (fines)
Saving money (deposit-refund system)
Product bans (e.g. bags)

...
...
...

We have to work on both sides,
eliminating motivational support from the pro-littering side and activating and empowering motives on the anti-littering side...

The “arts” narrative



The “fun” narrative



<https://www.youtube.com/watch?v=cbEKAwCoCKw>

The “new norm” narrative



The “new norm” narrative



The “prominent-waste-picker” narrative

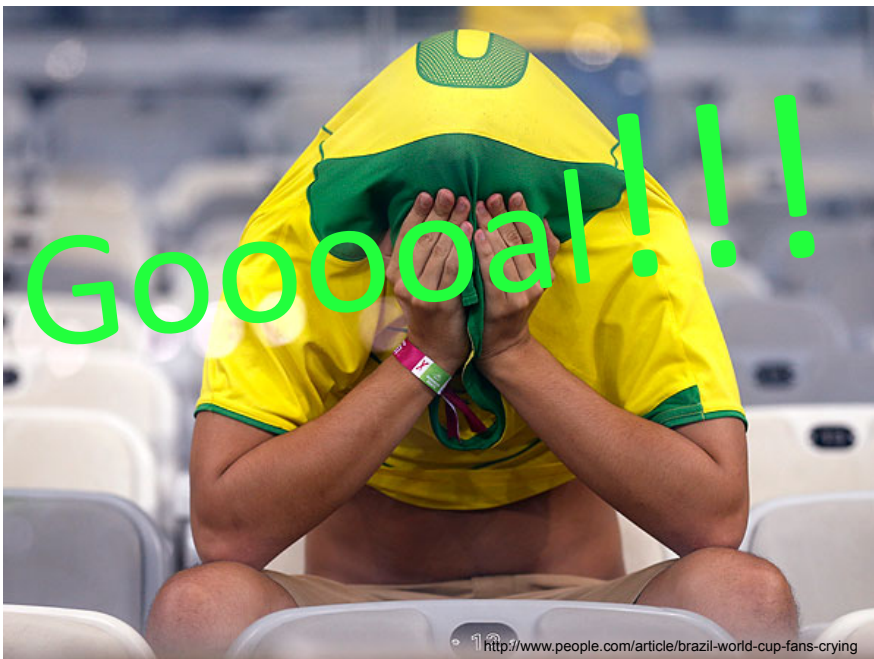


The “futebol” narrative



You can do a lot of things with waste
but never ever just let it go...!

BUT: If you do loose a piece of trash
this is going to happen....



If you dispose of properly, you win,
everybody wins, Rio wins, Brazil wins, the ocean wins!

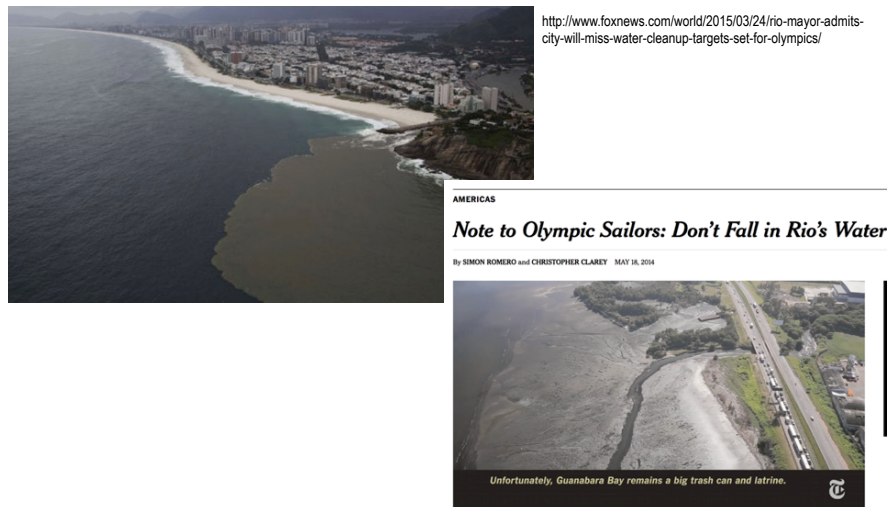


The “self-esteem” narrative

- Littering would make you feel bad about yourself: LOSER!



The “reputation” narrative (negative)



http://www.nytimes.com/2014/05/19/world/americas/memo-to-olympic-sailors-in-rio-dont-touch-the-water.html?_r=0

Two years ahead of the 2016 Summer Olympics, sailors on Rio's Guanabara Bay train in water tainted by sewage runoff and garbage from poor neighborhoods. By Jimmy Chalk on May 18, 2014. Photo by Ann Carolina Remondet for The New York Times. Watch in Times Video »

The “reputation” narrative (positive)

What does your bag
say about you?



Make a statement. Bring your own bag
every time you go to the store.

<https://www.pinterest.com/bagthebaguga/trendy-reusable-bags/>



The "waste-picking-as-a-tourist-attraction" narrative



The "accuracy in disposing" narrative



The "waste-disposing-as-a-super-cool-sport" narrative



6. Conclusion

- Identify stakeholders and powerful players
- Define your system and its borders in a co-design process, together with stakeholders
- Identify their interests and value system
- Check on barriers
- Check on available and affordable change tools
- Measure the critical variables in pretests, get baseline data.
- Consider perceived severity and perceived vulnerability (sufficient tension?)
- Consider perceived self-efficacy (enough skills, capacity?) and perceived response efficacy (is it helping to solve the problem?)
- If we want to influence and persuade people, we have to consider their actual state of mind and their actual motives. There is no other way.
- Influence determinants through modifying or complementing message components.
- Consider intrinsic/extrinsic rewards (benefits) for status quo behavior and set that in relation to perceived response costs and perceived benefits of change.