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French Alliance  
for Environmental Research



# French Research



Success  
Stories

for  
**Sustainability  
Science**



SUSTAINABLE  
DEVELOPMENT **GOALS**

The research projects presented in this document are among the most representative of Sustainability Science involving French research teams and most commonly cited within the scientific community.

The research organisations and institutions highlighted are members of the French Alliance for Environmental Research for the environment: it does not systematically represent the international research groups involved in the work described.



# Interview

from Scientific American,  
September 2019



## Sustainability Science era: how does science reinvent itself in the obligatory framework of global warming and global challenges?

Sustainability Science emerged in connection with sustainable development and a problem solving-approach. The idea is to propose solutions and to anticipate the difficulties and complex trade-offs implied by the Sustainable Development Goals<sup>1</sup>.

Many of these goals seem to beat odds with each other. But they are all potentially synergistic, too. If we work solely objective by objective, we risk improving one at the expense of the other.

Sustainability Science gained momentum at the turn of this century with the realization that global resources are finite. Its goal is to understand the entire causal chains of the ecological and social phenomena it addresses, so it must integrate key effects at all scales - from local to global. It is therefore inherently interdisciplinary. It also encourages scientists to work with the communities involved and to develop solutions for and with all actors in the field.

The National Academy of Sciences, in the United States, made Sustainability Science a priority in 1999 and the Chinese Academy of Sciences followed suit in 2009. **Scientific research devoted to this field has continued to grow exponentially since, even in the French sphere.**



### Note

1. The 17 Sustainable Development Goals have been defined in common by the UN State members

**Pr. Jean-Paul Moatti,  
CEO of the French National Research  
Institute for Sustainable Development and  
President of AllEnvi**

## Food Safety / Sustainable consumption

# 2

ZERO  
HUNGER



# 3

GOOD HEALTH  
AND WELL-BEING



# 12

RESPONSIBLE  
CONSUMPTION  
AND PRODUCTION



# Animal products for sustainable diets

**Reducing meat consumption improves the sustainability of diets by reducing greenhouse gases, eutrophication and soil acidification.** This change can however alter the nutritional value of these diets, as the bioavailability<sup>1</sup> of many essential nutrients is better when they come from animal products. In addition, the balance between foods produced within the same animal production system (e.g. beef and milk) is seldom taken into account in studies on sustainable nutrition.

To consider these two factors when determining more sustainable diets, the authors compared three diet models. The first model only requires compliance with recommended dietary allowances. The second model also takes into account the bioavailability of iron, zinc, proteins and vitamin A. The third model also integrates links between co-produced foods of animal origin.

As a result, regardless of the model, reducing the environmental impact of a diet by 30% requires drastically increasing the proportion of fruit, vegetables and starchy foods. Meat consumption must be reduced by 78% and 67% in the first two models. In the third model, it is only reduced by 32% due to the consideration of links between co-produced foods of animal origin. The latter diet could therefore gain wider public acceptance as it is more reflective of predominant eating habits.

## Note

1. Bioavailability: proportion of a nutrient in food effectively absorbed by the body. It varies depending on the food and diet of the individual concerned.

## Publication

Barre T, Perignon M, Gazan R, Vieux F, Micard V, Amiot M-J, Darmon N, *Integrating nutrient bioavailability and co-production links when identifying sustainable diets: how low should we reduce meat consumption?* *PLOS ONE* (February 2018).

DOI:10.1371/journal.pone.0191767



# Fishery: when territoriality conflicts with sustainability

Consisting of floating buoys bound together by a rope, which itself is anchored to the ocean floor, moored fish aggregating devices (moored FADs) are used to attract and aggregate migratory fish (dolphinfish, tuna), thereby improving fishery. By doing so, they contribute to food safety by helping "small" fisheries earn their livelihood.

In Guadeloupe, the use of these devices soared in the 1990s. As part of recent research, linked to SDG 14 which advocates a "sustainable use of marine resources", researchers examined the consequences of this boom in moored FADs, on the scale of Guadeloupe's Désirade island, by interviewing 33 fishermen. Their results show that the maritime space around the island is now divided into unofficial territories where 10 to 20 FADs are installed. Used more or less exclusively by a single fisherman, these virtually privatised areas cause conflicts and competition between fishermen for these territories.

Hence the excessive surge in the number of FADs, which are installed further and further, thereby resulting in greater fishermen mobility and a rise in fuel costs. As a result, the benefits of moored FADs are wasted because of the lack of regulation. Researchers hope that their work will help local authorities remedy the situation, for example by deciding to limit the number of FADs authorised per fisherman.

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## Publication

Guyader O, Frangoudes K & Kleiber D, *Existing Territories and Formalization of Territorial Use Rights for Moored Fish Aggregating Devices: the Case of Small-Scale Fisheries in the La Désirade Island (France)*, *SOCIETY & NATURAL RESOURCES*, 31:7, 822-836 (March 2018).

DOI: 10.1080/08941920.2018.1443235



## Food Safety / Sustainable fishing

2

ZERO HUNGER



12

RESPONSIBLE CONSUMPTION AND PRODUCTION



14

LIFE BELOW WATER



12

RESPONSIBLE  
CONSUMPTION  
AND PRODUCTION



14

LIFE  
BELOW WATER



15

LIFE  
ON LAND



# What are the links between biodiversity, ecosystem services and human well-being?

The notion of ecosystem services<sup>1</sup> still involves blind spots on which scientists are striving to shed light. The multiplicity and variety of their functions make it impossible to identify their quantitative and qualitative links with biodiversity: the increase in biodiversity does not necessarily go hand in hand with the enhancement of ecosystem services.

There are no rules similar to the laws of physics in this regard, and the issue should be investigated on a case-by-case basis to determine when to intervene and reinforce biological diversity in order to maintain or improve associated services. Similarly, the systematic relationship between ecosystem services and human well-being cannot be reflected in simple indicators: for example, what benefits farmers does not necessarily benefit the food industry or tourists.

These considerations can be summarised in three questions: how to integrate Human interventions into the analysis of ecosystems? Who benefits from ecosystem services? What are the best practices for the sustainable governance of ecosystem services? To address these issues in an interdisciplinary manner, experts formed a research platform within the Future Earth international programme. They intend to join forces with a view to gaining a better understanding of and more control over the sustainability of these services, and contribute to IPBES<sup>2</sup>'s research.

## Note

1. Set of values assigned to the various functions of ecosystems
2. International biodiversity platform

## Publication

Bennett E.M, Cramer W, Begossi A, Cundill G, Diaz S, et al. *Linking biodiversity, ecosystem services, and human well-being: three challenges for designing research for sustainability*, CURRENT OPINION IN ENVIRONMENTAL SUSTAINABILITY (June 2015).

DOI: 10.1016/j.cosust.2015.03.007.



# Quinoa, adaptation of sustainable farming to globalisation

**Bolivian producers are capable of producing on a large scale in response to the worldwide craze for quinoa, while retaining a sustainable farming approach.** Cultivated for 7,000 years, this small seed has become a staple food for Western consumers over the past forty years. This is an economic windfall for these small Andean producers who grow quinoa under the extreme conditions of arid and cold highlands. There is also a risk of eroding the social organisation of their communities as well as their natural resources.

To address this issue, these communities worked with French and Bolivian researchers on local and consensual solutions. Having inherited ancestral self-governance practices, Bolivian producers are committed to preserving the collective use of land within the communities, preventing the emergence of a land market. Traditionally mobile, they continue to work in both urban and rural areas, thus avoiding the pitfalls of specialisation and excessive reliance on external market forces. By reinvesting profits in nearby towns, they contribute to rebalancing regional development on the scale of the entire country.

By revising the standards governing the use of their common assets – land – quinoa producers have managed to protect their resources, ensure fair access thereto and therefore satisfy the criteria of international fair trade. Growing the "Inca seed" is a great example of resilience and adaptation to sustainability issues.

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## Publication

Winkel T, Bommel P, Chevarría-Lazo M, Cortes G, Del Castillo C, Gasselin P, Léger F, Nina-Laura JP, Rambal S, Tichit M, Tourrand JF, Vacher JJ, Vassas-Toral A, Vieira-Pak M, Joffre R ; *Panarchy of an indigenous agroecosystem in the globalized market: The quinoa production in the Bolivian Altiplano*; GLOBAL ENVIRONMENTAL CHANGE 39 (2016): 195–204.  
DOI:10.1016/j.gloenvcha.2016.05.007.



## Climate Change Adaptation / Land degradation / Resources

1

NO  
POVERTY



8

DECENT WORK AND  
ECONOMIC GROWTH



12

RESPONSIBLE  
CONSUMPTION  
AND PRODUCTION



Coastal protection /  
Environment /  
Adaptation to  
climate change

9

INDUSTRY INNOVATION  
AND INFRASTRUCTURE



13

CLIMATE  
ACTION



14

LIFE  
BELOW WATER



# Facing extreme events, predicting marine submersion

The demographic attractiveness of coastal areas increases the vulnerability of populations to marine submersion<sup>1</sup> and erosion. If the evolution of storms and cyclones with climate change remains uncertain, the rise in sea level will inexorably increase submersion in the coming decades.

The ANR SPICY projects (2014-2018, pilot site in Reunion Island) and RISCOPE (2017-2021, pilot site in Brittany) are experimentally developing methods and tools allowing, starting from the operational marine-weather forecasts, to identify the stakes of a territory exposed to submersion. These projects use innovative techniques to deal with uncertainty management issues (for example, via overall simulations) and computing times (using, among other things, the development of meta-models).

By implementing multidisciplinary approaches, based on the needs of crisis managers and questioning their practices, the purpose of SPICY and RISCOPE is also to produce decision support tools and informations that can be directly used by communities and State services (trafficability, power cuts, etc.). On a large scale, these projects contribute to raising awareness on the effects of climate change.

## Note

1. Temporary flooding of the coastal zone by the sea in meteorological conditions (strong depression and sea wind) and severe tides

## Publication

Rohmer J., Lecacheux S., Pedreros R, Bonnardot F., Quetelard, H. *Dynamic parameter sensitivity in numerical modeling of cyclone-induced waves: a multi-look approach using advanced meta-modelling techniques*, NATURAL HAZARDS (August 2016);

DOI: 10.1007/s11069-016-2513-8

<http://spicy.brgm.fr>

<https://perso.math.univ-toulouse.fr/riscope/>



# Global warming: how to improve the understanding of ecosystem stability

## Gains and losses in terms of species diversity affect environmental stability and the sustainability of ecosystem functions and services.

Various models and experiments have already highlighted positive and negative effects, as well as diversity's lack of effect on the three individual components of stability: temporal variability, resistance and resilience.

In this study, researchers examined communities of aquatic ciliates<sup>1</sup> to understand how the temporal variability, resistance and overall stability of the ecosystem reacted to diversity, i.e. species richness.

They found that species richness increased temporal stability but reduced resistance to warming: two stability components therefore co-varied negatively<sup>2</sup>.

As a result, by linking the concept of ecosystem multifunctionality to that of ecosystem stability, researchers suggest that the perceived effects of diversity on environmental stability can be changed, and that this knowledge can be translated into pertinent information in order to driver ecosystem preservation policies.

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## Notes

1. Group of microscopic living beings, abundant in ponds and stagnant water, easily identified by their cells covered with short cilia. They form a large part of freshwater plankton.
2. Few biodiversity manipulation studies have found such negative covariation, despite general predictions on the negative effects of diversity on the individual components of stability.

## Publication

Pennekamp F, Pontarp M, Tabi A, Altermatt F, Alther R, *Biodiversity increases and decreases ecosystem stability*, NATURE (October 2018), DOI:10.1038/s41586-018-0627-8



Aquatic biodiversity / Sustainable Communities / Impact of climate change / Vulnerability and Integrated Coastal Management

11

SUSTAINABLE CITIES AND COMMUNITIES



13

CLIMATE ACTION



14

LIFE BELOW WATER



Aquatic biodiversity / Sustainable Communities / Impact of climate change / Vulnerability and Integrated Coastal Management

12

RESPONSIBLE CONSUMPTION AND PRODUCTION



14

LIFE BELOW WATER



17

PARTNERSHIPS FOR THE GOALS



# New, more global regulations on fisheries

***Argopecten purpuratus*, more commonly known as “Chilean scallop”, is of vital economic importance for Chile**, as it is exported to Europe. However, the harvesting - legal and illegal - of this species has led to a sharp decline in its natural populations.

Therefore, in the late 1990s, the Chilean government created the Rinconada Marine Reserve (north-east of the country), where fishing for this species is prohibited. To assess the effectiveness of this measure, a French-Chilean team analysed the reproduction and evolution of the population of *A. purpuratus* within the reserve, as well as the proportion of small and large individuals, from 2001 to 2009.

Researchers saw – among other things – a 28% drop in the number of individuals between May 2003 et May 2009, as well as the mass disappearance of large scallops. Biologists believe these results are direct evidence of illegal fishing in the reserve.

"The failure of current policies and scallop conservation strategies calls for new rules to restore stock sizes, maintain reproductive performance and limit illegal fishing", researchers advocate. They believe that "regulated fishery, with fishing quotas depending on available stocks, would effectively guarantee the recovery and sustainability of stocks".

## Publication

Avendano M, Cantallinez M, Thouzeau G, *Evidence of clandestine harvest and failure of conservation policies for *Argopecten purpuratus* in the Rinconada Marine Reserve (Chile)*. AQUATIC CONSERVATION. 2017; 27: 588–603.

DOI: 10.1002/aqc.2721



# One Health: 360° view of health and the environment

**Circulation of infectious agents, spread and emergence of epizootic<sup>1</sup>, zoonotic diseases<sup>2</sup> and epidemics, risk of a pandemic... serious crises such as bird flu, chikungunya, Ebola or Zika** have recently shown that health safety must be viewed on a worldwide scale, from a global and cross-cutting perspective, and by factoring in human health, animal health, plant health, ecosystem health and biodiversity as well as their interactions.

This is the purpose of the One Health concept, created in 2004, and the authors of this article suggest extending the scope of this concept to non-communicable chronic diseases related to exposure to multiple stressors. Furthermore, this concept cannot be separated from the notion of Ecosystem Health, i.e. the growing impact on human health and well-being of an increasingly polluted planet with dwindling resources.

An ecosystem approach, involving physicians, veterinarians, biologists and ecologists, was used to identify the origin and develop appropriate tools to combat schistosomiasis in Corsica in the 2010s. While the One Health approach has yet to fully integrate scientific and political institutional organisations, the authors stress the need to take into account ecological, evolutionary and environmental sciences to understand and control the emergence and re-emergence of infectious diseases and to address the issues raised by antimicrobial and pesticide resistance.

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## Notes

1. Epidemic affecting a specific animal population.
2. Diseases and infections whose agents are passed from animals to humans, and vice versa

## Publication

Destoumieux-Garzón D, Mavingui P, Boetsch G, Boissier J, Darriet F, Duboz P, Fritsch C, Giraudoux P, Le Roux F, Morand S, Paillard C, Pontier D, Sueur C and Voituron Y, *The One Health Concept: 10 Years Old and a Long Road Ahead*. FRONTIERS IN VETERINARY SCIENCE, 2018, 5:14.

DOI: 10.3389/fvets.2018.00014



Claude Bernard



Health /  
Environment /  
Ecosystems

3

GOOD HEALTH  
AND WELL-BEING



13

CLIMATE  
ACTION



15

LIFE  
ON LAND





Climate Change  
Adaptation /  
Sustainable Cities /  
Water Resources

3

GOOD HEALTH  
AND WELL-BEING



11

SUSTAINABLE CITIES  
AND COMMUNITIES



13

CLIMATE  
ACTION



# Adapting cities to heat waves

In a context of climate change, the increase in the frequency and duration of heat waves, enhanced by the urban heat island phenomenon, is a major health risk for the inhabitants of many cities.

Adaptation strategies such as the greening of cities are often proposed to mitigate the urban heat island, because the vegetation allows to regulate the urban microclimate by evapotranspiration. The effectivity of these strategies, however, depends on the irrigation of the vegetation, which raises the issues of the water availability and of the volume of water to supply for the effectiveness of the mitigation strategy.

In this study, the researchers compared the impact of scenarios of vegetation watering and pavement watering for the Paris urban area that would have developed along a "Business as usual" and with and under heatwave conditions as expected in 2100. Their results show that the vegetation watering, though using a large amount of water, is necessary and efficient in reducing air temperature and heat stress, but mainly in residential areas where vegetation density is high enough. Pavement watering is only relevant in the densely built city center, where it provides daytime local cooling with much more lesser water consumption than for vegetation.

## Publication

Daniel, M, Lemonsu A and Vigié V : *Role of watering practices in large-scale urban planning strategies to face the heat-wave risk in future climate.* URBAN CLIMATE, 23, 287–308 (March 2018)  
DOI:10.1016/j.uclim.2016.11.001



# Optimising the food chain, or soil-to-plate sustainability

**Feeding a larger than ever population, and feeding it properly, is a real challenge for scientists.** Optimising the food chain is both their goal, i.e. designing healthy, acceptable and sustainable diets, and their method, i.e. identifying through mathematical modelling the combinations most likely to meet all sustainable nutrition requirements. The objective is to taken into account multiple health recommendations, a variety of nutritional situations, extremely varied economic, social and cultural contexts, and reconcile often diverging production factors and environmental concerns.

This publication encourages us to reflect on a diet that responds to the contradictory challenges of junk food and lifestyle diseases in developed countries and Global South cities, and of malnutrition and hunger elsewhere. These new diets must also include the extra costs associated with quality food, the eating habits or acceptance of populations... Similarly, production methods should be arbitrated on the basis of nutritional as well as environmental criteria, including the impact of intensive farming, food security issues and the challenge of preserving resources and the climate.

The sustainable nutrition equation is extremely complex and mathematics are an essential tool to bring about tomorrow's virtuous diets, from soil to plate.

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## Publication

Gazan R, Brouzes, CMC, Vieux F, Maillot M, Lluch A, Darmon N, *Mathematical Optimization to Explore Tomorrow's Sustainable Diets: A Narrative Review*, ADVANCES IN NUTRITION, 2018;9:602–616.

DOI: 10.1093/advances/nmy049



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Food Safety /  
Sustainable  
consumption

2



ZERO  
HUNGER

3



GOOD HEALTH  
AND WELL-BEING

12



RESPONSIBLE  
CONSUMPTION  
AND PRODUCTION



Fight against global  
warming / Sustainable  
production

2

ZERO  
HUNGER

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INDUSTRY INNOVATION  
AND INFRASTRUCTURE

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CLIMATE  
ACTION

## 4 per 1,000 initiative, the solution through soils

Launched during COP 21, the "4 per 1,000: soils for food security and the climate" initiative underlines the role played by soil organic carbon (SOC) in the following three areas: food and nutritional security, adaptation to climate change and mitigation of the impact of human activities.

The initiative has determined an ambitious objective of 4 per 1,000 (i.e. 0.4%) annual increase in worldwide stocks of soil organic carbon, particularly in agricultural land, with a view to sequestering an amount of carbon in the soil equivalent to the annual increase in greenhouse gases.

Calculated in relation to the SOC stocks of all soils throughout the world, this 4 per 1,000 target reflects the technical sequestration potential of these soils. However, because of socio-economic constraints, the achievable potential is probably substantially lower.

The 4 per 1,000 target must therefore be implemented by taking into account the reference levels of differentiated SOC stocks.

Terrestrial negative emissions resulting from sequestration could make a significant contribution to reducing anthropogenic CO<sub>2</sub> equivalent emissions, identified based on contributions determined at national level and pledged by the countries as part of the Paris agreement on climate.

Consequently, the 4 per 1,000 initiative promotes "no-regret" solutions for agriculture insofar as the increase in SOC also helps improve the soil's fertility and ability to adapt to climate change. Care must be taken to help stakeholders develop these practices over long periods (20 years) while guaranteeing the economic and social conditions for their implementation. Researchers, stakeholders, decision-makers (public, private, etc.) must therefore work together towards this end.

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### Publication

Soussana JF, Lutfalla S, Ehrhardt F, Rosenstock T, Lamanna C, Havlik P, Richards M, Wollenberg E, Chotte JL et al. *Matching policy and science: rationale for the '4 per 1000 – soils for food security and climate' initiative*. SOIL & TILLAGE RESEARCH. (May 2019).  
DOI: 10.1016/j.still.2017.12.002.



# Coastal groundwater faced with global and societal changes

In Brazil, as in many emerging countries, demographic pressure is so strong in coastal areas that water resources are becoming scarce: coastal groundwater is exposed to salinisation and contamination. The COQUEIRAL project (Water quality issues in the urban environment of Recife) analyses these degradation mechanisms (salinisation/contamination), relying in particular on a societal and structural approach, via the example of the city of Recife.

The Recife region is a “hotspot” with characteristics typical of emerging countries, such as urbanisation, unequal distribution of wealth, governance issues, rapid industrial and tourism development, etc. This leads to strong pressure on water resources (quantity and quality) in a context of global, societal and environmental changes.

This original, multi-disciplinary approach to the degradation of water resources involves sociological aspects of water management, collective and individual issues, practices and related perceptions, by examining the specific urbanisation and water governance conditions in Recife.

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## Publication

Petelet-Giraud E, Cary L, Cary P, Guillaume B, Giglio-Jacquemot A, et al. *Multi-layered water resources, management, and uses under the impacts of global changes in a southern coastal metropolis: When will it be already too late? Crossed analysis in Recife, NE Brazil*. SCIENCE OF THE TOTAL ENVIRONMENT, 2018, 618, pp.645-657. [10.1016/j.scitotenv.2017.07.228].



Water pollution /  
Coastal protection /  
Environment

6

CLEAN WATER  
AND SANITATION



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CLIMATE  
ACTION



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LIFE  
BELOW WATER



Food Safety /  
Sustainable production  
and consumption

1

NO  
POVERTY



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LIFE  
BELOW WATER



17

PARTNERSHIPS  
FOR THE GOALS



# Objectives and limitations of the long-term management of fisheries

**Fish stock conservation, minimal impact on the environment, but also survival of fishermen, development of local fisheries: to advise fishing regulation authorities in the best possible way, scientist must establish multi-dimensional objectives as well as limits beyond which fishing is no longer acceptable or sustainable.** An international team analysed the studies published as well as research in this field, presented during the "ICES/Myfish" international symposium on this subject. Organised by the International council for the exploration of the sea (ICES) in Athens (Greece) at the end of 2015, it brought together more than 70 experts from around the world.

The researchers' aim was to identify ways to take better account of environmental, economic, social and institutional considerations when determining fishing objectives and limits.

They ultimately suggested ten avenues to achieve this, such as "extend collaboration between ecological, economic and social scientists", "clearly define the composition and influence of stakeholders in decision-making processes" or "build and maintain trust, interaction, common ground and common language in conjunction with the stakeholders". With a major pre-requisite: "determine ecological, economic and social indicators agreed upon and clearly linked to management measures".

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## Publication

Rindorf A, Dichmont C, Thorson J, Charles A, 5, Clausen L., Degnbol P, Garcia D, Hintzen N, Kempf A, Levin P, Mace P, Maravelias C, Minto C, Mumford J, Pascoe S, Prellezo R, Punt A, Reid D, Roeckmann C, Stephenson R, Thebaud O, Tserpes G, Voss R, *Inclusion of ecological, economic, social, and institutional considerations when setting targets and limits for multispecies fisheries*, ICES JOURNAL OF MARINE SCIENCE (January 2017), 74(2), 453–463.  
DOI:10.1093/icesjms/fsw226



# Sustainable bait

**Lugworms are marine benthic polychaete worms that inhabit coastal ecosystems. Although they are harvested by anglers, who use them as bait, they are not considered fish species. In the absence of a regulatory framework, this harvesting activity can therefore result in declining sand worm populations, while altering the physical characteristics of beaches and biodiversity.**

On four sites of a marine protected area (MPA) in the Manche department in France, researchers assessed the abundance, spatial distribution and life history traits of two cryptic species of burrowing sand lugworms<sup>1</sup>.

The comparison between abundance data and data on the harvesting of this bait reveals the need for a management plan on certain sites to ensure the sustainability of the activity.

It was estimated that the retail value associated with the harvesting of lugworms in the MPA is similar to that of shrimp. These results confirm the need to define regulations on fishing for this bait, and to learn how to differentiate between the two species.



## Note

1. Cryptic species show little or no morphological differences, but differ at a genetic level.

## Publication

De Cubber L, Lefebvre S, Fisseau C, Cornille V, Gaudron S-M, *Linking life-history traits, spatial distribution and abundance of two species of lugworms to bait collection: A case study for sustainable management plan*, MARINE ENVIRONMENTAL RESEARCH (July 2018)

DOI: 10.1016/j.marenvres.2018.07.009



Aquatic biodiversity / Sustainable Communities / Impact of climate change / Vulnerability and Integrated Coastal Management

10

REDUCED INEQUALITIES



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CLIMATE ACTION



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LIFE BELOW WATER



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GOOD HEALTH  
AND WELL-BEING



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SUSTAINABLE CITIES  
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CLIMATE  
ACTION



## Note

1. Co-developed by Ineris and CNRS and used in particular for the national forecast portal, [www.prevoir.org](http://www.prevoir.org) and the Copernicus Atmosphere Monitoring Service

# Improving air quality: the co-benefits of climate change mitigation

**Air quality and climate change are strongly linked.** This link has consequences for both mitigation and adaptation to climate change strategies. In terms of mitigation, climate policies involve energy efficiency measures and other technological measures that also have an impact on air pollutant emissions. In terms of adaptation, atmospheric chemistry is sensitive to climate change, which is also reflected in the frequency and severity of meteorological phenomena, which may lead to the formation of pollution episodes (for example, heat waves and related ozone pollution).

To quantify these interactions, modeling suites have been developed by coupling climate and atmospheric chemistry models at different spatial scales. With respect to air quality, the *Chimere air quality model* has been coupled with various emission projections for air pollutant management strategies, to evaluate associated costs and benefits.

The future increase in ozone pollution induced by climate change is now well established. But it is also shown that the evolution of the future concentrations of ozone and particulate matter remains largely dependent to the reduction of emissions of atmospheric pollutants and their precursors. Which motivates the development of tailored mitigation strategies.

Modelling studies also show that the health benefits associated with improved air quality almost outweigh the costs of climate change mitigation policies. According to the Global Energy Assessment scenarios, the costs of mitigating climate change to limit global warming to 2 degrees by the end of the century would reach 65 billion euros per year in 2050, whereas that the tangible and intangible health benefits generated would amount 62 billion euros. So that air quality constitutes a substantial positive externality of climate change mitigation.

## Publication

Schucht S, Colette A, Rao S, Holland M, Schoepp W, Kolp P, Klimont Z, Bessagne B, Szopa S, Vautard R, Brignon JM and Rouil L. *Moving towards ambitious climate policies: Monetised health benefits from improved air quality could offset mitigation costs in Europe*, ENVIRONMENTAL SCIENCE & POLICY 50 (2015), pp. 252-269.

DOI: 10.1016/j.envsci.2015.03.001



# Collaborative research for resilient urban services



**When applied to the city, the concept of resilience may be defined as the ability of an urban system to withstand disruption and regain its functions following this disruption.** This overall definition does not however allow for the precise definition of what a resilient city is, all the more so as the required characteristics for this status are often contradictory: autonomous yet connected, redundant yet efficient, flexible yet robust. . . .

The current challenge is to help local authorities and urban stakeholders understand and apply the resilience approach. The technical networks and urban services which contribute to urban development provide a very interesting case study for the application of this concept. The authors successfully tested an integration and collaboration approach, in conjunction with the department heads of the city of Paris. During the initial stage, every manager completed a self-assessment to identify their department's dependencies and ability to remain operational in the event of disruptions. Workshops were subsequently organised to raise the managers' awareness of their interdependencies and foster the debate with a view to finding technical and organisational solutions as part of an integrated approach. Lastly, this macroscopic analysis was complemented by a territorial analysis of the resilience of urban services.

The results of this study show that managers can base their strategy on the protection, adaptation or rather recovery of their service. However, these parameters are sometimes contradictory and pose a threat to the resilience of the overall system.

By highlighting the various strategies implemented by the managers, the region's resilience can be examined on different scales: the urban service, the urban services system, the city of Paris and its metropolitan area. Spatial and temporal aspects emphasise the shortcomings as well as leeway in terms of the management of resilient urban services.

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## Publication

Toubin M, Laganier R, Diab Y, Serre D, *Improving the Conditions for Urban Resilience through Collaborative Learning of Parisian Urban Services*, JOURNAL OF URBAN PLANNING AND DEVELOPMENT (July 2014)  
DOI: 10.1061/(ASCE)UP.1943-5444.0000229



Reduction of  
inequalities /  
Economic growth /  
Reduced ecological  
footprint

9

INDUSTRY INNOVATION  
AND INFRASTRUCTURE



11

SUSTAINABLE CITIES  
AND COMMUNITIES



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CLIMATE  
ACTION





French Alliance  
for Environmental Research

## French Alliance for Environmental Research

### FOUNDERS



### ASSOCIATE MEMBERS

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