ΠΑΝΕΠΙΣΤΗΜΙΟ ΑΘΗΝΩΝ, Α΄ ΕΡΓΑΣΤΗΡΙΟ ΠΑΘΟΛΟΓΙΚΗΣ ΑΝΑΤΟΜΙΚΗΣ

ΠΡΟΓΡΑΜΜΑ ΜΕΤΑΠΤΥΧΙΑΚΩΝ ΣΠΟΥΔΩΝ

«ΠΕΡΙΒΑΛΛΟΝ ΚΑΙ ΥΓΕΙΑ. ΔΙΑΧΕΙΡΙΣΗ ΠΕΡΙΒΑΛΛΟΝΤΙΚΩΝ ΘΕΜΑΤΩΝ ΜΕ ΕΠΙΠΤΩΣΕΙΣ ΣΤΗΝ ΥΓΕΙΑ»

MSc: "Environment and Health. Capacity building for decision making"

Επιστημονική Υπεύθυνη και Διευθύντρια ΠΜΣ

Αν. Καθ. Πολυξένη Νικολοπούλου-Σταμάτη

Τίτλος ΜΔΕ :

Resilience Building for Health, the Environment and Disaster Risk Reduction, in the Context of Rio+20

Οικοδομώντας την ελαστική προσαρμοστικότητα στους τομείς της Υγείας, του Περιβάλλοντος και της Μείωσης Διακινδύνευσης Καταστροφών, στο πλαίσιο της πολιτικής του Ρίο+20

Όνομα: ΑΝΝΑ ΠΑΠΑΧΑΤΖΗ
Αριθμός μητρώου: 2010670
Α΄ πτυχίο ΑΕΙ: ΑΡΧΙΤΕΚΤΩΝ ΜΗΧΑΝΙΚΟΣ
Επιβλέπων καθηγητής: Pr. LUC HENS

ΑΘΗΝΑ 2014

ΠΑΝΕΠΙΣΤΗΜΙΟ ΑΘΗΝΩΝ, Α΄ ΕΡΓΑΣΤΗΡΙΟ ΠΑΘΟΛΟΓΙΚΗΣ ΑΝΑΤΟΜΙΚΗΣ

ΠΡΟΓΡΑΜΜΑ ΜΕΤΑΠΤΥΧΙΑΚΩΝ ΣΠΟΥΔΩΝ

«ΠΕΡΙΒΑΛΛΟΝ ΚΑΙ ΥΓΕΙΑ. ΔΙΑΧΕΙΡΙΣΗ ΠΕΡΙΒΑΛΛΟΝΤΙΚΩΝ ΘΕΜΑΤΩΝ ΜΕ ΕΠΙΠΤΩΣΕΙΣ ΣΤΗΝ ΥΓΕΙΑ»

MSc: "Environment and Health. Capacity building for decision making"

Επιστημονική Υπεύθυνη και Διευθύντρια ΠΜΣ

Αν. Καθ. Πολυξένη Νικολοπούλου-Σταμάτη

Τίτλος ΜΔΕ :

Resilience Building for Health, the Environment and Disaster Risk Reduction, in the Context of Rio+20

Οικοδομώντας την ελαστική προσαρμοστικότητα στους τομείς της Υγείας, του Περιβάλλοντος και της Μείωσης Διακινδύνευσης Καταστροφών, στο πλαίσιο της πολιτικής του Ρίο+20

Όνομα: ΑΝΝΑ ΠΑΠΑΧΑΤΖΗ
Αριθμός μητρώου: 2010670
Α΄ πτυχίο ΑΕΙ: ΑΡΧΙΤΕΚΤΩΝ ΜΗΧΑΝΙΚΟΣ

Επιβλέπων καθηγητής: Pr. LUC HENS
Πρόεδρος Επιτροπής: Αν. Καθ. ΠΟΛΥΞΕΝΗ ΣΤΑΜΑΤΗ-ΝΙΚΟΛΟΠΟΥΛΟΥ
Μέλος Επιτροπής: Αν. Καθ. ΑΝΔΡΕΑΣ ΛΑΖΑΡΗΣ

ΑΘΗΝΑ 2014

Table of Contents

List of figures, charts, tables, maps

SUMMARY

Health was described as a pillar of Sustainable Development [SD] in 1992. In Rio+20 Declaration it is considered as precondition for, outcome of, indicator of SD in all its three dimensions – Environment/Economy/Society. At the same time health is unequivocally the major issue at stake, because it is affected directly and indirectly by the tremendous effects of human influence to the environment.

SD brought together the great global issues of peace, freedom, development, and environment. One of the key reasons for the lack of progress on SD since the first Earth Summit in 1992 has been the delay to address successfully this integrated approach. The emergence of sustainability science in the 21st century as a new interdisciplinary, unified scientific endeavor, engaged the scientific community with policy makers, aiming to address the overarching objectives of sustainability in a common scheme. Some trends concerning environment and life support show that there has been some progress towards SD while several others prove that sustainability if far from being achieved. Such is the case of the elimination of poverty and hunger.

Sustainability is inextricably linked to basic questions of equity —fairness, social justice and greater access to a better quality of life. Although 23% of the global disease burden is attributable to the environment sustainability is not exclusively or even primarily an environmental issue, but it is fundamental about how we choose to live our lives with an awareness that everything we do has consequences for billions of others and many ecosystems. Environmental degradation intensifies inequality through adverse impacts on already disadvantaged people and inequalities in human development amplify environmental degradation. Climate change is probably the greatest global agent of environmental inequity. This combination of increasing hazard and decreasing resilience makes climate change a global driver of disaster risk that will increase the impact of disasters on the poor and already disadvantaged.

The choice of inaction violating moral and ethical principles, the "Business-As-Usual" choice leading to the collapse of essential ecological services, the "Dynamics-As-Usual" model pointing towards the path of incremental improvements in reaction to perceived crises, will soon put our global commons at great risk. Our common future needs far-reaching approaches, risk and policy driven, not disaster or event driven and a shift toward a long-term perspective that aims to anticipate the troubles ahead. Such is the approach introduced by Rio+20, the milestone for international development policy which set the groundwork for a new transformative paradigm for SD that fully integrates its three dimensions, looking through the prism of human rights and deprivations and our fragile planet.

Almost two years after the Rio+20 declaration, there is a clear call for action in a number of thematic areas and cross-cutting issues related to health and well-

being, which share common development objectives as well as common threats. The incremental effects of anthropogenic climate change are contributing directly to the global burden of disease as well as indirectly by deteriorating the interrelated systems. Although the need to meet primary health care needs, to control communicable diseases, to protect vulnerable groups, to address urban health challenges, and to reduce health risks from environmental pollution and hazards was clear in Agenda 21, emerging issues such as non-communicable diseases (NCDs) and the health consequences of combined climate - environmental changes were not addressed.

The importance of managing the effects to health and SD from the current patterns of development and the anthropogenic interference with climate- the biggest global threat of 21st century- is unequivocal. Rio+20 addressed the current gaps in SD and their implications on global health.

Physical sites and urban settlements can generate urban pathologies and vulnerabilities which may lead to future disasters. The exposure of populations to natural risks and the scientific certainty that along with twenty-first century has come the age of mega disasters led Rio+20 to emphasize the importance of increasing the number of urban settlements that are implementing policies for sustainable urban planning and design in order to respond effectively to the expected growth of urban populations in coming decades.

A great number of global health challenges are posed by the unsustainable urban planning that leads through several different paths to environmental and health implications and the manifestation of health risks. Unsustainable patterns of development also affect health through a complex relationship with globalization due to the exposure to health impairing conditions and access to health care.

Unsustainable urban growth leads to deterioration of the same environmental elements that quality of life actually relies on; good air quality, low noise levels, clean and sufficient water, high quality public spaces, thermal comfort in local and microclimate, and social equity. Climate change, as a magnifier and multiplier of underlying risks shaping the global burden of disease, poses a real threat to cities' development and competitiveness, as extreme weather or climate events threaten to damage infrastructure, reduce efficiency, and exacerbate urban poverty. Rio+20 underlined the importance of considering disaster risk reduction, resilience and climate change in sustainable urban planning for a safe and healthy living environment.

The urban determinants of health refer to the socioeconomic, cultural and environmental conditions that influence the health of individuals and populations, such as the urban governance, the natural and built environment, the social and economic environment, food security and quality, services and health emergency management. Health determinants have combined to create a triple threat of "urban

diseases and health conditions", which consists of infectious communicable diseases, noncommunicable diseases (NCDs), injuries and violence.

Climate change has already been changing the geographic distribution, frequency and intensity of weather-related hazards. Climate change can affect health by six ways: changing patterns of disease and morbidity, food, water and sanitation, shelter and human settlements, extreme events, and population and migration. There is very high confidence that climate change currently contributes to the global burden of disease and premature deaths. Climate change not only introduces new threats to global health, but also threatens to reverse the progress that the global public health community has been making against many diseases.

This combination of increasing hazard and decreasing resilience makes climate change a global driver, magnifier and multiplier of disaster risk. As climate change may be "the biggest global health threat of the 21st century", and as it works synergistically with urbanization to increase disease burdens, understanding of both the risks to health as well as the health co-benefits of addressing climate change through adaptation and mitigation is extremely important.

Preventable environmental causes of ill-health and mortality led to Rio +20 commitment to promote sustainable development policies aiming to safe and healthy living environment for all. To effectively address the present and emerging challenges for global health, and seize new opportunities for development, Rio+20 recognized the need of a holistic approach interpreted in two ways; either as the triad of health and SD which shows how health and environment-economy-society relate in order to develop sustainably, or as the triangle of disaster risk management which expresses the need for a more integrated approach to disaster risk management and underlines the importance of addressing disaster risk reduction, resilience and climate change as a common.

Disaster risk is associated with unsustainable elements of development. Conversely disaster risk reduction can contribute to achieving SD. The International Strategy for Disaster Reduction [ISDR] aims at supporting global disaster risk reduction measures to ensure a safer world. Europe and Greece embraced ISDR, forming respectively the UNISDR Europe and the NHP-DRR. The HNP-DRR has a focus on reducing the risk of hazards occurring with a major frequency and having a big social and economic impact.

Rio+20 draw the policy framework for the Hyogo Framework of Action 2005-2015. The "new deal" is the shift of Disaster Risk Management Policy from effective response and recovery to Disaster Risk Reduction. Being the new paradigm, risk management is embedded in development processes. The dynamic relationship of climate change, health and the environment justifies the credence to the HFA as a policy framework appropriate for managing risks that either result directly and/or indirectly to health or have health at their epicenter. In order to ensure an

effective integration of SD to DRR frameworks, a more proactive approach with policies, monitoring mechanisms, and formal periodic review processes is implemented.

In the midst of the systemic environmental – societal and economic crisis the HFA is adopted and already under implementation in Europe, and Greece. The HFA is a vehicle for cooperation by Governments, organizations and civil society actors toward achieving "The substantial reduction of disaster losses, in lives and the social, economic and environmental assets of communities and countries".

Thinking on resilience within climate change has been influenced by two schools; disaster risk and SES, so that in the face of natural disasters and climate change resilience has become associated with systems regenerative abilities and capacity to maintain desired functions in the face of shocks and stress. The common denominator of the above approaches is the system's ability to sustain a structural and functional integrity when it is being threatened.

In order to help highlighting, strengthening and promoting resilience for health risk reduction there could be drawn an analogy between resilience and the mechanism of homeostasis for maintaining internal viability and the defense of physiological events essential for well-being of the body. The analogy between homesostasis and resilience refers to the impact of resilience on disaster risk mitigation or to the ability of a system to build and increase the capacity for learning and adapting, thus improving.

In resilience thinking focusing more on processes than outcomes can serve better the long-term perspective of sustainable scenarios, instead of short-term recovery measures that may not take into account vulnerability changes with time and probable emergence of new vulnerability versions in the future. While traditionally there was an overreliance on preparedness and response to disasters, changing the focus to risk reduction and developing resilience does more to prevent potential hazards from becoming disasters. The importance of learning, innovation, leadership, and adaptive management is emphasized within this more forward looking aspect of resilience.

The major goal of health risk management in the context of Rio+20 is not the reduction of disaster loss per se, but encouraging social improvement through sustainable development and human welfare and well-being. Rio+20 recognized that goals of SD can only be achieved where populations can reach a state of physical, mental and social well-being. The WHO definition describes health as "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity." Well-being is getting at the center of policies as it is considered a possible reorientation for 21st-century public policy goals.

The physical, social and attitudinal environment can function either as barriers or facilitators of the person's functioning. Resilience as a positively charged concept

is a facilitator of healthy life and well-being. Well-being and health are interactive concepts with some common determinants, such as health system, the broader political, economic and social context, as well as other intermediary factors, such as the degree of social stratification or exposures that could either increase or reduce vulnerabilities.

Concepts like salutogenesis, resilience and social capital focus on well-being. Health assets operate therefore as a 'resilience factor' in disease risk exposure, as protective factors to buffer against life's stresses and as promoting factors to maximize opportunities for health and well-being.

Implementing the HFA in the case of outdoor air pollution in Greece is suggested due to the nature of the threat to health of the exposed population and the set of laws and official policies introduced as a response to the particular crisis. It is worth observing that the new context of uncertainties and weaknesses lacks a sense of sustainable direction and drives recovery paths that may lead to more exposure and less resilience, thus even greater vulnerability in an after all unrecovered riskscape.

Key words: urban pathologies, urban health determinants, climate change, disaster risk drivers, sustainable development, Rio +20, social inequity, environmental degradation, emerging global threats, resilience, homeostasis, well-being, HFA

CONCEPTUAL FRAMEWORK

This study is rooted in the assumption that Rio+20 and the Hyogo Framework for Action 2005-2015- its vehicle for cooperation by Governments, organizations and civil society actors toward achieving "The substantial reduction of disaster losses, in lives and the social, economic and environmental assets of communities and countries"- give shape to the environment that could accommodate the challenges of environmental threats to health, particular of climate change, and deal with any future scenarios it may generate.

To support this assumption, three reference fields are examined; the road from Rio Declaration on Environment and Development in 1992 to Rio+20 in 2012; the environmental challenges for health in the 21st century; and the Disaster Risk Reduction in a common scheme with Resilience and Climate Change.

Rio +20 was adopted in the Conference of Sustainable Development in 2012. Consequently, Chapter 1 discusses the idea of Sustainable Development, and how it has evolved so far. The gaps and the challenges to its implementation in health sector are also examined. A reasonable question is whether SD is the panacea that will deal with the contemporary as well as the emerging threats which pose global health risks and may threaten our common future. To answer the main question four following questions are addressed:

1) Why do the political and scientific global stage still examine health issues in the context of Rio Declaration, twenty years after it was addressed?
2) Has SD "delivered" since 1992 in terms of environmental protection, economic development and social equity?
3) What were and what are the main gaps for the implementation of SD Goals?
4) In what way do Rio+20 policy relates to the environment and health in the era of global, emerging threats?

Chapter 2 further discusses the environmental challenges to health in the 21st century and explores the disaster landscape. It focuses on the environmental degradation with direct and indirect adverse effects on health, as well as social and environmental determinants of health. Unsustainable urbanization and climate change are two major health determinants contributing to the global burden of disease, largely due to preventable diseases. The critical question is how can ill-health and mortality- especially the preventable- be addressed properly in the particular risk and policy scape. What is the new deal for Rio+20 in this context?

To uncover the nature of the threats to health in order to address them properly, the following questions are being examined:

1) What are the root causes of environmental degradation and its manifestations?

2) Which are the environmental and social health determinants and how do they affect health?

3) How can preventable health threats be addressed by managing environmental health determinants?

4) How does the holistic approach proposed by Rio+20 serve the objective?

The focus of Chapter 3 is on Disaster Risk Reduction addressed as a common with resilience and climate change. Risk management and its evolution in times of SD and climate change as well as the Rio+20 mandate, call for the Hyogo Framework for Action 2005-2015 being implemented to address environmental health threats. To set the foundation for resilience building in health and the environment, realizing the core meaning of resilience is of great importance. Thus, resilience is examined through the lens of far-reaching aiming that supports sustainability and well-being assets that enhance health. Furthermore, analogies are drawn between resilience and homeostasis, the mechanism of adaptation and improvement. The Greek case-study has an interesting institutional framework that was established as a response to the environmental and health risks generated by the particular air pollution episodes. The critical question is whether there has been given a sustainable direction to the suggested policies, leading to less exposure and more resilience, thus reduced vulnerability and finally disaster risk reduction, which is a strategic goal of Rio+20 and Hyogo Framework for Action. Answering that will affirm the hypothesis that HFA could adequately address the challenges of environmental threats to health, particularity in the era of climate change.

The questions examined are:

1) How can health risks be addressed through the HFA?

2) How can resilience be built for health and the environment?

3) What are the aspects in the recent case of Greek outdoor air pollution suggesting the implementation of HFA?

Chapter 1 From Rio Declaration on Environment and Development in 1992 to Rio+20.

1.1 Sustainable Development. The story so far

"In a few decades, the relationship between the environment, resources and conflict may seem almost as obvious as the connection we see today between human rights, democracy and peace[*]*."*

Wangari Maathai (1940 - 2011), environmental activist,
first African woman to receive the Nobel Peace Prize in 2004

What are the main trends that sustainable development (SD) has truly affected at the global level since 1992? It is rather difficult to say as sustainability science is a field defined by the problems it addresses rather than the disciplines it employs, similar to health science. Different conclusions are reached by choosing different scopes and completely different time scales. With numerous assessments that differ in terms of scope, scale, organization, process, participation, resources, policy, perspective and data, SD's landscape is too diverse for general observations (United Nations 2013, 3).

However, it is undoubtable that SD brought together the great global issues of peace, freedom, development, and environment. All of the above universal aspirations are closely interlinked. The Brundtland report in 1987, entitled *Our Common Future*, popularized the concept of SD which was later adopted as an overarching objective by Governments at the Earth Summit of 1992 in Rio de Janeiro, together with Rio Principles and the global action plan Agenda 21[†]. This policy framework emerged with limited scientific input, but it didn't either adequately reflect the fast changing geo-political reality and emerging global risks. Rio declaration in 1992 embraced integrating economic growth, social equity and environmental sustainability. In Johannesburg in 2002 overarching objectives of, and essential requirements for sustainable development were poverty, sustainable consumption and production, and environmental protection. Since then an enormous amount of literature has been produced from political and academic circles, to civil society, to national and international development institutions with broad assessments coming for the

[*] http://centrum.humanitasafrika.cz/en/african-update/178/tribute-to-wangari-maathai

[†] Agenda 21 is a comprehensive plan of action to be taken globally, nationally and locally by organizations of the United Nations System, Governments, and Major Groups in every area in which human impacts on the environment.
http://sustainabledevelopment.un.org/content/documents/Agenda21.pdf

Millennium ecosystem assessment[*], IPCC reports[†] and yearly reports on the status of Millennium Development Goals[‡] (Le Blanc 2012). The highly interrelated nature of these objectives, the limited resources at their disposal, and the long implementation processes involved made their comprehensive and integrated approach highly significant. One of the key reasons for the lack of progress on SD since the first Earth Summit in 1992 has been the delay to address successfully this integrated approach. Consequently, the expected outcomes - elimination of poverty, reduction of disparities in standard living, patterns of consumption and production compatible with the carrying capacity of ecosystems, sustainable management of renewable resources- and the agreed means to achieve them have not materialized nor has the development agenda embraced "the needs of the present without compromising the ability of future generations to meet their own needs"[§] (Le Blanc 2012). The emergence of sustainability science in the 21st century as a new interdisciplinary, unified scientific endeavor, engaged the scientific community with policy makers, aiming to address the overarching objectives of sustainability in a common scheme.

1.2 Current and emerging gaps in SD and their implications on global health

1.2.1 Environmental degradation and inequities

Some trends towards sustainable development concerning environment and life support show that there has been some progress at the expense of worsening trends in other respects (Figure 1). This progress can be measured for example at the protected terrestrial and marine areas that have been greatly expanded, at temperate and boreal forests that have been reforesting since the 1980s, at concentrations of local air pollutants that have decreased in some areas, at ozone layer that is on a long-term path to stabilization by 2020/2030. On the opposite line, several other trends show that in many cases development is far from being achieved. For example unabated loss of biodiversity by at least 10% its pre-human levels. Fewer forests, more land for agriculture until 2030 and reversing afterwards. Collapse of ocean fisheries; high human induced impacts are showed on marine ecosystems in 41 per cent of the oceans in 2012. One-half of the terrestrial ecosystems and one-quarter of

[*] Millennium Ecosystem Assessment, 2005. Ecosystems and Human Well-being: Synthesis. Island Press, Washington, DC. http://www.maweb.org/documents/document.356.aspx.pdf

[†] http://www.ipcc.ch/publications_and_data/publications_and_data_reports.shtml#.Usuzq_RdVW8

[‡] Millennium Development Goals: 1.Eradicate extreme poverty and hunger 2.Achieve universal primary education 3.Promote gender equality and empower women 4.Reduce child mortality 5.Improve maternal health 6.Combat HIV / AIDS, malaria and other diseases 7.Ensure environmental sustainability 8.Develop a global partnership for development http://www.undp.org/content/undp/en/home/mdgoverview/

[§] sustainable is the "development which meets the needs of the present without compromising the ability of future generations to meet their own needs." the Brundtland report, Our Common Future, 1987

the freshwater supply are developing with anthropogenic interference. Global deterioration of urban air pollution and accelerated increase in GHG emissions support global warming. Although enormous achievements have been made during the last decades implying social sustainable development, yet we have not managed to eliminate poverty and hunger. That leads to 383 million employed people getting by on less than US$1.25 per day, and 850 million people suffering from hunger, numbers which have hardly changed over several decades. There exist 200 million more slum dwellers today than twenty years ago and 2.4 billion people lack access to basic sanitation. Water pollution continues to claim the lives of millions; 88% of the diarrhoeal deaths are due to unsafe water (WHO 2014), while 740 million people lack access to safe drinking water. Human interference with phosphorus and nitrogen cycles is well beyond safe thresholds. Although life expectancy extended by 22 years since 1950, there are persistent gaps between regions and a widening gap between

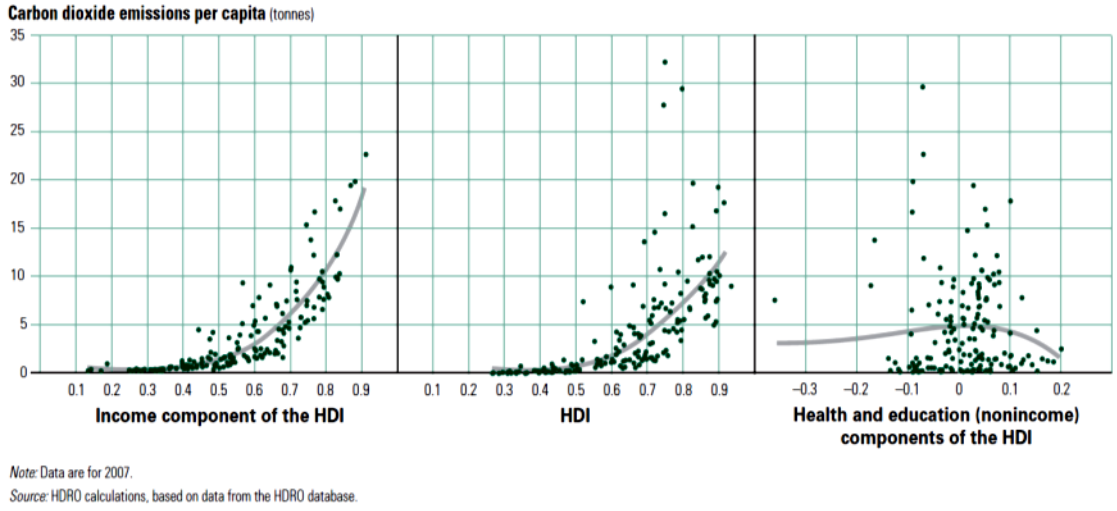


Figure 1 The association with carbon dioxide emissions per capita is positive and strong for income, positive for the HDI and nonexistent for health and education, from UNDP, Human Development Report 2011, Sustainability and Equity: A better Future for All, p. 5

men and women (UN Department of Economic and Social Affairs, Population Division 2013, 39), and our DALY's* have increased (United Nations 2013, 5-6). Furth more, Agenda 21 has succeeded in making limited progress, and mainly on a sector by sector basis, without integrating approach for analysis and decision making (United Nations 2013, 7).

Although 23% of the global disease burden† is attributable to the environment (WHO 2014) sustainability is not exclusively or even primarily an environmental

* One DALY can be thought of as one lost year of "healthy" life. The sum of these DALYs across the population, or the burden of disease, can be thought of as a measurement of the gap between current health status and an ideal health situation where the entire population lives to an advanced age, free of disease and disability. http://www.who.int/healthinfo/global_burden_disease/metrics_daly/en/

† The burden of disease is a measurement of the gap between a population's current health and the optimal state where all people attain full life expectancy without suffering major ill-health.

issue, but it is fundamental about how we choose to live our lives with an awareness that everything we do has consequences for billions of others and many ecosystems. In this context, sustainability is inextricably linked to basic questions of equity — fairness, social justice and greater access to a better quality of life, according to the UN Development Programme's Human Development Report 2011 (UN, Human Development Report Team 2011).

Environmental degradation intensifies inequality through adverse impacts on already disadvantaged people and inequalities in human development amplify environmental degradation (UN, Human Development Report Team 2011, 1). Significant, persistent and avoidable differences in opportunities to health and risk of illness and premature death are very impressive in European Region, with the difference between the lowest and highest life expectancy at birth being 16 years (WHO-Regional Office for Europe 2013, 46). Climate change is probably the greatest global agent of environmental inequity, as it has brought benefits to affluent societies yet most of the burdens fall on developing countries. Changes in the climate means threaten to undermine the resilience of poorer countries and their citizens to absorb loss and recover from disaster impacts, through for example, decreases in agricultural productivity, water and energy stress, and increasing disease vectors. This combination of increasing hazard and decreasing resilience makes climate change a global driver of disaster risk that will increase the impact of disasters on the poor (UN 2009, 15). In many cases the most disadvantaged people bear and will continue to bear the repercussions of environmental deterioration, even if they contribute little to the problem* (UN, Human Development Report Team 2011, 3). The burden is not borne equally, as the risk of injury and death due to extreme weather events is higher among children, women and elderly (UN, Human Development Report Team 2011, 9). A striking observation following Hurricane Katrina reflects even one more aspect of intra-generational inequalities:

> *Live images of uncollected corpses and families clinging to rooftops made vivid what decades of statistics could not: that being poor in America, and especially being poor and black in a poor southern state, is still hazardous to your health.*[†]
>
> *(Atkins and Moy 2005)*

On one hand there are those who believe that the choice of inaction violates moral and ethical principles. Future generations will face a drastically reduced universe of possible choices as pursuing "Business-As-Usual" (BAU) will lead to the

---

Reference: Modified definition (WHO, 2000). Loss of health in populations is measured in disability-adjusted life years (DALYs), which is the sum of years of life lost due to premature death and years lived with disability (Smith, Cho Tang and Nutbeam 2006, 2).

[*] HDRO calculations based on data from the HDRO database and B. Hughes, M. Irfan, J. Moyer, D. Rothman, and J. Solorzano, 2011, "Forecasting the Impacts of Environmental Constraints on Human Development," Human Development Research Paper, United Nations Development Programme, New York, who draw on forecasts from International Futures, Version 6:42.

[†] http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1261174/

collapse of essential ecological services. On the other hand, technology optimists let the future and richer generations pay for the cleanup that needs to be done after our choices[*]. Another large part of general public and politicians is not willing to pay the price now in the hope that future generations will gain from the shift to sustainability (Le Blanc 2012). After all it is a difficult call to trade future gains with immediate losses, especially for those who lack the moral imperative to ensure that the present is not the enemy of the future or don't feel the collective responsibility towards the least privileged among us today and in the future around the world, as Helen Clark[†] pointed out in the Human Development Report 2011.

As far as the path to our common future and the magnitude and dynamics of the future sustainability challenges are concerned, experts express impressively strong consensus about the major sustainability issues and the broad direction of trends. Many BAU scenarios have explored the potential consequences of the world continuing its dominant development model. "Dynamics-As-Usual" (DAU) are the most recent scenarios of this type, and the closest to future projections. According to them, if we continue the historical path of incremental improvements in reaction to perceived crises, instead of a shift toward a long-term perspective that aims to anticipate the troubles ahead, in 2050 our global commons will be at great risk (Le Blanc, 2012, p. 5). The world will be with persistent poverty and hunger, more crowded and thirsty; two thirds of world population will be living under water stress. One billion people will be without access to basic services, energy-hungry and still fossil-fueled. Although economy will thrive, some of the most vulnerable and poorest economies will remain marginalized (Le Blanc, 2012, pp. 5-6). Furthermore, humanity will be witnessing detrimental threats to its social fabric as we know it. In this context, our common future needs far-reaching approaches, risk and policy driven, not disaster or event driven (Rosenberg 2011, 177).

Rio+20, as a sustainable summit, was a milestone for international development policy. Following on from the UN Millennium Summit in 2000 and the establishments of the Millennium Development Goals (MDG's), and giving direction to the MDG's after 2015, Rio+20 represented the starting point of new processes. The decisions made set the groundwork for a new transformative paradigm for SD that fully integrates its three dimensions […*The goals should address and incorporate in a balanced way all three dimensions of sustainable development and their interlinkages*…] (UN 2012, 47). It also reached a shared understanding of how to integrate equity into policies and programmes generating positive synergies. Its objectives were to secure renewed political commitment and to assess the progress to

[*] as a classic example of Environmental Kuznets Curve. This is a hypothesized relationship between various indicators of environmental degradation and income per capita. In the early stages of economic growth degradation and pollution increase, but beyond some level of income per capita (which will vary for different indicators) the trend reverses, so that at high-income levels economic growth leads to environmental improvement. This implies that the environmental impact indicator is an inverted U-shaped function of income per capita.

[†] Administrator in the United Nations Development Programme

date and remaining gaps in implementation of outcomes from previous summits, as well as to address new and emerging challenges. As Rio+20 was formed in a world with many preoccupations about emerging and unprecedented challenges (e.g. global financial crisis, climate change, food crisis, energy crisis) it tried to look at development from the prism of human rights and deprivations and our fragile planet.

1.3 The challenge of addressing health issues in the context of Rio+20

Almost two years after the Rio+20 declaration, the main challenge and aspiration for Rio+20 is whether this time it will better serve humanity and show commitment to SD goals by addressing the current global challenges and health issues in particular. From the point of view of Stakeholder Forum* and Natural Resources Defense Council (NRDC)† (Stakeholder Forum, Natural Resources Defence Council 2012) the key issues, in terms of the "grade"‡ of looming commitment to goals that Rio+20 established, are: a) the establishment of an intergovernmental process to develop SDG§, b) the establishment of a high-level political forum on SD**, and c) the establishment of an intergovernmental committee to develop an effective SD financing strategy††. The above are considered as landmark commitments due to their crucial role in shaping the agenda of SD. Other significant commitments formulating the Institutional Framework for SD (IFSD) are: the strengthening of the role of the UNEP‡‡, b) the integration of the three dimensions of SD across the UN system§§, c) ensuring the rights of future generations*** (Stakeholder Forum, Natural Resources Defence Council 2012, 8-21).

Furthermore, Rio+20 calls for action in a number of thematic areas and cross-cutting issues relating to health and well-being: Health and population; food security and nutrition and sustainable agriculture; water and sanitation; energy and sustainable energy for all; employment, decent work and social protection; oceans and seas; sustainable fisheries; disaster risk reduction; climate change; biodiversity; forests and mountains; mining; land degradation-desertification and drought; chemicals and waste; sustainable production and consumption; sustainable tourism and transport; sustainable cities and human settlement; education, gender equality and women's empowerment, small island developing countries and least developed countries (UN 2012). All the mentioned areas have external, interrelating dimensions and they share

* Nonprofit International Organization
† Nonprofit environmental advocacy organization
‡ Estimated by the language in the outcome document, the originality of the goal and the ability to monitor the progress of the commitment.
§ §248-249 of the Rio+20 outcome document
** §84-86 of the Rio+20 outcome document
†† §255-257 of the Rio+20 outcome document
‡‡ §88 of the Rio+20 outcome document
§§ §93 of the Rio+20 outcome document
*** §86 of the Rio+20 outcome document

common development objectives as well as common threats. They interact in many direct and indirect ways, through a complex set of interdependent relationships. Therefore, they altogether contribute to a shared understanding of the global challenges.

Regarding health and population in particular, the rest of human and natural systems addressed by Rio+20 exert significant pressures on human health and vice versa, anthropogenic interference poses serious risks to them. In addition, the incremental effects of anthropogenic climate change are contributing directly to the global burden of disease as well as indirectly by deteriorating the other systems with changes in their exposure and vulnerability. Rio+20 addressed the current gaps in SD and their implications on global health. Since 1992, Agenda 21[*] has served as a roadmap for designing and implementing SD plans at the national level. In Chapter 6, concerning protection and promotion of human health, the emphasis was on five areas; the need to meet primary health care needs, to control communicable diseases, to protect vulnerable groups, to address urban health challenges, and to reduce health risk from environmental pollution and hazards. Nevertheless, emerging issues such as non-communicable diseases (NCDs) and the health consequences of climate and environmental changes were not clearly incorporated. Since then, the World Health Organization (WHO) and other agencies have attempted to address these concerns in many occasions [†] (WHO, PAN AMERICAN HEALTH ORGANIZATION 2011).

The importance of managing the effects to health and SD from the current patterns of development and the anthropogenic interference with climate- the biggest global threat of 21st century- is unequivocal. Health is recognized in the outcome document of Rio+20 as a precondition for, an outcome of, and an indicator of all three dimensions of SD (UN 2012, 27). And yet, it could be argued that this recognition is not that striking. Although in the 1992 Rio Declaration of the United Nations Conference on Environment and Development health was described as a pillar of SD, in the outcome document of Rio+20 there was a focus on inequity and the three dimensions of SD (Table 1). The opposing argument would be that this shift of interest can be interpreted as an acknowledgment of the fact that health issues are actually integrated in all these aspects of *the future we want* (UN 2012) and thus they should be addressed through every thematic or integrated policy aiming to promote a fairer and more sustainable world, especially in a context of the emerging global threats.

[*] http://sustainabledevelopment.un.org/content/documents/Agenda21.pdf

[†] e.g. Commission on Health and Environment (1992), the Commission on Macro Economics and Health (2001), the Commission on the Social Determinants of Health (2005).

RIO DECLARATION ON ENVIRONMENT AND DEVELOPMENT (UN 1993) *Principle 1* *Human beings are at the center of concerns for sustainable development.* *They are entitled to a **healthy** and productive life in harmony with nature.* *RIO DECLARATION ON ENVIRONMENT AND DEVELOPMENT (UN 2012)* *Annex: THE FUTURE WE WANT* *I. Our Common Vision* *6. We recognize that people are the center of sustainable development and in this regard, we strive for a world which is just, equitable and inclusive, and we commit to work together to promote sustained and inclusive economic growth, social development, environmental protection and thereby to benefit all.*

Table 1 Health in the context of SD in Rio Declarations in 1992 and 2012

Chapter 2 Environmental challenges for health in the 21st century

2.1 The disaster landscape of the 21st century

> *For fortified towns the following general principles are to be observed. First comes the choice of a very healthy site. Such a site will be high, neither misty nor frosty, and in a climate neither too hot nor cold, but temperate; further, without marshes in the neighborhood.*
>
> Vitruvius, Book I, chapter 4 §1: The site of a city
> (Vitruvius 27-36 BC [1914], 17)

In the 21st century our perception of urbanism is formed by a set of spatial characteristics such as urban consumption patterns, demographic weight, traffic volumes, flows of capital, labour, goods or environmental footprint, rather than walls and neighborhoods. Urban sustainability is aimed through sectoral development policies, goals and targets with spatial dimension, such as improving health and decreasing poverty; improving energy efficiency; increasing water efficiency and re-use; improving the resilience of cities to natural disaster risks; and many others. Nevertheless, it is the physical site and the structure of an urban settlement rather than all the complex dynamics that make the root causes of urban pathologies and vulnerabilities which may lead to future disasters. Such pathologies, in both their strongest sense of the term as well as the metaphorical are discussed in the following section.

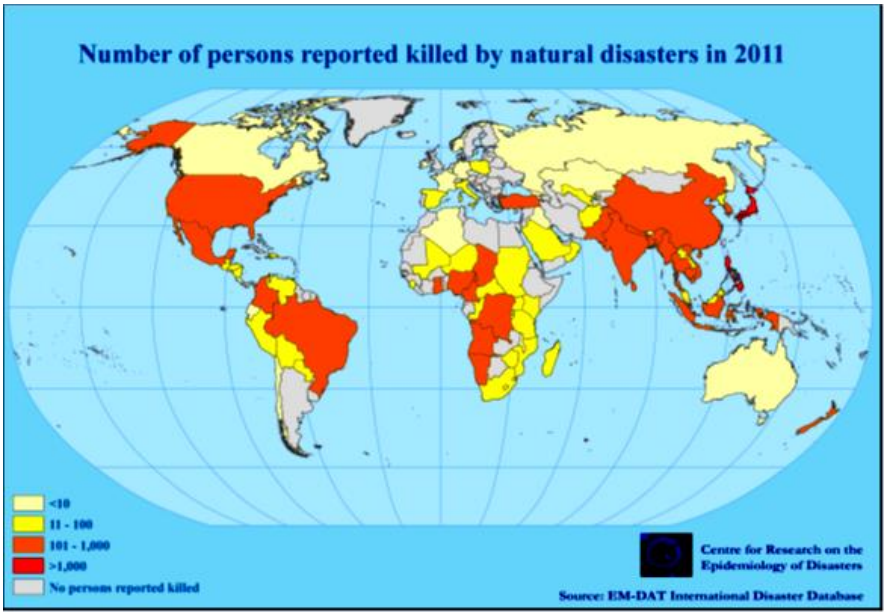
More than half the world's population lives in cities and is expected to be 67 per cent urban in 2050. The urban areas of the world are expected to absorb all the population growth expected over the next four decades and most of it is expected to be concentrated in the cities and towns of the less developed regions (UN Department of Economic and Social Affairs, Population Division 2012, 1-2).

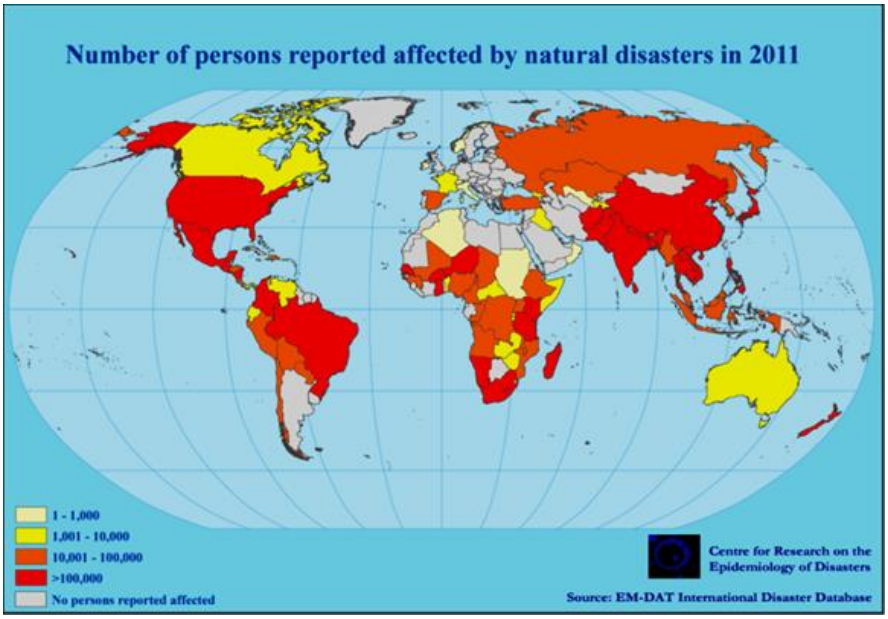
Millions of people annually are affected by different types of disasters (natural, technological, natech*, biological, societal). In 2011, about 890 million people were living in areas of high risk of exposure to at least one natural hazard (Σφάλμα! Το αρχείο προέλευσης της αναφοράς δεν βρέθηκε.). Between half and two thirds of the cities with 1 million inhabitants or more are located in areas that face high risk of exposure to at least one natural disaster (UN Department of Economic and Social Affairs, Population Division 2012, 17). 663 million people are potentially

* A natech disaster is a technological accident triggered by a natural disaster which results in significant adverse effects to the health of people, property, and/or the environment. The technological accident can include damage to industrial facilities and damage to lifelines systems that can hamper response to the accident.

affected by flooding, which is the most frequent and greatest hazard for the 633 largest cities or urban agglomerations, with 233 of them located in or close to areas with a high risk of flooding, and 148 of them not being coastal cities (UN Department of Economic and Social Affairs, Population Division 2012, 17). 277 million people live in some of the largest cities of the world at high risk of droughts and 229 million reside in cities at high risk of cyclones (UN Department of Economic and Social Affairs, Population Division 2012, 17). Larger population in urban areas, especially along coastal regions, not only result in more people being exposed to environmental hazards but also to disasters. And it is a not only a common perception but also a scientific certainty that along with twenty-first century has come the age of mega

disasters, with surprising alterations in number, type, clusters, sequences, rates of change, volatility, and non-linearities.





Map 1 Numbers of persons reported killed and affected by natural disasters in 2011 http://www.emdat.be/sites/default/files/Maps/2011/prepress-killed2011.pdf, http://www.emdat.be/sites/defaul t/files/Map s/2011/prepress-affected2011.pdf

Disasters have the tendency to visualize the social ills of a location or society (Miller and Rivera 2008). According to the EM-DAT*, from 2000 to 2013 there have been 788 natural disasters in Europe alone, which resulted in 140.350 deaths, 33.529 injured people, 11.878.094 affected people, 190.263 homeless people, 12.101.886 total affected and total damage of 162.289.391.000 USD.† Floods are the most common natural disaster in Europe. In recent years, Europe has witnessed some of the largest flooding events in its history. Indeed, 7 out of the 20 most important floods ever recorded in Europe (in terms of the total reported number of affected people) occurred during the 2000-2009 decade. Recent major flooding events include the 2007 floods in the United Kingdom and the Elbe and Danube river floods during the summer of 2002. Over the last decade, floods in Europe have killed more than 1000 people and affected over 3,4 million others. Over the last 30 years, worldwide a total of 3.119 floods resulted in more than 200,000 deaths and affected more than 2,8 billion people (Debarati 2010, 14).

Although each disaster offers a chance to seize opportunities and to address social challenges, rarely are communities, nations or regions prepared for and capable of absorbing the shocks caused by natural or human induced risks. Realizing the need to enhance public perception about environmental and urban challenges to global health and in order to support the efforts towards the implementation of sustainable strategies-goals-measures and actions, Rio +20 emphasized the importance of increasing the number of metropolitan regions, cities and towns that are implementing policies for sustainable urban planning and design in order to respond effectively to the expected growth of urban populations in coming decades (UN 2012, 26).

2.1.1 Definitions of Hazard, Risk, Exposure, Vulnerability, Disaster and Disaster risk

To deal with the environmental challenges for health in the 21st century is important to start with the definitions of hazard, risk, exposure, vulnerability, disaster and disaster risk, since they go hand in hand with both the concepts of environment and health. Besides, they are broadly used in different scientific areas related to risk management, where perspectives from several distinct sciences and research

* Since 1988 the WHO Collaborating Centre for Research on the Epidemiology of Disasters (CRED) has been maintaining an Emergency Events Database EM-DAT, which was created with the initial support of the WHO and the Belgian Government. CRED was established in 1973 as a non-profit institution, with international status under the Belgian Law, and became a World health Organization Collaborating Centre in 1980. The main objective of EM-DAT is to serve the purposes of humanitarian action at national and international levels. It is an initiative aimed to rationalize decision making for disaster preparedness, as well as providing an objective base for vulnerability assessment and priority setting. It contains essential core data on the occurrence and effects of over 18,000 mass disasters in the world from 1900 to present. http://www.emdat.be/ (assessed in 30/1/14)

† http://cred01.epid.ucl.ac.be:5317/?after=2000&before=2013&continent%5B%5D=Europe&dis_group%5B%5D=Natural&agg1=dis_group&agg2=

communities are unfolded to provide important insights into the status of knowledge base which are not only the different goals, viewpoints and approaches that are brought together to provide the integration of knowledge, but the vocabularies and terminology as well. Largely since the field of risk management lacks research activities concerning its basic key – concepts that would safe guard the autonomy and its cognitive characteristics, the definitions are useful not only to avoid misinterpretations and misconceptions which are common thing in interdisciplinary collaborations, but also as the foundations for the development of new concepts, central to the contemporary understanding and evolving practice of disaster risk reduction (Sapountzaki 2007) (V. Masoura 2009) (Masoura, Sapountzaki and Katsogiannou 2013).

Hazard is a dangerous phenomenon, substance, human activity or condition that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage, according to UN International Strategy for Disaster Reduction (UNISDR)‡. In technical settings, hazards are described quantitatively by the likely frequency of occurrence of different intensities for different areas, as determined from historical data or scientific analysis. (UNISDR 2009, 17).

Risk is the combination of the probability of an event and its negative consequences. The term has two distinctive connotations; in popular usage the emphasis is usually placed on the concept of chance or possibility; whereas in technical settings the emphasis is usually placed on the consequences, in terms of "potential losses" for some particular cause, place and period (UNISDR 2009, 25). Also, risk factor expresses social, economic or biological status, behaviours or environments which are associated with or cause increased susceptibility to a specific disease, ill health, or injury. As is the case with risk behaviours, once risk factors have been identified, they can become the entry point or focus for health promotion strategies and actions (WHO/HPR/HEP 1998, 28).

Exposure is people, property, systems, or other elements present in hazard zones that are thereby subject to potential losses. Measures of exposure can include the number of people or types of assets in an area. These can be combined with the specific vulnerability of the exposed elements to any particular hazard to estimate the quantitative risks associated with that hazard in the area of interest (UNISDR 2009, 15).

Vulnerability is "the characteristics and circumstances of a community, system or asset that make it susceptive to the damaging effects of a hazard." There are many aspects of vulnerability, arising from various physical, social, economic, and environmental factors. Examples may include poor design and construction of buildings, inadequate protections of assets, lack of public information and awareness,

‡ The UN General Assembly adopted the International Strategy for Disaster Reduction in December 1999 and established UNISDR, the secretariat to ensure its implementation. UNISDR, the UN office for disaster risk reduction, is also the focal point in the UN system for the coordination of disaster risk reduction and the implementation of the international blueprint for disaster risk reduction - the "Hyogo Framework for Action 2005-2015: Building the resilience of nations and communities to disasters". http://www.unisdr.org/who-we-are/mandate

limited official recognition of risks and preparedness measures, and disregard for wise environmental management. Vulnerability varies significantly within a community and over time. This definition identifies vulnerability as a characteristic of the element of interest (community, system or asset) which is independent to exposure. However, in common use the word is often used more broadly to include the element's exposure.

"Vulnerability" and "capacity" are considered as sufficient for explaining the ranges of success or failure that are found in different recovery scenarios and are thus averse to the use of the term at all. Vulnerability both potentiates original loss and damage and also impedes recovery, while capacity building can change this adverse balance and contribute to greater sustainability and reduced disaster risk (UNISDR 2009, 30)

Disaster is a serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources. Disasters are often described as a result of the combination of: the exposure to hazard; the conditions of vulnerability that are present; and insufficient capacity or measures to reduce or cope with the potential negative consequences. Disaster impact may include loss of life, injury, disease and other negative effects on human physical, mental and social well-being, together with damage to property, destruction of assets, loss of services, social and economic disruption and environmental degradation. (UNISDR 2009, 9). In the equation: Risk=Hazard X Vulnerability, "Hazard" refers to exogenous threats to health, safety and well-being arising from environmental factors and "Vulnerability" is mainly socioeconomic and political, referring to the capacity to "respond", "recover", "mitigate" and "prepare" (Dore and Elkin 2003, 75-76).

Disaster risk is the potential disaster losses, in lives, health status, livelihoods, assets and services, which could occur to a particular community or a society over some specified future time period (UNISDR 2009, 10). This definition reflects the concept of disasters as the outcome of continuously present conditions or risk.

"Potential disasters (or hazards if you prefer) are just as important (practically as well as theoretically) as those which actually occur."

(Britton 1987)

2.2 Environmental degradation and determinants of health

2.2.1 Unsustainable urbanization as health determinant

A strong realization of our times is that a number of global health challenges are posed by the urban planning systems, either their absence or failure. The demographic challenges due to the rapid urbanization mainly of small- and medium-sized towns with the expanding youth population in developing nations, while on the other hand the shrinking populations, ageing and the increasing multicultural composition, are very eloquent phenomena of unsustainable urbanization", that urban planning policies failed to predict and manage, leading to environment and health implications and the manifestation of health risks in both local and global scale. On top of these phenomena, the population displacement due to wars and armed conflicts, as well as over time developing environmental degradation and unprecedented mega-disasters, contribute to the unplanned urban mutations. The increasing informality in urban activities, mostly driven by the global economic crisis; the increasing social and spatial inequalities posed by and contributing to urban sprawl and unplanned periurbanization; the cities' excessive dependence on fossil fuel-powered transportation means; the economic challenges of uncertain future growth; and last but not least the environmental challenges of climate change, are some of the underlying risk drivers shaping the global burden of disease (UN Habitat 2009).

Besides, there are many examples depicting how unsustainable patterns of development affect health through globalization. The complex relationship between globalization and health, through the lens of exposure to health impairing conditions and access to health care, is formed by direct and indirect interactions such as: unofficial movement of hazardous waste from developed world to developing countries, with poorer safety precautions; erosion of public services linked with consequences of globalization in some countries impacting negatively on health by undermining health services, supply of utilities and education; reduction of taxes and trade liberalization leading to increased use of tobacco in low-income countries with detrimental effects to health; trade barriers as well as economic crisis leading to morbidity and more acute poverty by limiting domestic enterprise and manufacturing growth; the constraints in the use of international trade and intellectual property rights bringing implications in the performance of health care in developing world, such as the case of drugs for treating HIV/AIDS; the "digital divide" exacerbating access to health information for individuals as well as communities (WHO/SDE/HDE 2002, 37).

How cities develop matters primarily to environmental damage that actually spreads beyond their physical limits. Urban growth brings growth to urban concerns. One striking example is the urban heat island phenomenon (UHI), whose intensity rises proportionally to the dimension and population of the urban setting. Unsustainable urban growth led to deterioration of the same environmental elements

that quality of life actually relies on; good air quality, low noise levels, clean and sufficient water, high quality public spaces, thermal comfort in local and microclimate, not to mention social equity. Rising Human Development Index (HDI) has been associated with environmental degradation- though the damage can be traced largely to economic growth (UN, Human Development Report Team 2011, 4). The relationship between environmental risks and the HDI is observed through three general finding concerning temporal and spatial scales:

- As the HDI rises household environmental deprivations- indoor air pollution, inadequate access to clean water and improved sanitation- decline and are more severe at low HDI levels.
- Following an inverted U-shaped curve, according to some suggestions, environmental risks with community effects- such as urban air pollution- seem to rise and then fall with development.
- Rising HDI affects in a similar way the environmental risks with global effects, like greenhouse gas emissions.

Although climate change is considered a global phenomenon, it can be observed through its manifestations in lower spatial scales, such as regional or urban. Climate change, as a magnifier and multiplier of underlying risks and emerging ones, poses a real threat to cities' development and competitiveness, as extreme weather or climate events, rising coastal waters, more severe storms and heat waves, threaten to damage infrastructure, reduce efficiency, exacerbate urban poverty (Kamal-Chaoui and Sanchez-Reaza 2012, 130-131). Phenomena with unprecedented severity like polar vortex[*], which affected US in the beginning of 2014, and which may be a manifestation of climate change, interrupt the normal patterns of human and social functioning, contributing to the number of at least 140 000 excess deaths annually by the year 2004 due to the global warming that has occurred since the 1970s[†]. Rio+20 underlined the importance of considering disaster risk reduction, resilience and climate change in sustainable urban planning (UN 2012, 26).

[*] The polar vortex is the pattern of winds around the North Pole
http://www.arctic.noaa.gov/detect/climate-strat.shtml
[†] http://www.who.int/mediacentre/factsheets/fs266/en/

2.2.1.a "Urban" diseases and health conditions

A healthy city is one that is continually creating and improving those physical and social environments and expanding those community resources which enable people to mutually support each other in performing all the functions of life and developing to their maximum potential. (WHO/HPR/HEP 1998)

Health promotion Glossary, WHO, 1998

Promoting sustainable development policies for a safe and healthy living environment for all- particularly children, youth, women, elderly and disabled- a commitment that was made in Rio+20 outcome document (UN 2012, 26), needs to identify the determinants of health in urban settlements. Health is influenced by a broad range of determinants that lie beyond the health sector. Urban determinants of health refer to the socioeconomic, cultural and environmental conditions that influence the health of individuals and populations. Such specific health determinants in urban settings are considered the urban governance, the natural and built environment, the social and economic environment, food security and quality, services and health emergency management. All the above can influence equity in health, which is at the top of Rio+20 agenda, depriving the population from fair chances to attain their full health opportunity, although no one should be disadvantaged from achieving this potential (WHO 2014). Urban health inequities, systematic, socially produced and unfair, are the result of the circumstances in which people grow, live, work and age, and the health systems they can access, which in turn are shaped by broader political, social and economic forces. In many cities around the world, health determinants have combined to create a triple threat of "urban diseases and health conditions", which consists of infectious communicable diseases, noncommunicable diseases (NCDs), injuries and violence. This perception is underlined by the fact that the 10 leading causes of death in the world, from 2000 to 2011 were ischaemic heart disease, stroke, lower respiratory infections, chronic obstructive lung disease, diarrhoea and HIV/AIDS (WHO 2013).

(a) Communicable - Infectious diseases are a major threat in many cities due to population density, overcrowding, lack of safe water and sanitation systems, international travel and commerce, lack of provision of health care services, and poor healthcare access, particularly in slums. Infectious diseases are waterborne diseases (diarrhoeal disease, hepatitis A and E, leptospirosis), diseases associated with crowding (measles, meningitis, acute respiratory infections (ARI)), vector-borne diseases (malaria, dengue) (WHO/CDS/NTD/DCE 2006).

Urban growth has outpaced the ability of governments to build essential infrastructures, and one in three urban dwellers lives in slums[*] or informal settlements. In 2001 31% of earth's population lived in slums (UN HABITAT 2003, 14). Slum dwellers are most at risk for adverse health outcomes such as early childhood death, have less access to health services such as skilled birth attendance, and are also disadvantaged in terms of their living conditions, such as access to piped water. Improving the lives of at least 100 million slum dwellers was a Millennium Development Goal [†](MDG) target relevant to sustainable cities. Rio+20 outcome document recognized the need for a holistic approach to urban development and human settlements that provides for affordable housing and infrastructure and prioritizes slum upgrading and urban regeneration (UN 2012, 26).

In European Region emerging and re-emerging communicable diseases, like HIV infection as well as tuberculosis (TB) remain a priority area in many countries. Global outbreaks, such as pandemic H1N1 influenza in 2009, are of special concern, as well as silent threats such as the growing antimicrobial resistance (WHO-Regional Office for Europe 2013, 46).

(b) Noncommunicable diseases (NCDs) are the leading global causes of death, causing more deaths than all other causes combined, and they strike hardest at the world's low- and middle-income populations. NCDs chronic diseases are cardiovascular diseases, diabetes, cancers and chronic respiratory diseases. 45% of DALYs in low- and middle-income countries are caused by noncommunicable disease (WHO 2014)s. Of the 57 million global deaths in 2008, 36 million, or 63%, were due to NCDs. Chronic diseases cause increasing numbers of deaths worldwide. Lung cancers (along with trachea and bronchus cancers) caused 1.5 million (2.7%) deaths in 2011, up from 1.2 million (2.2%) deaths in 2000. Similarly, diabetes caused 1.4 million (2.6%) deaths in 2011, up from 1.0 million (1.9%) deaths in 2000. (WHO 2013) Their conditions are exacerbated in urban areas by unhealthy diet, harmful use of alcohol, overweight and obesity, raised cholesterol, and insufficient physical activity, exposure to air pollutants (including tobacco smoke), and cancer- associated infections[‡] (Alwan 2011).

---

[*] UN-HABITAT defines a slum household as a group of individuals living under the same roof in an urban area who lack one or more of the following:

- Durable housing of a permanent nature that protects against extreme climate conditions.
- Sufficient living space which means not more than three people sharing the same room.
- Easy access to safe water in sufficient amounts at an affordable price.
- Access to adequate sanitation in the form of a private or public toilet shared by a reasonable number of people.
- Security of tenure that prevents forced evictions (UN HABITAT 2003, 243)

[†] Millennium Development Goals

1Eradicate extreme poverty and hunger, 2Achieve universal primary education, 3Promote gender equality and empower women, 4Reduce child mortality, 5Improve maternal health, 6Combat HIV / AIDS, malaria and other diseases, 7Ensure environmental sustainability, 8Develop a global partnership for development.

[‡] human papillomavirus, Hepatitis B virus, Hepatitis C virus and Helicobacter pylori

Approximately 3.2 million deaths each year are attributable to insufficient physical activity, while globally, around 31% of adults aged 15 and over were insufficiently active in 2008 (men 28% and women 34%) (WHO 2014).

Outdoor urban pollution is estimated to cause 1.3 million deaths worldwide each year. Citizens of middle-income countries disproportionately experience this burden (WHO 2011). Air pollution now rivals smoking as one of the largest global causes of premature mortality – with over 6 million deaths a year (Figure 2).

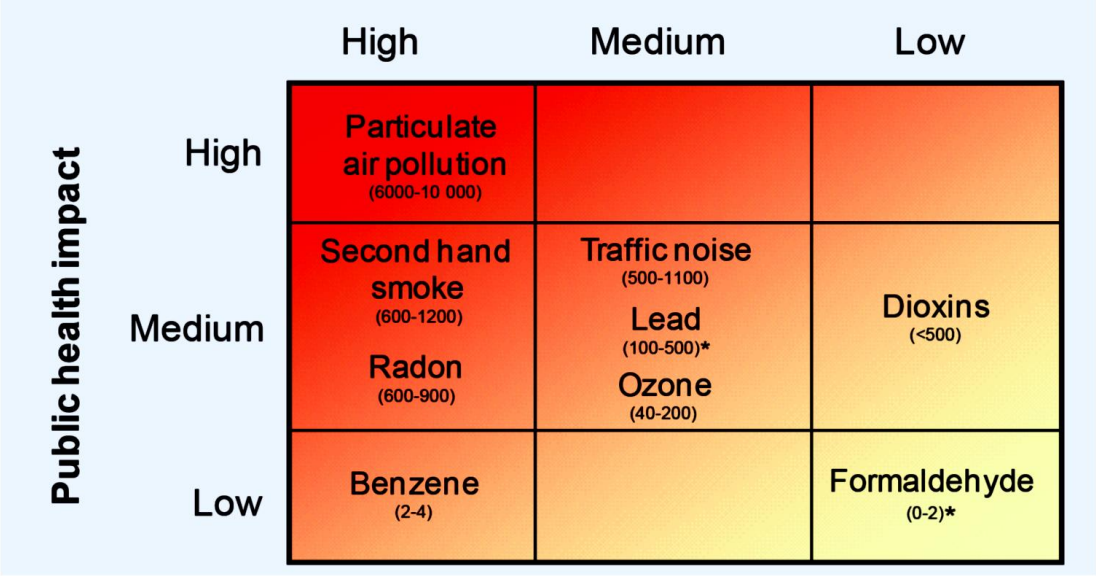


Figure 2 Relative public health impact of the selected environmental stressors in undiscounted un-ageweighted DALYs per population of a million in the participating countries for year 2004, from EBoDE, 2011, European Perspectives on Environmental Burden of Disease , p. 56.

Some 3.5 million deaths/year may be due to household air pollution from rudimentary biomass and coal stoves and some 1.3 billion people lack access to electricity and rely on kerosene lamps and other polluting alternatives for lighting (WHO/HSE/PHE 2012).

In European Region the NCDs account for the largest proportions of mortality and premature death, with the four leading causes of lost DALYs being the unipolar depressive disorders, ischaemic heart disease, adult-onset hearing loss, and Alzheimer and other types of dementia (WHO-Regional Office for Europe 2013, 46).

(c) Injuries and violence complete the landscape of urban threats to health. In many developing countries, urbanization and the increased number of motorized vehicles have not been accompanied by adequate transport infrastructure, enforcement of traffic regulations or implementation of measures to ensure improved road safety. Every year the lives of almost 1.24 million people are cut short as a result of a road traffic crash. Between 20 to 50 million more people suffer non-fatal injuries, with many incurring a disability as a result of their injury (WHO 2013)

Each year, more than 1.6 million people worldwide lose their lives to violence. For every person who dies as a result of violence, many more are injured and suffer from a range of physical, sexual, reproductive and mental health problems (WHO 2014). Major contributors to urban violence include social exclusion, poverty, unemployment and poor housing conditions.

2.2.2 Climate Change as health determinant

> *[…] the bodies of animals are made up of the elements, and these bodies, as we believe, giving way and breaking up as a result of excess or deficiency in this or that element, we cannot but believe that we must take great care to select a very temperate climate for the site of our city, since healthfulness is, as we have said, the first requisite.*
>
> *Vitruvius, Book I, chapter 4, §8: The site of a city*
> (Vitruvius 27-36 BC [1914], 19)

Climate change is reaffirmed by Rio+20 as one of the greatest challenges of our time. Rio +20 emphasized that adaptation to climate change represents an immediate and urgent global priority (UN 2012, 37).

2.2.2.a Climate change as the biggest global health threat

IPCC defines *climate change* as a change in the state of the climate that can be identified (e.g. using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. It refers to any change in climate over time, whether due to natural variability or as a result of human activity. This usage differs from that in the United Nations Framework Convention on Climate Change (UNFCCC) [*], where climate change refers to a change of climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and that is in addition to natural climate variability observed over comparable time periods (IPCC 2007, 30).

According to IPCC AR4 (IPCC 2007, 869) *adaptation* is adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderate harm or exploits beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory, autonomous and planned adaptation. Anticipatory or proactive adaptation takes place before impacts of climate change are observed. Autonomous or spontaneous adaptation does not constitute a conscious response to climatic stimuli but is triggered by ecological changed in natural systems and by market or welfare changes in human systems. Planned adaptation is the result of a deliberate policy decision, based on an awareness that conditions have changed or are about to change and that action is required to return to, maintain, or achieve a desired state. According to IPCC (Lavell, et al. 2012, 36) adaptation to climate

[*] as in article 1 of the United Nations Framework Convention on Climate Change in 1992.

change, refers to both human and natural systems. Adaptation in human systems is defined as the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities. In natural systems, adaptation is defined as the process of adjustment to actual climate and its effects; human intervention may facilitate adjustment to expected climate. Disaster studies use "coping" as a concept to explain social responses to environmental stress and shock by some 30 years, preceding "adaptation" as a concept which is broadly used by the climate change community to express similar concepts (Pelling 2011).

Climate change has already been changing the geographic distribution, frequency and intensity of weather-related hazards and threatens to undermine the resilience of poorer countries and their citizens to absorb loss and recover from disaster impacts. Health impacts of disasters are typically greater in communities with the least resources. Dimensions of disadvantage can interact, compounding adverse impacts, for example the intensity of health risks is higher where water and sanitation are inadequate, deprivations that often coincide (UN, Human Development Report Team 2011, 8). Climate change will magnify the uneven distribution of risk skewing disaster impacts even further towards poor communities in developing countries (UN 2009, 4).A 10 percent increase in the number of people affected by an extreme weather event reduces a country's Human Development Index (HDI)[†] almost 2 percent, with larger effects on income and in medium HDI countries (UN, Human Development Report Team 2011, 9). The countries with the highest relative risk and the lowest resilience to disaster impacts are those with small and vulnerable economies, such as many SIDS[‡] and LLDCs[§]. The low resilience of these countries is associated with extreme limitations in their ability to participate in global trade. Efforts are therefore required to coordinate policies on trade and productive sector development in these countries. (UN, 2009, p. 18).

According to the Lancet[**] report, climate change can affect health by six ways: changing patterns of disease and morbidity, food, water and sanitation, shelter and human settlements, extreme events, and population and migration (Lancet and University College London Institute for Global Health Comission 2009, 1697). There is very high confidence that climate change currently contributes to the global burden of disease and premature deaths (IPCC 2007, 393). There is emerging evidence of climate change effects on human health, that shows that climate change has altered the distribution of some infectious disease vectors (medium confidence), has altered the seasonal distribution of some allergenic pollen species (high confidence) and increase heatwave-related deaths (medium confidence). New challenges and costs to the control of infectious diseases are rising as some me are highly sensitive to rainfall

[†] Greece is ranked 29th between the 47 countries with Very High Human Development Index (UN, Human Development Report Team 2011)
[‡] Small islands developing countries
[§] Landlocked developing countries
[**] Also retrieved in http://www.ucl.ac.uk/global-health/project-pages/lancet1/ucl-lancet-climate-change.pdf

and temprerature, including cholera and the diarrhoeal diseases, as well as vector borne diseases, such as malaria, dengue and schistosomiasis. For example, the change in climate broadens the range of dengue, which is the world's most important vector-borne viral disease that is sensitive to the climate, through heavy rainfall and a rise in temperature, even droughts (IPCC 2007, 403-404), and increases the rate of transmission to unexposed areas, such as regions of Australia and New Zealand. Approximately one-third of the world's population is exposed in areas suitable for dengue transmission and by 2080 approximately 6 billion people will be at risk of contracting dengue as a consequence of climate change, compared with 3.5 billion if the climate remains unchanged[††] (Lancet and University College London Institute for Global Health Comission 2009). Climate change not only introduces new threats to global health, but also threatens to reverse the progress that the global public health community has been making against many diseases (WHO, United Kingdom Health Protection Agency, UNISDR 2011).

After many years with only limited manifestations, dengue returned to the European region, being either imported or transmitted by the *Aedes*[‡‡] vectors, and it is driven by climate change, trade and travel. It is second only to malaria, with more than 3000 cases reported between 2010 and 2013. In 1927 and 1928 it killed up to 1500 people in several outbreaks in Greece and Turkey, where the vector *Ae.aegypti* was present. Recently dengue cases have been reported in Croatia, France and Portugal (WHO Regional Office for Europe 2013). The epidemiological situation in 2011 concerned a total number of 610 cases that were notified by 14 from 22 reporting EU/EEA countries. An outbreak of autochthonous dengue started in October 2012 in Madeira, with more than 2000 reported cases. The potential for the establishment of dengue transmission in European countries were the competent vectors are present is of particular concern (European Centre for Disease Prevention and Control 2013, 145-146).

This combination of increasing hazard and decreasing resilience makes climate change a global driver, magnifier and multiplier of disaster risk. As climate change may be "the biggest global health threat of the 21st century", and as it works synergistically with urbanization to increase disease burdens, understanding of both the risks to health as well as the health co-benefits of addressing climate change through adaptation and mitigation is extremely important (Lancet and University College London Institute for Global Health Comission 2009)[§§].

[††] Also retrieved in http://www.ucl.ac.uk/global-health/project-pages/lancet1/mhecc1.pdf
[‡‡] *Ae. Aegypti and Ae. Albopitcuts* (tiger mosquito or forest day mosquito).
[§§] Although climate change is an overarching theme, it is a striking observation that it is the least presented among national assessment reports than have been submitted to the Commission on Sustainable Development (CSD) for implementation from 2004 through 2011[§§]. (United Nations 2013, 4)

2.3 Managing preventable morbidity and mortality through environmental health determinants in the context of Rio+20

The outcome of the urban and environmental degradation, is the reduction of the capacity of the environment to meet social and ecological objectives and needs. It can alter the frequency and intensity of natural hazards and increase the vulnerability of communities (UNISDR 2009, 14). Realizing that 13 million deaths each year are due to preventable environmental causes and also that preventing environmental risk can save as many as 4 million lives a year, predominantly in developing countries, among children aged less than 15 years,* makes Rio +20 commitment (UN 2012, 26) to promote sustainable development policies aiming to safe and healthy living environment for all, extremely important. This goal also refers to inclusive housing and social services, affordable and sustainable transport and energy, promotion-protection and restoration of safe and green urban spaces, safe and clean drinking water and sanitation, healthy air quality, generation of decent jobs, sustainable management of waste, and therefore it calls for action in health related development issues as described below:

Access to better energy services including sustainable cooking and heating solutions, which can significantly reduce childhood pneumonia and adult cardiopulmonary disease deaths from indoor air pollution. Improving access to low-emission, renewable energy technologies can benefit health and contribute to long-term goals of sustainability (WHO/HSE/PHE 2012).

Greater focus on urban planning measures including more sustainable, energy-efficient housing and transport – which can significantly reduce many NCDs risks, e.g. cardiopulmonary diseases from air pollution, health risks from physical inactivity and traffic injury. Safe, equitable, energy-efficient transport including opportunities for physical activity (WHO/HSE/PHE 2012)

More sustainable water usage, meeting basic needs for safe drinking-water, and stewardship of water supplies to grow food. Available health evidence indicates that rated of access to safe drinking water still remain very low within countries among more vulnerable groups. It is a main global health challenge to prevent water quality-related disease, as almost 1 billion people lack access to an improved supply, 2 million annual deaths are attributed to unsafe water, sanitation and hygiene, more than 50 countries still report cholera to WHO, millions are exposed to unsafe levels of naturally-occurring arsenic and fluoride that lead to cancer and tooth/skeletal damage, an estimated 260 million are infected by Schistosomiasis. Sustainability of water resource management, which is critical to long-term sustainability of drinking water supply as well as to other water resources vital to health and the environment, need to be considered particularly in an era of climate change as there are many emerging

*http://www.who.int/gho/en/index.html

challenges like use of wastewater in agriculture with serious public health risks. (WHO 2014), (WHO/HSE/PHE 2012)

Better sanitation in cities and villages to protect against the spread of communicable diseases. If the trend continues as currently projected, by 2015 there will be 2.7 billion people without access to basic sanitation (WHO 2011).

Sustainable food systems that combat hunger and contribute to better health and nutrition; Current patterns of food production and consumption are associated with a number of significant public health concerns. Increased obesity affects mainly the low and middle income countries while under-nutrition causes more than one-third of under-five mortality; 2 billion farm workers and their families are exposed to certain water-borne, vector-borne and zoonotic diseases, as well as agrochemicals. In terms of sustainability, the negative effects of changing temperatures and precipitation in developing countries has been described as the largest single negative impact of climate change on global health (WHO/HSE/PHE 2012).

Assurance that all jobs and workplaces meet minimum safety and health standards to reduce cancer, chronic lung diseases, injuries and early deaths. Some 2.3 million people die every year from work-related diseases and injuries, and when nearly 1 million of these deaths are from 3 key occupational risks- injuries, carcinogens, and airborne particles. Healthy and safety measures along with promoting and protecting the health of workers, could be in terms of green economy, aiming also to poverty reduction (WHO/HSE/PHE 2012).

2.3.1 A holistic approach to global health

Health promoting policy and modifying the physical environment in which people live, and their lifestyle[†], have particular value because of their potential sustainability (Smith, Cho Tang and Nutbeam 2006).To effectively address the present and emerging challenges for global health, that are mentioned above, and seize new opportunities for development, Rio+20 recognized the need of a holistic approach. This approach could be interpreted in two ways as presented in the following sections.

2.3.1.a The triad of health and SD

The first is about setting clear how health and environment-economy-society relate in order to develop sustainably and thus to emphasize the importance of health as part of this mechanism. Health was described as a pillar of SD in 1992. In Rio+20 it is considered as precondition for, outcome of, indicator of SD in all its three dimensions (UN 2012, 27). Health contributes to economic, social and environmental development through multiple pathways, that are not independent of one another, rather they are all interconnected on a virtuous triangle (WHO/SDE/HDE 2002, 29) as depicted in (Figure 3).

Health can be seen as the outcome and beneficiary of SD. For example, with proper environmental management, which according to Global Health Observatory is the key to avoiding a quarter of all preventable illnesses that are directly caused by environmental factors, and can save as many as 4 million lives a year,[‡] health can be benefited from SD. A healthy and supportive environment for health is a prerequisite for good health. Creating supportive environments for health could offer people protection from threats to health, and enable them to expand their capabilities and develop self-reliance in health (WHO/HPR/HEP 1998, 30).

Health can also be considered as a key contributor to SD. For example, this can be implemented by incorporating health impact assessments (HIA) in plans and strategies about economic and urban development. Another example, is that good health contributes to the achievement of sustainability goals. Universal health coverage can be supportive to SD, since a healthier population contributes more effectively to the economical and societal system. In fact, thhe health of populations is critical for social coherence and economic growth and a vital resource for human and

[†] Lifestyle (lifestyles conducive to health) is a way of living based on identifiable patterns of behaviour which are determined by the interplay between an individual's personal characteristics, social interactions, and socioeconomic and environmental living conditions. – a term found in http://www.who.int/healthpromotion/about/HPR%20Glossary%201998.pdf

[‡]http://www.who.int/gho/en/index.html

social development, as it is perceived as a major public good bringing economic and security benefits (WHO-Regional Office for Europe 2013, 44).

Last but not least, health indicators can be used for monitoring progress and identifying success of SD, thus completing the three-faceted linkage between health and SD, set in Rio+20. Health indicators can mark progress and identify barriers in all that aim to promote a fairer, greener and more sustainable approach to future development. Such indicators could measure various attributes, like attributable health burden (i.e. rates of adult and child disease burden and injuries –deaths and DALYs- attributable to household air pollution from the incomplete combustion of biomass fuels and coal for cooking and heating); annual average $PM_{10/2.5}$ concentrations in relation to WHO air-quality guidelines, in regards to the impact of urban air quality to premature mortality from cardiorespiratory disease; number of health impact assessments performed annually, by country, of all water resource development projects entering the planning cycle, in terms of strategic approach; proportion of land use, building infrastructure, economic development plans that incorporate health impact assessment of disaster-related risks into plans and strategies; prevalence of obesity in children under 5 years and in adults; proportion of workforce exposed to carcinogens, air pollution, noise, hazardous chemicals, biological agents, risk of injuries, ergonomic and psychosocial stressors at the workplace, disaggregated by gender, economic sector, and type of employment. [§]

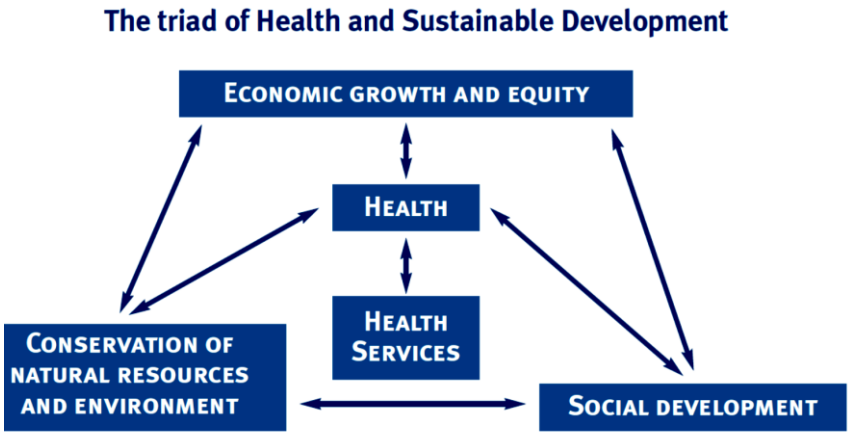


Figure 3 The triad of Health and Sustainable Development, from WHO/SDE/HDE 2002, p.30

[§] http://www.who.int/hia/health_indicators/en/index.html

2.3.1.b The triangle of disaster risk management

The other way of interpreting the holistic approach to emerging challenges for global health, can be examined in combination with another priority that Rio+20 has placed in order to support SD to ensure the provision of the global public good of health. It has highlighted the need for a more integrated approach to disaster risk management and underlined the importance of addressing disaster risk reduction, resilience and climate change as a common (UN 2012, 26). The articulation of this concept and its implementation will be argued in the next chapter.

Chapter 3 Disaster Risk Reduction, Resilience and Climate Change as a common

3.1. Managing Health Risks in the context of Disaster Risk Reduction

If mother nature does the demolition work, society can make choices about how to rebuild itself.

(Paton 2006, 8)

3.1.1 Risk management and its evolution in times of SD and climate change

Disaster risk, as discussed in the previous chapters, is associated with unsustainable elements of development such as environmental degradation. Conversely disaster risk reduction can contribute to achieving SD, through reduced losses and improved development practices. Nevertheless, it could be argued that in the past it had been difficult for countries to address underlying risk drivers -such as poor urban development and local governance, vulnerable rural livelihoods, and more recently environmental degradation due to climate change- in order to maintain SD and eliminate or at least mitigate the risk of damage to health and other losses. Moreover the governance arrangements for disaster risk reduction did not facilitate the integration of risk considerations into development. The recent economic crisis in Greece that resulted in serious air pollution episodes during winter, as the economic hardship has compelled residents to burn low quality fuel- wood and waste materials- that pollutes the air and threatens health. Moreover the country faces the difficulty of Greek officials to address an immediate and effective response to the problem. This is an illustrative example of a deficit in urban governance (Perkins 2013) (Die Welt 2013) (Alternate Minister of Economics, Minister and Deputy Minister of Environment, Energy and Climate Change 2014).

In general, institutional and legislative arrangements for disaster risk reduction and development sectors are usually connected weakly (UN 2009, 17).
The international frameworks concerning disaster risk management over the past deca des have persistently called for the need to ensure that they will
be considered and implemented not in isolation, rather in close connection with SD and environmental policies and programs. There is an even clearer call for the post-2015 frameworks and agreements on SD, climate
change and disaster risk reduction to allow for an integrated development of future policies, plans, programs at all levels; international, national and local (UNISDR 2013). The call and challenges of attaining a more holistic and reflexive approach to living with climate change and its impacts are dominant in the existing policy landscape.

The International Strategy for Disaster Reduction [ISDR][*], a system of partnerships aiming at supporting global disaster risk reduction measures to ensure a safer world, was adopted by United Nations Member States in 2000 and is owned by local, national, regional and international organizations. Its approach was widely embraced by EU Member States, which in 2007[†]established the UNISDR[‡] Europe[§]. Europe presents a heterogeneous risk pattern with highly developed countries in Western Europe and less developed sub-regions. Despite the wealth of expertise, knowledge and know-how in disaster risk reduction, risks associated with disasters in Europe are increasing, without, nevertheless, making any distinctions between developed and less developed countries. As the continent is exposed to a variety of natural hazards there are areas within the European region that are hot spots for mortality risk and risk of economic losses (United Nations Office for Disaster Risk Reduction 2013, 13).

Five years later, at the peak of its socio-economic crisis, Greece announced the Hellenic National Platform for Disaster Risk Reduction [HNP-DRR], on 31 May 2012. This initiative is positively appreciated as an expression of building resilience to risks. The NHP-DRR (UNISDR Europe Office 2013, 33-36) is co-ordinated by the General Secretariat for Civil Protection of the Ministry of Citizen Protection. National Platforms are nationally owned and led multi-stakeholder forum or committee working on disaster risk reduction. They are having an impact on mainstreaming disaster risk reduction approaches and they reflect the commitment of each government to implement national and local disaster risk reduction activities while linking up to international efforts (United Nations Office for Disaster Risk Reduction 2013, 25). The HNP-DRR has a focus on reducing the risk of natural and manmade hazards occurring with a major frequency and having a big social and economic impact on the country. It also has responsibilities for the multi-sectoral co-ordination of public authorities in disaster prevention and mitigation measures. Within the structure of the HNP_DRR many bodies and their political subdivisions are represented, including the Ministry of Health, with National Centre for Health Operations (UNISDR Europe Office 2013, 34). The legal framework of Operations Centre of the Coordinating Body of Health Sector provides for an operational plan under Article 15, paragraph 4 of Law No 3370/2005 "Organization of public health services and other provisions "(G.G. 176A/11.7.05) to address health crisis.

After a long time of arguing for the advantages of managing the environmental risks as embedded within SD in seeking to reduce risk, it was Rio+20 that emphatically draw the policy framework for the implementation of this idea; the

[*]UNISDR serves as the focal point in the United Nations system for the coordination of disaster reduction and to ensure synergies among the disaster reduction activities of the United Nations system and regional organizations and activities in socio-economic and humanitarian fields. http://www.unisdr.org/files/33373_33373annualreporteuropeweb.pdf accessed 1/2014

[†] two years after the World Conference on Disaster Reduction that adopted the HFA

[‡]The United Nations secretariat to ISDR is UNISDR, the United Nations Office for Disaster Risk Reduction

[§] http://www.unisdr.org/files/19617_overviewnpeuropeefdrr20130802.pdf

Hyogo Framework for Action 2005-2015 (HFA)[**]. A remarkable step of development made here is the shift of Disaster Risk Management Policy towards the direction that climate change is pointing at; going from effective response and recovery to disaster risk reduction, as it is expressed in the Hyogo Framework for Action. Instead of "disaster reduction" the term "disaster risk reduction" provides a better recognition of the ongoing nature of disaster risks and the ongoing potential to reduce these risks (UNISDR 2009, 11). UNISDR defined Disaster Risk Reduction as "*the concept and practice of reducing disaster risk through systematic efforts to analyze and manage the causal factors of disasters, including through reduced exposure to hazards, lessened vulnerability of people and property, wise management of land and the environment, and improved preparedness for adverse events*" (UNISDR 2009, 10-11). Furthermore, being the new paradigm of Disaster Risk Management Policy, risk management is embedded in development processes, as it is clearly expressed in the Global Assessment Report (GAR13)[††] (UNISDR 2013, 7).

The main outcomes of the Rio+20 Conference acknowledged disaster risk reduction and building resilience as very essential to SD. Going even further, the post-2015 framework for disaster risk reduction related to the SD Goals with a proposal to build resilience and reduce deaths from natural disasters, in the Report of the High Level Panel of Eminent Persons on the Post-2015 Development Agenda (The High-Level Panel of Eminent Persons on the Post-2015 Development Agenda 2013) [‡‡]. They also related through the global agreement on climate change[§§], by mutually reinforcing coherence and complementarity (UNISDR 2013).

Among several frameworks and directives in Europe in the field of Climate Change Adaptation (CCA) and Disaster Risk Reduction (DRR)[***] (Council of Europe, UN ISDR Regional Office Europe 2011, 6) the Hyogo Framework for Action 2005-2015 is considered as a comprehensive, integrated, multi-disciplinary approach to identifying and implementing DRR measures. The HFA is one of the first steps that has shown the importance of setting a blueprint for actions for governments, international organizations, NGOs, academic institution and civil society organizations guiding them on how to collaborate on CCA and DRR. It is also an example of countries coming together to unanimously decide on a single framework in which to work towards DRR as a means to adapt to climate change (European

[**] http://www.unisdr.org/we/coordinate/hfa
[††] http://www.preventionweb.net/english/hyogo/gar/2013/en/home/index.html
[‡‡] http://www.post2015hlp.org/
[§§] As in Warsaw climate change conference (COP 19 / CMP 9) on November 2013 http://ec.europa.eu/clima/events/articles/0086_en.htm
[***] Other frameworks are: The EU's White Paper 'Adapting to Climate Change: Towards a European framework for action'; The Cancun Adaptation Framework, and part of the Cancun Agreements at the 2010 Climate Change Conference in Cancun, Mexico (COP 16); The EU Water Framework Directive on establishing a framework for Community action in the field of water policy (DIRECTIVE 2000/60/EC); The European Parliament and Council of the European Union Communication on "Addressing the challenge of water scarcity and droughts in the European Union"; he EU Flood Framework Directive on the assessment and management of flood risks (DIRECTIVE 2007/60/EC); The EU Civil protection, prevention of disasters (Council Decision 2007/779/ EC).

Forum for Disaster Risk Reduction 2013). As it is discussed at the previous chapter, climate change is the global driver of disaster risk that will increase the impact of disasters on health and the environment through the combination of increasing hazard and decreasing resilience. This dynamic relationship justifies the credence to the HFA as a policy framework appropriate for managing risks that either result directly and/or indirectly to health or have health at their epicenter.

The past frameworks for disaster risk reduction have called for integration of disaster risk reduction into sustainable development. However, it seems that the effect ive integration was left to development actors and mechanisms. In order to ensure an effective integration, a more proactive approach seems necessary as well as a more concrete guidance on how this integration can really take place. The integration can be fostered through three complementary means: policies, monitoring mechanism s, and formal periodic review processes[†††].

Therefore, such was the unreservedly credence to Rio+20 and the HFA that in the midst of the systemic environmental – societal and economic crisis, of a speed, scope and scale quite unprecedented, like climate change, HFA was wholeheartedly adopted and is already under implementation in Europe, and Greece. Having already adopted the NHP-DRR in 2012, the national progress report of Greece[‡‡‡] for the implementation of the HFA (2011-2013) was conducted by General Secretariat for Civil Protection (General Secretariat for Civil Protection (GSCP) 2013).

[†††] http://www.unisdr.org/files/35706_chapeau.pdf
[‡‡‡] http://www.preventionweb.net/english/professional/policies/v.php?id=29038

3.1.2 The Hyogo Framework for Action 2005-2015

In January 2005, at the World Conference on Disaster Reduction, 168 states, and among them UN Member States adopted the Hyogo Framework for Action (HFA) 2005-2015 to significantly reduce disaster risk. The International Strategy for Disaster Reduction (ISDR) provided a vehicle for cooperation by Governments, organizations and civil society actors toward achieving "The substantial reduction of disaster losses, in lives and the social, economic and environmental assets of communities and countries".

It has three strategic goals (Chart 1) (Chart 2):

(1) The more effective integration of disaster risk considerations into sustainable development policies, planning and programming at all levels, with a special emphasis on disaster prevention, mitigation, preparedness and vulnerability reduction; (2) The development and strengthening of institutions, mechanisms and capacities at all levels, in particular at the community level, that can systematically contribute to building resilience7 to hazards; (3) The systematic incorporation of risk reduction approaches into the design and implementation of emergency preparedness, response and recovery programmes in the reconstruction of affected communities (United Nations Office for Disaster Risk Reduction 2007, 4).

At the national level the strategic goal statements illustrate the ways in which countries are moving from a culture of reactive response and recovery from disasters to proactive risk reduction and safety. This requires a significant change from a mind-set of crisis to one of resilience (United Nations Office for Disaster Risk Reduction 2013, 14).

The HFA outcome is further elaborated into the following five priorities for action (United Nations Office for Disater Risk Reduction 2007, 6):

Priority 1: The necessary institutional basis for implementing disaster risk reduction;

Priority 2: Risk assessment and early warning;

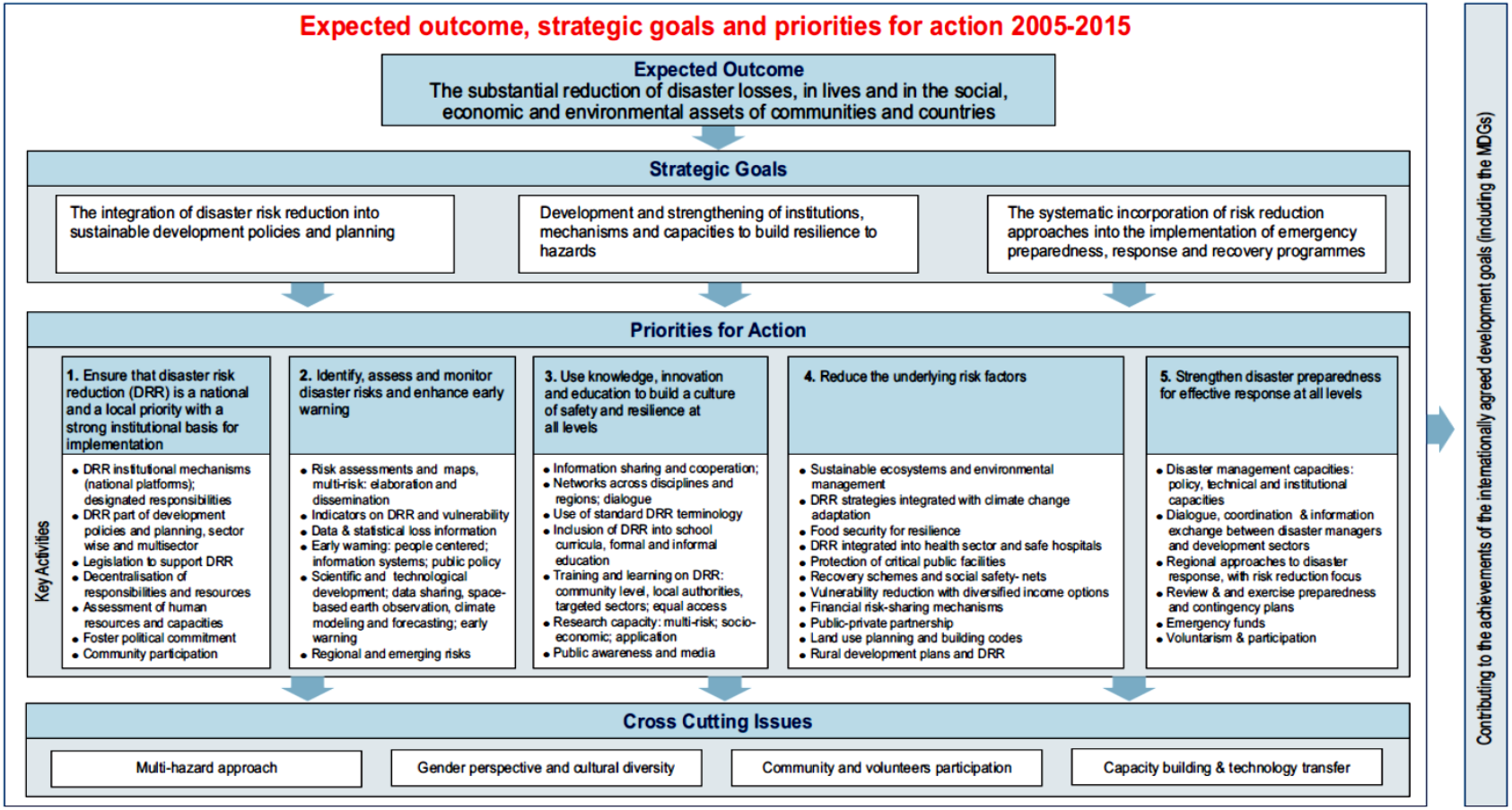
Priority 3: Knowledge, innovation and education;

Priority 4: Reduction of the underlying risk factors;

Priority 5: Preparedness for response.

International Strategy for Disaster Reduction

SUMMARY of the Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters (Hyogo Framework)



DRR= disaster risk reduction

www.unisdr.org

Chart 1 Summary chart of the HFA (1/2), http://www.unisdr.org/files/8720_summaryHFP2005-2015.pdf

Chart 2 Summary chart of the HFA (2/2), http://www.unisdr.org/files/8720_summaryHFP2005 2015.pdf

Continued
SUMMARY of the Hyogo Framework for Action 2005-2015:
Building the Resilience of Nations and Communities to Disasters (Hyogo Framework)

Implementation and Follow-Up

In order to achieve the goals and act upon the priorities identified in this Framework, the following tasks have been identified to ensure implementation and follow-up by States, regional and international organizations in collaboration with civil society and other stakeholders. The ISDR partners, in particular the Inter-agency Task Force on Disaster Reduction and secretariat, are requested to assist in implementing this Framework for Action.

General Considerations

- Implementation by different stakeholders, multi-sectoral approach; participation of civil society (NGOs, CBOs, volunteers), scientific community & private sector is vital
- States primarily responsible; an enabling international environment is vital, incl. strengthened regional capacities
- Build multi-stakeholder partnerships
- Particular attention to:
  - Small island developing States: Mauritius Strategy;
  - Least developed countries;
  - Africa
- States, regional and international organizations to foster coordination among themselves and a strengthened International Strategy for Disaster Reduction (ISDR)
- Follow-up integrated with other major conferences in fields relevant to DRR; reviews as appropriate

Actors

Critical tasks

States

- Designate national coordination mechanisms for the implementation and follow up, communicate to the ISDR secretariat;
- National baseline assessments of the status of DRR;
- Publish and update a summary of national programme for DRR including international cooperation;
- Develop procedure for reviewing national progress including systems for cost benefit analysis and ongoing monitoring on risk;
- Consider acceding to, approving or ratifying relevant international legal instruments and to make sure they are implemented;
- Promote the integration of DRR with climate variability and climate change into DRR strategies and adaptation to climate change; ensure management of risks to geological hazards.

Regional Organizations and Institutions

- Promote regional programmes including for technical cooperation, capacity development, the development of methodologies and standards for hazard and vulnerability monitoring and assessment, the sharing of information and effective mobilization of resources;
- Undertake and publish regional and sub-regional baseline assessments;
- Coordinate and publish reviews on progress and support needs, and assists countries in preparation of national summaries;
- Establish specialized regional collaborative centers;
- Support the development of regional mechanisms and capacities for early warning, including for tsunami

International Organizations (including UN System and IFIs)

- Engage in the implementation of the ISDR by encouraging integration of DRR into humanitarian and sustainable development fields;
- Strengthen the capacity of the UN system to assist disaster-prone developing countries in DRR and implement measures for assessment of progress;
- Identify actions to assist disaster-prone developing countries in the implementation of the Hyogo Framework, ensure their integration and that adequate funding is allocated; assist in setting up national strategies and programmes for DRR;
- Integrate actions into relevant coordination mechanisms (UNDG, IASC, RCs and UN Country Teams);
- Integrate DRR into development assistance frameworks such as CCA/UNDAF, PRSP;
- In collaboration with networks and platform support: data collection and forecasting on natural hazards and risks; early warning systems; full & open exchange of data;
- Support States with coordinated international relief assistance, to reduce vulnerability & increase capacities;
- Strengthen international mechanisms to support disaster stricken States in post-disaster recovery with DRR approach
- Adapt & strengthen inter-agency disaster management training for DRR and capacity building.

ISDR (Inter-Agency Task Force on Disaster Reduction & secretariat)

- Develop a matrix of roles and initiatives in support of follow/up to the Hyogo Framework;
- Facilitate the coordination of effective actions within the UN system and other international and regional entities to support the implementation of the Hyogo Framework, identify gaps, facilitate processes to develop guidelines and policy tools for each priority area;
- In broad consultation, develop generic, realistic and measurable indicators. These indicators could assist States in measuring progress in the implementation of the Hyogo Framework;
- Support national platforms & regional coordination;
- Register relevant partnerships with Commission on Sustainable Development;
- Stimulate the exchange, compilation, analysis and dissemination of best practices, lessons learnt;
- Prepare periodic review on progress towards achieving the objectives of the Hyogo Framework and provide reports to the UNGA & other UN bodies

Resource Mobilization: States, Regional and International Organizations

- Mobilize resources and capabilities of relevant national, regional and international bodies, including the UN system;
- Provide and support the implementation of the HFA in disaster prone developing countries, including through financial and technical assistance, addressing debt sustainability, technology transfer, public-private partnership and North-South and South-South cooperation;
- Mainstream DRR measures into multilateral and bilateral development assistance programmes;
- Provide adequate voluntary financial contribution to the UN Trust Fund for DR to support follow-up activities to Hyogo Framework; review usage and feasibility for the expansion of this fund;
- Develop partnership to implement schemes that spread out risks, reduce insurance premiums, expand insurance coverage and increase financing for post-disaster reconstruction, including through public and private partnerships. Promote an environment that encourages a culture of insurance in developing countries.

Source: Outcome of the World Conference on Disaster Reduction, Hyogo, Kobe Japan, 18-22 Jan 2005

www.unisdr.org

The HFA also ensures that countries shall monitor their improvements on the five priorities of action using an agreed set of common indicators. [*]In Europe there have been regional, national and local progress reports[†] regarding the implementation of HFA and a peer review report for its implementation in the United Kingdom (UNISDR, EC, OECD 2013).

As indicators for Priority 1 are considered the following (United Nations Office for Disaster Risk Reduction 2013, 23):

1.1 National policy and legal framework for disaster risk reduction exists with decentralized responsibilities and capacities at all levels;

1.2 Dedicated and adequate resources are available to implement disaster risk reduction activities at all administrative levels;

1.3 Community participation and decentralization are ensured through the deletion of authority and resources to local levels;

1.4 A national multi-sectoral platform for disaster risk reduction is functioning.

As indicators for Priority 2 are considered the following (United Nations Office for Disaster Risk Reduction 2013, 28):

2.1 National policy and local risk assessments based on hazard data and vulnerability information are available and include risk assessments for key sectors;[‡]

2.2 Systems are in place to monitor, archive and disseminate data on key hazards and vulnerabilities;[§]

2.3 Early warning systems are in place for all major hazards, with outreach to communities;

2.4 National and local risk assessments take account of regional/trans-boundary risks, with a view to regional cooperation on risk reduction.

According to the Global Assessment Report on Disaster Risk Reduction 2011 (UNISDR 2011), among the challenges in early warning systems, translating warning into concrete local action is crucial, even in countries with effective capacities for forecasting, detecting and monitoring hazards and suitable technologies for disseminating advance warnings. For such systems to be effective, four elements must

[*] In the last reporting cycle 17 European countries reported their progresses against the HFA indicators.
[†] Reports for the periods 2009-2011, 2011-2013
[‡] Greece will have completed its flood hazard maps by December 2013 and its flood risk maps by December 2015. (General Secretariat for Civil Protection (GSCP) 2013)
[§] Greece reported that the Institute for Astronomy, Astrophysics, Space Applications and Remote Sensing is developing a real-time fire hotspot detection service. The pilot application was made available to the public in the summer of 2012. The service monitors atmospheric conditions over Athens and recognizes changes arising from Saharan dust intrusions, fire smoke dispersion, volcanic ash flight and other sources. (General Secretariat for Civil Protection (GSCP) 2013)

be in place: accurate hazard warning; an assessment of likely risks and impacts associated with the hazard; a timely and understandable communication of the warning; and the capacity to act on the warning, particularly at the local level[**].

As indicators for Priority 3 are considered the following (United Nations Office for Disaster Risk Reduction 2013, 32);

3.1 Relevant information on disasters is available and accessible at all levels, to all stakeholders (through networks, development of information sharing systems, etc.);

3.2 School curricula, education material and relevant training include disaster risk reduction and recovery concepts and practices;

3.3 Research methods and tools for multi-risk assessments and cost-benefit analysis are developed and strengthened;

3.4 Countrywide public awareness strategy exists to stimulate a culture of disaster resilience, with outreach to urban and rural communities.

As indicators for Priority 4 are considered the following (United Nations Office for Disaster Risk Reduction 2013):

4.1 Disaster risk reduction is an integral objective of environment-related policies and plans, including for land use, natural resource management and adaptation to climate change;

4.2 Social development policies and plans are being implemented to reduce the vulnerability of populations most at risk;

4.3 Economic and productive sectoral policies and plans have been implemented to reduce the vulnerability of economic activities;

4.4 Planning and management of human settlements incorporate disaster risk reduction elements, including enforcement of building codes;

4.5 Disaster risk reduction measures are integrated into post-disaster recovery and rehabilitation processes;

4.6 Procedures are in place to assess the disaster risk impacts of major development projects, especially infrastructure.

[**] http://www.preventionweb.net/preventionweb-files/english/hyogo/gar/2011/en/hfa/challenges.html For example through UNDP's early warning system support to the Philippines, within minutes of a 9.0 earthquake off the coast of Japan on 11 March 2011, more than 120,000 people living in an exposed coastal community in the Philippines were alerted to a possible tsunami through messages received on their mobile phones[**].

As indicators for Priority 5 are considered the following (United Nations Office for Disaster Risk Reduction 2013, 38):

5.1 Strong policy, technical and institutional capacities and mechanisms for disaster risk management, with a disaster risk reduction perspective, are in place;

5.2 Disaster preparedness plans and contingency plans are in place at all administrative levels, and regular training drills and rehearsals are held to test and develop disaster response programmes;

5.3 Financial reserves and contingency mechanisms are in place to support effective response and recovery when required;

5.4 Procedures are in place to exchange relevant information during hazard events and disasters, and to undertake post-event reviews.

3.1.3 Implementing the Hyogo Framework for Action for health risk reduction

For a disaster to be entered into the EM-DAT database of the CRED and the UNISDR, at least one of the following criteria must be met: a report of 10 or more people killed; a report of 100 people affected; a declaration of a state of emergency by the relevant government; a request by the national government for international assistance*.

As it is discussed in the previous section, health risks and crisis, that either result directly and/or indirectly to health or have health at their epicenter, can be efficiently addressed through the HFA. Health, disaster risk reduction and sustainability are inextricably linked in conceptual, pragmatic and institutional ways. Consequently, the HFA 2005-2015 as well as the post-2015 framework for disaster risk reduction could be adapted and implemented by health sector. This approach embraces three complementary and strategic goals:

1. Health risk prevention and the pursuit of development pathways that minimize disaster risk generation;

2. Health risk reduction, i.e. actions to address existing accumulations of disaster risk; and

3. Strengthened resilience, i.e. actions that enable nations and communities to absorb loss and damage, minimize impacts and bounce forward (ISDR 2013, 7).

The five priorities for action towards strengthening resilience to disasters, as addressed in the HFA 2005-2015 (United Nations Office for Disater Risk Reduction 2007, 6) in regards to health sector are formed as follow (WHO, United Kingdom Health Protection Agency, UNISDR 2011):

Priority 1: Disaster risk management for health as a national and local priority

Human health is a priority of disaster risk management and is included in each part, prevention, preparedness, response and recovery. In terms of prevention and preparedness, the HFA places emphasis on more comprehensive risk assessment and more resilient and prepared communities. Response and recovery require coordination and early action with particular attention to nutrition, water, sanitation, shelter for the displaced, and health services. Furthermore, health system resilience and capacity for emergency risk management are critical for effective disaster management.

* http://www.emdat.be/criteria-and-definition

1.1 Development and implementation of health and multisectoral polices, strategies and legislation to provide direction and support for disaster risk management, especially at local levels;

1.2 Health sector and multisectoral coordination mechanisms at local and national levels to facilitate joint action on risk reduction, response and recovery by the various health and non-health actors;

1.3 Commitment of sufficient resources to support disaster risk management for health.

Priority 2: Health risk assessment and early warning

2.1 Assessment of risks to health and health systems;

There are three broad elements which are usually considered in risk assessment: hazard analysis which is about the identification of the hazards and assessment of the magnitude and probability of their occurrence; vulnerability analysis of individuals, populations, infrastructure and other community elements to the hazards; capacity analysis is about the capacity of the system to manage the health risks, by reducing hazards or vulnerability, or responding to, and recovering from a disaster.;

2.2 Determining risk management measures based on risk assessments;

2.3 Surveillance and monitoring of potential threats to health, particularly from biological, natural and technological (such as chemical and radiological hazards) sources to enable early detection and warning to prompt action by the public, health workers and other sectors.

Priority 3: Education and information to build a culture of health, safety and resilience at all levels

Strengthening the knowledge, skills and attitudes of professionals in health and other sectors through education, training and technical guidance, for managing the health risks of disasters.

Information, education and risk communication for households and communities at risk to promote healthy behaviours to reduce risks and prepare for disasters.

Priority 4: Reduction of underlying risk factors to health and health systems

Under this priority a series of key activities are described: sustainable ecosystems and environmental management; Disaster Risk Reduction (DRR) strategies integrated with climate change adaptation; food security for resilience; DRR integrated into health sector and safe hospitals; protection of critical public facilities; recovery schemes and social safety-nets; vulnerability reduction with diversified income options; financial risk-sharing mechanisms; public-private partnership; land use planning and building codes; rural development plans and DRR.

The underlying health status of people at risk of disasters should be improved through poverty reduction measures and systems. New hospitals should be built with a sufficient level of protection and existing health care infrastructure should be strengthened to remain functional and deliver health services in emergency situations. Protection of other vital infrastructure, and facilities that have the potential to generate risks to public health, such as water and sanitation systems and chemical facilities, should also apply risk management measures. Business continuity across all health care setting should be ensured through adherence to building standards and retrofitting of vulnerable health infrastructure, protection of ecosystems, and ensuring effective insurance regimes and micro-finance.

Priority 5: Disaster preparedness for effective health response and recovery at all levels.

Disaster preparedness, including response planning, training, pre-positioning of health supplies, development of surge capacity, and exercises for health care professionals and other emergency service personnel, is critical for the effective performance of the health sector in the response.

3.2 Setting the foundations for resilience building in health and the environment

The scientific community predicts that climate change will soon be testing the resilience of social and ecological systems and uncovering vulnerabilities (Blasiak, Okayasu and Matsumoto 2012), though, there is already enough evidence about climate change contributing to the global burden of disease and premature deaths by revealing existing, enhancing persisting, generating new and even reviving once-vanquished vulnerabilities.

If vulnerabilities are easy to detect, where is resilience truly thriving and how could it be enhanced? It has been claimed that the antonym of resilience is "vulnerability". Vulnerability is "the degree to which a socio-economic system is either susceptible or resilient to the impact of natural hazards and related technological and environmental disasters. The degree of vulnerability is determined by a combination of several factors including hazard awareness, the condition of human settlements and infrastructure, public policy and administration, and organized abilities in all fields of disaster management. Poverty is also one of the main causes of vulnerability in most parts of the world." (WHO 2014). Consequently, any factors that reduce vulnerability may automatically be considered as increasing resilience. In this context, resilience to risks and disasters affecting health can be enhanced by addressing the underlying factors that contribute to vulnerability- primarily poverty, inequality, and environmental degradation, as presented in the previous chapters.

When dealing with the dipole structure of vulnerability - resilience in the context of SD we have to acknowledge the causal complexity of this system. Although being a particularly important aspect of sustainability, resilience is not always a desirable attitude. It may truly be a path to vulnerability reduction, but only with respect to the risks confronted at a specific moment and for the benefit of the actor undertaking the initiative (Sapountzaki and Papachatzi, Private Resilience Response against Collective Recovery Interests: The Case of the Mega-Fires of Ilia , Greece, in August 2007 2011, 499).Thus, we shouldn't attach the sustainability-label uncritically nor should we condemn urbanization or other aggravating health determinants as the scourge of environmental health.

Resilience policies may have adverse effects if not applied properly in each individual framework. For example, water reuse in irrigation, which in general is considered as a sustainable policy for water management, may entail exposure to future risks as an important determinant of the spread of infectious diseases such as malaria and schistosomiasis. Indeed, although the measure of reuse of wastewater for irrigation is taken to combat water scarcity, it has adverse implications for human health under certain conditions. In most low-income countries, the use of sewage and wastewater for irrigation is a common practice that allows for faecal-oral disease

transmission. As climate change continues to threat rural populations with water scarcity thus making the use of wastewater likely to increase, in combination with the unaffordable treatment of wastewater, health risks from pathogenic organisms won't be prevented (IPCC 2007, 418).

Conversely, urbanization can positively influence population health by making it easier to provide safe water and improved sanitation. It is its rapid and unplanned spread that relates to adverse health outcomes and unsustainable development (IPCC 2007).

It is clear enough that it is not always easy to track these positive entities which characterize resilience and mark it in particular contexts of SD. Looking to the core meaning of resilience will help start building its conceptual and actual framework for implementation of health policies.

3.2.1 Defining resilience in the context of social-ecological systems

Resilience is widely employed in the fields of disaster risk management and adaptation, and subject to a wide range of interpretations and levels of acceptance as a concept. It has been used as a term in disaster studies since the 1970's and has its origins in engineering and ecology. It is used along with the terms vulnerability and adaptive capacity, but takes on specific definitions and functions within the social and natural sciences, especially amid climate change. Older conceptions of resilience, as "bouncing back", and 'coping", emphasize a return to a previous status quo. Resilience was also interpreted as the ability to "resile from" or "spring back from" a shock. In IPCC AR4 glossary (IPCC 2007, 880) and the Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation (SREX)[*] (Lavell, et al. 2012, 34) it is defined as "The ability of a social or ecological system to absorb disturbances while remaining the same basic structure and ways of functioning, the capacity for self-organisation, and the capacity to adapt to stress and change". The above term is also endorsed by World Health Organization as a definition regarding Emergencies in Humanitarian Health Aid (WHO 2014) (Relief Web Project 2008).

Holling, who first introduced the term in 1973, described how resilience determines the persistence of relationships within a system and that is a measure of the ability of this system to absorb changes of state variables, driving variables, and parameters and still persist (Holling 1973, 17). He highlighted the fact that

> *"The resilience and stability viewpoints of the behavior of ecological systems can yield very different approaches to the management of resources. The stability view emphasizes the equilibrium, the maintenance of a predictable world… The resilience framework can accommodate this shift of perspective, for it does not require that precise capacity to predict the future, but only a qualitative capacity to devise systems that can absorb and accommodate future events in whatever unexpected form they may take."*
>
> (Holling 1973, 21)

The rich theoretical landscape concerning resilience and adaptive management continues to expand. Thinking on resilience within climate change has been influenced by two schools; disaster risk and SES[†] so that in the face of natural

[*] http://ipcc-wg2.gov/SREX/images/uploads/SREX-All_FINAL.pdf

[†] Ecosystem resilience is the capacity of an ecosystem to tolerate disturbance without collapsing into a qualitatively different state that is controlled by a different set of processes. A resilient ecosystem can withstand shocks and rebuild itself when necessary. Resilience in social systems has the added capacity of humans to anticipate and plan for the future. Humans are part of the natural world. We depend on

disasters and climate change resilience has become associated with systems regenerative abilities and capacity to maintain desired functions in the face of shocks and stress (Pelling 2011). Resilience is introduced in the Terminology on Disaster Risk Reduction (UNISDR 2009, 24) as*" the ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions*". According to SES theory, resilience as applied to ecosystems, or to integrated systems of people and the natural environment, has three defining characteristics; the amount of change the system can undergo and still retain the same controls on function and structure; the degree to which the system is capable of self-organization; the ability to build and increase the capacity for learning and adaptation. The common denominator of the above approaches is the system's ability to sustain a structural and functional integrity when it is being threatened.

These main characteristics of resilience can be relatively easily detected in natural systems that are inherently resilient, but when it comes to social systems it is a considerably complex process. But just as courage may only become apparent in dangerous situations, perhaps a system's resilience cannot be observed until it faces the appropriate amount of external stress, or until it becomes evident after it is totally lost. This was the case with the human species in its evolutionary path; it experienced environmental challenges, which applied selective pressure upon its genome. Ancestors who were efficient at conserving energy, combating dehydration, fighting injurious agents, anticipating adversaries, minimizing exposure to danger and preventing tissue strain and damage have been favored by such selection (Chrousos 2009, 379). These are manifestations of resilience which ensured the functional integrity of human species. In dealing with external challenges evolution provided a rich set of mechanisms to maintain internal stability. This function of internal regulation of physiological events, as an anticipation and/or reaction to unpredictable change, which suggests the occurrence of resilience, is called homeostasis.

In order to help highlighting, strengthening and promoting resilience for health risk reduction there could be drawn an analogy between resilience and the mechanism of homeostasis. This is a thought that will be explored in the next section.

---

ecological systems for our survival and we continuously impact the ecosystems in which we live from the local to global scale. Resilience is a property of these linked social-ecological systems (SES). http://www.resalliance.org/

SES theory was pioneered in the 1980s by the Resilience Alliance, a voluntary organization of scientists of various disciplines, to explore the SESs' dynamics and their possible evolutions. These theories are based on concepts as adaptive cycles, resilience, adaptability, transformability, and hierarchy (panarchy), and aim to provide knowledge basis to manage complex adaptive systems and to achieve sustainable development in theory and in practice.

3.2.2 Drawing analogies between homeostasis and resilience

The term *homeostasis*[*] is used by physiologists pointing to *maintenance of nearly constant conditions in the internal environment*[†]. These constant conditions are maintained essentially by the help of all the organs and tissues of the body (Guyton and Hall 2006, 4). The functions performed maintain a basal health homeostasis (eustasis). The concept is linked to the mechanisms for maintaining internal viability and the defense of physiological events essential for well-being of the body: temperature, pH, glucose, protein, oxygen, sodium and calcium (Schulkin 2003). Mediators that regulate homeostasis not only influence energy metabolism, growth, reproduction, immunity and behavior, but it is them that the survival of complex organisms relies on – on both the individual and species levels (Chrousos 2009, 374).

Homeostasis is a complex dynamic equilibrium for all living organisms. It is constantly challenged by internal or external adverse effects, termed stressors. When a stressor exceeds a certain severity or temporal threshold, the adaptive homeostatic systems of the organism activate compensatory responses that functionally correspond to the stressor, in order to maintain equilibrium. The state in which homeostasis is actually threatened or perceived as to be threatened is defined as stress. The stress system has a basal circadian activity and also responds to stressors on demand[‡] (Chrousos 2009, 374). Homeostasis is essential for a sense of well-being, adequate performance of tasks and positive social interactions.

The interaction between homeostasis-disturbing stressors and stressor-activated adaptive responses of the organism can have three potential outcomes. First, the match may be perfect and the organism returns to its basal homeostasis or eustasis; second, the adaptive response may be inappropriate or insufficient (e.g. inadequate, excessive and/or prolonged) and the organism falls into cacostasis, also called allostasis, which might be harmful for the organism in the short term and/or long term; third, the match may be perfect and the organism gains from the experience and a new, improved homeostatic capacity is attained (hypertasis) (Chrousos 2009, 374-375). Selye coined the term heterostasis to describe a new equilibrium state following exposure to a stressor (Schulte 2014, 24). Maintaining functional homeostasis may require dynamic changes.

According to Schulkin allostasis is essential in maintaining internal viability amid changing conditions (Schulkin 2003), but inappropriate (in terms of both magnitude and duration) basal activity and/or responsiveness of the stress system might impair growth, development and body composition, and might account for

[*] The term "homeostasis" was coined by the American physiologist Walter Cannon in the beginning of the 20th century.
[†] The Defense of the Internal Milieu, as described by Bernard (1852, 1859)
[‡] The field of stress biology originated with Selye's conception of stress as a non-specific response to changes in demand, emerging from the earlier work of Walter Cannon defining the fight-or-flight response (Schulte 2014, 24).

many endocrine, metabolic, cardiovascular, autoimmune, allergic and behavioral disorders. The development and severity of the conditions that constitute allostasis depend on:

a) Genetic, epigenetic and constitutional vulnerability or resilience of the individual to stress;

b) Their exposure to stressors during "critical periods" of development;

c) The presence of concurrent adverse or protective environmental factors, and

d) The timing, magnitude and duration of stress (Chrousos 2009, 377).

Given the above it is concluded that resilience relates to homeostasis as a facilitator of either allostasis or hypertasis. In the case of allostasis, when the environmental demand exceeds the natural regulatory capacity of an organism, resilience to stress can affect positively the development and severity of allostasis. The analogy between homesostasis and resilience here refers to the impact of resilience on disaster risk mitigation. Although resilience has become a lens through which we can better view how aspects of natural and social systems interact to enable sustainability, developing resilience alone does not insulate sustainable development pathways from disasters. Yet, it reduces risk and enables a swifter response and recovery which will better protect live and secure development gains (Kipp 2012).

In the second case, resilience and homeostasis are connected through the concept of hypertasis– the improved homeostatic capacity that Chrousos termed, with which resilience identifies principally rather than basal homeostasis. In this case the analogy between homeostasis and resilience refers to the ability of a system to build and increase the capacity for learning and adapting, thus improving. Recent conceptions of resilience of social-ecological systems focus more on process than outcomes including the ability to self-organize, learn and adapt over time, even to improve essential basic structures and functions. The call for improvement is the common denominator between these two functions.

It is noted by both UNISDR and IPCC that new adaptation strategies, policies and measures at different levels and scales are needed to reduce the burdens of climate-sensitive and unsustainable development's health determinants. This can be achieved by applying management activities that seek to correct or reduce disaster risks which are already present (corrective disaster risk management) and obviate the development of new or increased disaster risks (prospective disaster risk management), especially avoidable ones, as mentioned in the previous chapter (UNISDR 2009, 22). Already implemented adaptation strategies need to be expanded to address the additional pressures of climate change, taking into consideration the unexpected extent, rate, limiting forces, and major drivers they may have (IPCC 2007, 418). It is clear that seeking to incorporate resilience thinking into DRR planning for heath will better prepare societies to mitigate, prepare for, and respond to health risks.

3.2.3 Far-reaching aiming for resilience building in health and the environment

In resilience thinking focusing more on processes than outcomes can also serve better the long-term perspective of sustainable scenarios, instead of short-term recovery measures that may not take into account vulnerability changes with time and probable emergence of new vulnerability versions in the future (Sapountzaki and Papachatzi, Private Resilience Response against Collective Recovery Interests: The Case of the Mega-Fires of Ilia , Greece, in August 2007 2011, 517). Avoiding temporary or medium-term health measures from becoming the long-term norm requires linking recovery with development strategies. This accords with the SES approach to resilience which emphasizes that the long-term health of a system is dependent upon change. It also accords with the "build back better" principle (Kipp 2012). In this context, to maintain high standards for public and global health, the promotion of far-reaching aiming scenarios, risk and policy driven, is essential as they are more effective than short-term, disaster or event driven.

Another way for resilience building in health is through materializing sustainable health promotion actions that can maintain their benefits for communities and populations beyond their initial stage of implementation. Sustainable actions can continue to be delivered within the limits of infrastructure, natural resources, finances, expertise and participation by stakeholders. Achieving the changes in risk factors and conditions that will result in health gain in populations requires the implementation of health promotion actions over years and decades (Smith, Cho Tang and Nutbeam 2006).

The resilience approach aims to make aid more efficient and effective by tackling the root causes of recurrent crises rather than just dealing with their consequences. This approach is a long-term commitment (United Nations Office for Disaster Risk Reduction 2013, 52). While traditionally there was an overreliance on preparedness and response to disasters, changing the focus to risk reduction and developing resilience does more to prevent potential hazards from becoming disasters. Aligning the recovery phase with development planning and risk reduction measures further strengthens the affected society to future hazards. Where the planning horizon of public health decision-makers is short aiming and on short-term risks, it cannot incorporate climate change concerns and future dynamics. The importance of learning, innovation, leadership, and adaptive management is emphasized within this more forward looking aspect of resilience. Together these concepts can accommodate the idea of addressing Disaster Risk Reduction, Resilience and Climate Change as a common, as described in Rio+20. At the same time these strategies offer potential pathways for transforming existing development visions, goals and practices into more sustainable futures and thus avoiding dynamic vulnerability perspectives. What better environment could accommodate the challenges of climate change and deal with any future scenarios it may generate?

The major goal of health risk management in the context of Rio+20 is not the reduction of disaster loss per se, but encouraging social improvement through sustainable development and human welfare and well-being. Mapping the processes and pathways towards resilience identifies the potential entry points for action to improve health and well-being and its distribution intra and intergenerationally.

3.2.4 Resilience flourishes in the state of well-being

In the outcome document of Rio+20 (UN 2012, 27) it is recognized that the goals of SD can only be achieved where populations can reach a state of physical, mental and social well-being (UN 2012, 27). The WHO definition describes health as "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity."[§] Well-being is getting at the center of policies as it is considered a possible reorientation for 21st-century public policy goals (WHO-Regional Office for Europe 2013, 40). In the *New European Policy for health-Health 2020* (WHO-Regional Office for Europe 2013) enhancing the well-being of the European Region population is among the headline targets. Creating resilient communities and supportive environments is also one of the four priorities. Building resilience is a key factor in protecting and promoting health and well-being at both the individual and community levels.

As discussed in the previous chapters the physical, social and attitudinal environment can function either as barriers or facilitators of the person's functioning (WHO 2001, 212-213). Resilience as a positively charged concept, is a facilitator of healthy life and well-being. As a positive asset it is considered to be thriving in environments with salient features that reflect good quality of life. The World Health Organization defined quality of life as "*an individual's perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns. It is a broad ranging concept affected in a complex way by the person's physical health, psychological state, personal beliefs, social relationships and their relationship to salient features of their environment*" (WHO-Division of mental health and prevention of substance abuse 1997). Quality of life is often treated as synonymous with well-being (WHO-Regional Office for Europe 2013, 127). Yet, there is no single definition of well-being, but health is a key component (WHO- Regional Office for Europe 2013, 139). Well-being and health are interactive concepts with some common determinants, such as health system, the broader political, economic and social context, as well as other intermediary factors, such as the degree of social stratification or exposures that could

[§] Preamble to the Constitution of the World Health Organization as adopted by the International Health Conference, New York, 19-22 June, 1946; signed on 22 July 1946 by the representatives of 61 States (Official Records of the World Health Organization, no. 2, p. 100) and entered into force on 7 April 1948.

either increase or reduce vulnerabilities (WHO- Regional Office for Europe 2013, 124) (Figure 4).

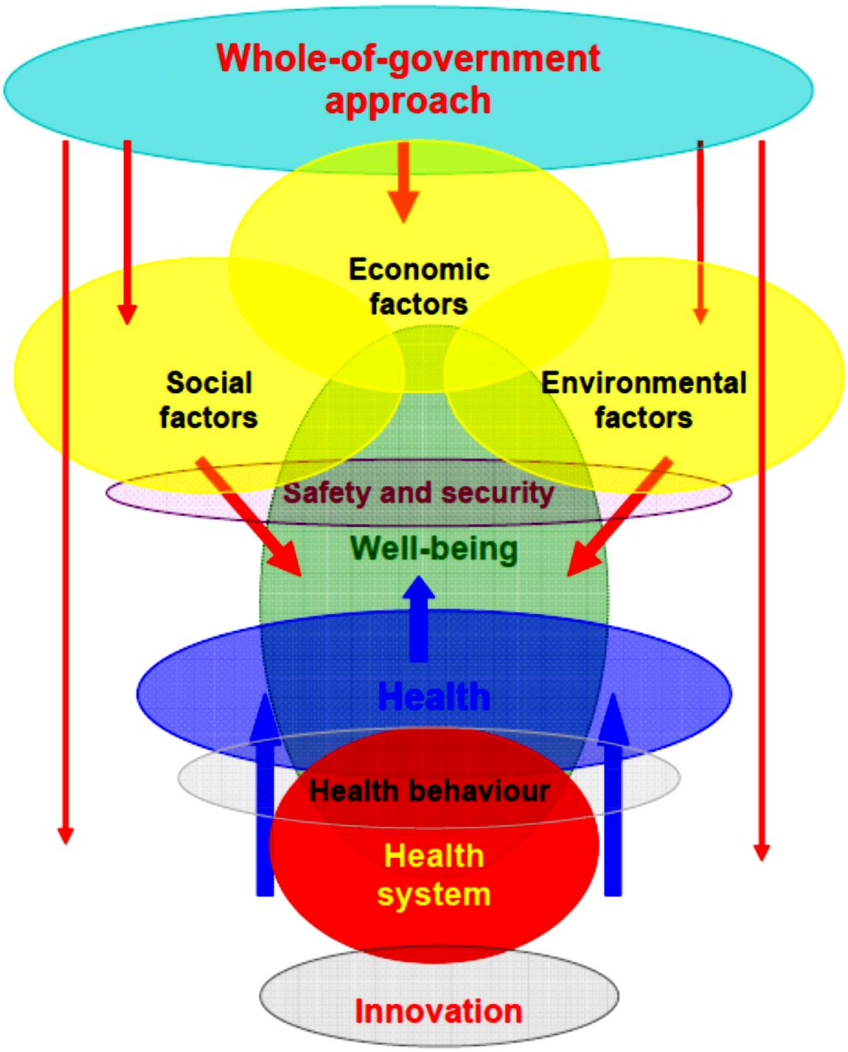


Figure 4 Overall framework of well-being, from WHO- Regional Office for Europe 2013, The European Health Report 2012, Charting the way to well-being, p.142.

In the *New European Policy for health-Health 2020* (WHO-Regional Office for Europe 2013) the focus is on resilience and assets that protect against harm and on reducing or altering exclusionary processes. Health assets refer to any factors (or resources) that enhance the ability to maintain and sustain health and well-being. Asset-based approaches enable protective factors that create and support health and well-being to be identified, while coping strategies draw on cultural resources and a wide range of positive social and environmental assets. Concepts that include salutogenesis, resilience and social capital focus on well-being and seek to create conditions in which everyone can flourish and lead lives that they value and not just avoid disease. These assets can be identified at the level of the individual, group or entire community. Health assets operate therefore as a 'resilience factor' in disease risk exposure, as protective factors to buffer against life's stresses and as promoting factors to maximize opportunities for health and well-being (WHO-Regional Office for Europe 2013).

Up till recently WHO has not measured on well-being. Instead, it has focused its reporting on death, disease and disability. WHO is partnering with other institutions to describe the well-being of populations and to measure progress on the enhancement of well-being in Europe in the context of Health 2020[*]. Ensuring a good life is a multidimensional concept with multiple determinants and thus it is not owned by any particular sector or service (WHO- Regional Office for Europe 2013, 19-20). Since 1990 the United Nations has regularly measured the well-being of countries through the Human Development Index (HDI). The Human development report 2010 has combined three dimensions of a long and healthy life; life expectancy at birth; access to knowledge; mean years of schooling and expected years of schooling; and a decent standard of living as measured by gross national income per capita. The OECD Better Life Initiative (OECD 2012) addresses well-being at the present time as quality of life and material living conditions and well-being in the future as sustainability. A consensus is emerging that the most important characteristics of well-being are its multidimensional nature and the combination of objective and subjective attributes. Well-being comprises an individual's experience of their life and a comparison of life circumstances with social norms and values (WHO- Regional Office for Europe 2013, 141).

In the emerging literature on salutogenesis[†]- the concept of creating health, developed by Antonovsky[‡]- health assets, resilience and capability is centrally

[*] Health 2020 is a joint commitment between the WHO Regional Office for Europe and the 53 European Member States. The policy sets out an action framework based on key action principles. Health 2020 is consistent with existing commitments endorsed by Member States, including the United Nations Millennium Declaration (8) and Millennium Development Goals (9), which embrace a vision for a world in which countries work in partnership for the betterment of everyone, especially the most disadvantaged people. .

[†] While Epidemiology asks "what are the causes and distribution of disease and early death in this group, community or population" salutogenesis asks, "What are the causes and distribution of health and wellbeing in this group, community or country population". (Harrison et al 2004 p. 9)

[‡] Antonovsky, A. (1979) *Health, Stress and Coping*. Jossey-Bass, San Francisco

concerned with positive adaptation, protective factors and 'assets' that moderate risk factors and therefore reduce the impact of risk on outcomes. The salutogenic model is a health promoting resource that encourages a person to feel physically and mentally healthy, with a good quality of life and sense of well-being. Two main factors promote salutogenesis: Generalised Resistance Factors (such as money, social support, knowledge, experience, intelligence and traditions) and Sense of Coherence (a positive way of viewing life and an ability to manage the many stresses met through life) (European Commission Directorate-General for Health and Consumers and the Spanish Ministry of Health and Social Affairs 2010). In salutogenic perspective of health, the context and meaning of health actions, and the determinants that keep people healthy, can improve the understanding about the kinds of factors influencing positive wellbeing in people who are living in adverse circumstances (Dunleavy, Lynne and Vaandrager 2012).

Individuals as well as communities and countries may have assets and capabilities that can protect and enhance health. These assets that may be found in their cultural capacities, social networks, and natural resources are important for fair and sustainable development (WHO-Regional Office for Europe 2013, 46).

As an illustrative example of positive perception of factors contributing adversely to health is the case of urban environment. Urban environment, which has proved to be an agent of several negative health determinants by generating the triple threat of "urban diseases", as discussed in the previous chapter, could be seen through the lens of well-being approach. The fact that world becomes numerically more urban is undoubtable. Thus it is important that decision makers accept urbanization as a positive phenomenon and an effective means for improving access to services, as well as economic and social opportunities, and develop overall national urban strategies towards this orientation (UN Habitat 2009). Moreover, the importance of resilience building through the approach of well-being is emphasized by the fact that changing the behavior and lifestyle of the population is less effective than strengthening capabilities. In the case of chronic NCDs, for example, although interventions aiming at modifying behavioral and lifestyle factors are likely to reduce health risks in the long term, addressing multiple determinants of health through prevention strategies, and thus building resilience, is expected to be more effective (WHO-Regional Office for Europe 2013, 55).

3.3 Case study: outdoor air pollution in Greece during economic crisis

Disaster risk arises when hazards interact with physical, social, economic and environmental vulnerabilities. Within each nation, including developed nations, poor people are the most affected. Poverty reduction is an essential component of reducing vulnerability to disasters. On the one hand, in the general context of disaster risk management, public health programmes build capacities and resilience of individuals and communities to risks, to reduce the impact, cope with and to recover from the effects of adversity. On the other hand, health systems with strong leadership and well-functioning governance arrangements perform better in general, and especially during crisis (WHO-Regional Office for Europe 2013, 56).

Many challenges remain to successfully embed a resilience culture into policies, programmes and planning. The core challenge relates to the need for the political will to advance disaster risk reduction to the top of the policy agenda. This has been a particular challenge especially owing to the prolonged economic downturn in Europe and the recent multi-dimensional crisis in Greece. Governments are finding it difficult to support public investment in disaster risk reduction when faced not only with more immediate needs and scarcer financial resources, but with unprecedented and systemic risks.

An illustrative case of the above conditions is the recent economic crisis in Greece that resulted in serious air pollution episodes during winter, as the economic hardship has compelled residents to burn low quality fuel that pollutes the air and has many adverse effects to health. This case is set in the disaster landscape of the 21st century, as presented in the previous chapter. Several social, economic and environmental determinants of morbidity and mortality can be identified, owing to the lifestyle choices made by the exposed population and environmental policies with limited or unsuccessful implementation. Unsustainable urbanization has shaped the shaky ground where social – including health system- investments are vulnerable to the first hazard manifestation. Climate change is already contributing to the burden of disease, by changing the frequency and intensity of weather-related hazards (cold wave in particular) and has undermined the resilience of poorer citizens to absorb loss and recover from disaster impacts. A holistic approach to populations' health risk, as described at the previous chapter, through the implementation of the triangle of disaster risk management in the context of Rio+20 and the Hyogo Framework of Action, as well as through the establishment and implementation of a far-aiming institutional framework that acknowledges the value of resilience and of its positive attributes, especially for the poor and vulnerable populations.

The following section sheds light on the institutional framework that was established as a response to the environmental and health risks generated by the particular air pollution episodes. It is worth observing that the new context of uncertainties and weaknesses lacks a sense of sustainable direction and drives recovery paths that may lead to more exposure and less resilience, thus even greater vulnerability in an after all unrecovered riskscape.

3.3.1 Reduction of health risks due to air pollution from PM

3.3.1.a Defining the risk

1. Characteristics and effects of air pollution due to PM_{10} and $PM_{2,5}$

PM is a mixture of aerosol particles (solid and liquid) covering a wide range of sizes and chemical compositions. PM_{10} /$PM_{2,5}$ refer to particles with an aerodynamic diameter of 10 /2,5 micrometers or less. They are either directly emitted as primary particles or they form in the atmosphere from emissions of SO_2, NO_x, NH_3 and NMVOCs. Important natural sources of PM are sea salt and natural re-suspended dust. They are also emitted from many anthropogenic sources, including both combustion and non-combustion sources (European Environment Agency 2013, 2).

Air pollutants released in one country may contribute to or result in poor air quality elsewhere. Moreover, important contributions from intercontinental transport influence O_3 and PM concentrations (European Environment Agency 2013, 17).

Air pollution has effects to health, the ecosystems, and the climate. Degraded air quality can also have substantial economic and social consequences, from health costs and costs from forest damage and a generally lower quality of life. Each pollutant produces a range of effects from mild to severe as concentration or exposure increase. Human exposure* is particularly high in urban areas where economic activities are concentrated. Causes of growing concern are concentrations of fine particulates, nitrogen dioxide (NO2), toxic air pollutants, and ground-level ozone pollution episodes (OECD 2013, 30-31).

Small particulates (PM_{10}) are capable of penetrating deep into the respiratory tract and causing significant health damage. Fine particulates ($PM_{2,5}$) cause even more severe health effects because they penetrate deeper into the respiratory tract, they are potentially more toxic and many include heavy metals and toxic organic substances. PM can cause or aggravate cardiovascular and lung diseases, heart attacks and arrhythmias. It can also affect the central nervous system and the reproductive system, and can cause cancer. One outcome of exposure to PM can be premature death. In terms of harm to human health PM and O_3 are the most problematic pollutants in Europe.

According to International Agency for Research on Cancer (International Agency for Research on Cancer, World Health Organization 2013) (IARC 2013)

* Human exposure can be defined as "the event when a person comes into contact with a pollutant of a certain concentration during a certain period of time". Conceptually, this occurs along the "environmental pathway" between concentration and dose, as follows: Source Emissions Concentrations Exposure Dose Health effects. From WHO Regional Office for Europe, 2006, WHO Air quality guidelines.

classified outdoor air pollution as carcinogenic to humans in Group1[†]. With sufficient evidence exposure to outdoor air pollution and PM in particular causes lung cancer; 223.000 deaths worldwide from lung cancer in 2010 resulted from air pollution. There is also a positive association of exposure to PM with increased risk of bladder cancer. This step in classifying outdoor pollution as carcinogenic to humans is very important as it is an avoidable risk which can be reduced significantly through sustainable management of its predominant anthropogenic sources; transportation, stationary power generation, industrial and agricultural emissions and household heating and cooking. Estimating the health impacts of air pollution is complex due to various factors contributing to the burden of disease, in terms of mortality and morbidity and unscheduled hospitalizations. There are also more subtle but sensitive indicators of effect such as physiological measures (e.g. changes in lung function, inflammations markers). Epidemiological studies conducted in many urban areas of the world have uncovered a new series of health end-points associated with exposure to air pollution (WHO Regional Office for Europe 2006).

Air pollution increases risks for a wide range of diseases, such as respiratory and heart diseases. Headache and anxiety due to SO_2. Impacts on the central nervous system due to PM, cardiovascular diseases due to PM, O_3, SO_2, irritation of eyes, nose and throat, breathing problems due to O_3, PM, SO_2, NO_2, BaP, impacts on the respiratory system (irritation, inflammation and infections, asthma and reduced lung function, chronic obstructive pulmonary disease due to PM, lung cancer due to PM, BaP, impacts on liver, spleen and blood due to NO_2, impacts on the reproductive system due to PM (European Environment Agency 2013, 19) (Figure 5).

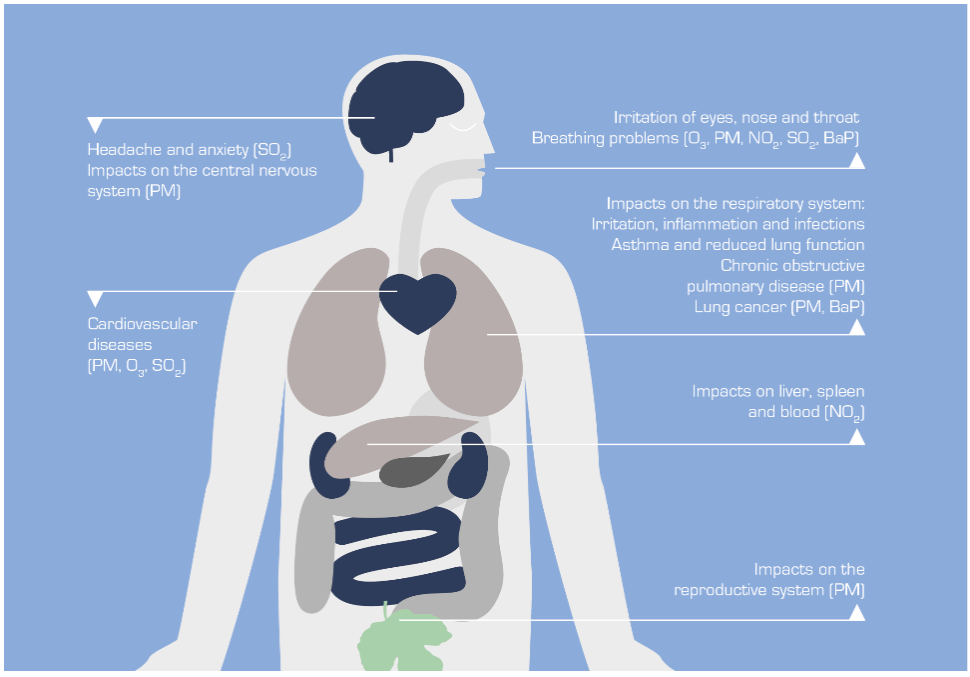


Figure 5 Health impacts of air pollution. From European Environment Agency, 2013, Air quality in Europe, 2013 Report, p.19

[†] http://monographs.iarc.fr/ENG/Classification/

Particulate matter (PM) also act as a greenhouse gas, mainly cooling the earth's climate, although in some case it can lead to warming. Particulate matter (PM) in the atmosphere can also alter rainfall patterns, and affect the surface albedo properties of snow (the extent to which the show reflects light). Impacts on climate are direct and indirect by some air pollutants that are "climate forcers" in the short term. As direct "climate forcers" ground-level O_3 and black carbon (a constituent of PM) contribute either negatively or positively to the global radiative forcing. As indirect effects, some particles can also cause changes on cloud properties, reflectivity and precipitation, formation and dynamics. O_3 impacts negatively to the vegetation, which is an important carbon sink. In this way, it impacts on global warming via its negative impact on vegetation. In fact, measures to cut black carbon and other pollutants leading to O_3 formation will have twin benefits, reducing both global warming and pollution effects to human health and ecosystems (European Environment Agency 2013, 9)**.**

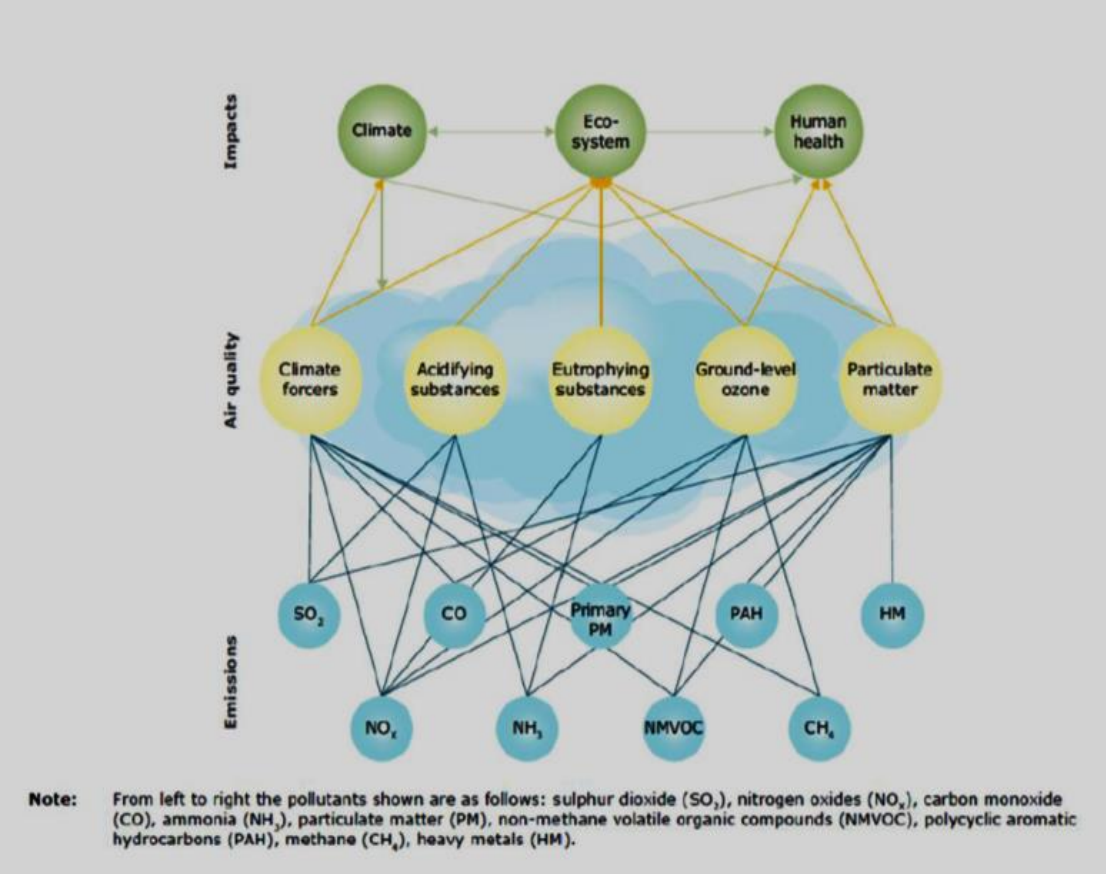


Figure 6 The complex problem of air pollution. From European Environment Agency, 2013, Air pollution fact sheet 2013- Greece, p.17

If no new policies are implemented for air pollution (particulate matter and ground-level ozone) reduction, the urban air quality will continue to deteriorate globally becoming the top cause of environmentally related deaths by 2050. The number of premature deaths worldwide is likely to reach 3,6 million by 2050, more than double, due to increasing urbanization and population. OECD countries are likely to have one of the highest ozone- related mortality rates, due to the great population ageing in the region (OECD 2012).

An urgent policy priority is needed to reduce the sources of particulate air pollutants. It is important to curb the growing health impacts of air pollution through more ambitious and targeted regulatory standards and economic instruments, such as taxes on polluting activities. Making pollution more costly than greener alternatives, cleaner public transport, behavioural changes in business models and lifestyle, synergies between air pollution reduction and climate change

Addressing air pollution requires local measures, greater international cooperation and a focus on the links between climate policies and air pollution policies. Air quality and climate change can be tackled together by an integrated approach (European Environment Agency 2013, 9;17).

Air pollution may be still an 'invisible killer', as Environment Commissioner Janez Potočnik said[‡], but air pollution with ambient PM is one of the most important controllable health threats (Figure 7).

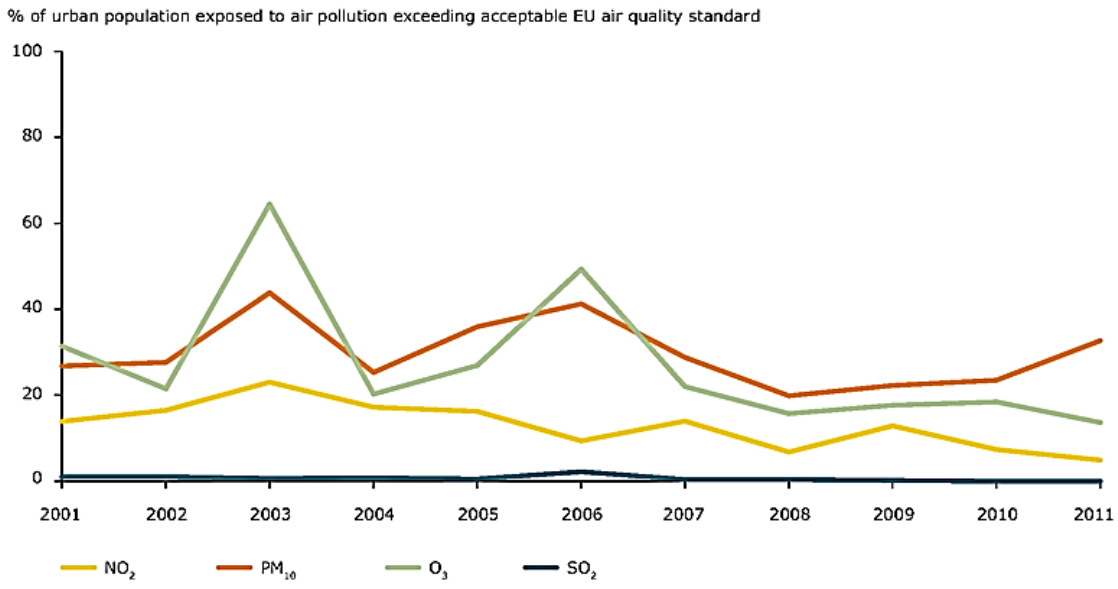


Figure 7 Percentage of the EU urban population exposed to air pollution exceeding EU air quality standards. From European Environment Agency, 2013, Air quality in Europe- 2013 report, p.11

[‡] http://europa.eu/rapid/press-release_IP-13-1274_en.htm

2. Health impacts of outdoor air pollution due to PM_{10} and $PM_{2,5}$ to populations in Europe and Greece

"Greek economic crisis has cleared the air"[§] and "Greek economic crisis leads to air pollution crisis"[**] were two strikingly opposite observations about the same risk-scape; Greek urban areas in the era of economic crisis. Air quality observations over Athens from 2008 onward (Vrekoussis 2013) proved the strong correlations between pollutant concentrations and economic indicators and showed that the economic recession has resulted in proportionally lower levels of pollutants in large parts of Greece, and Athens in particular. Levels of nitrogen dioxide fell over the whole country with a particularly steep drop of 30-40 percent over Athens. Nitrogen monoxide, carbon monoxide and sulphur dioxide also fell. This drop in pollution correlates with a decline in oil consumption, industrial activity and the size of economy. On the other hand, another study (Saffari, et al. 2013) focusing on the concentration of fine particles $PM_{2,5}$ over Thessaloniki during winters of 2012 and 2013 proved that their concentration has risen 30 percent since the financial crisis began. This air quality deterioration was mostly due to the increased price of fuel oil, which led citizens to burn the less expensive wood/biomass for domestic heating during the cold season. An interesting observation about the detrimental effects of $PM_{2,5}$ to human health is that correlation analysis indicated a strong association between reactive oxygen species (ROS) activity and concentration of levoglucosan[††], galactosan and potassium, underscoring the potential impact of wood smoke on PM-induced toxicity during the winter months in Thessaloniki (Saffari, et al. 2013).

At the same time, the fuels used for household heating, result to indoor air pollution, which also causes adverse effects to health and premature death.

According to the publication of 17 European cohort studies particulate matter air pollution contributes to lung cancer incidence in Europe (Raaschou-Nielsen, et al. 2013). A European cohort study from 14 population-based mother-child cohort studies in 12 European countries, showed that exposure to ambient air pollution during pregnancy is associated with restricted fetal growth, which is linked with adverse respiratory health in childhood. A substantial proportion of cases of low birth weight at term could be prevented in Europe if urban air pollution was reduced (Pedersen, et al. 2013).

[§] http://www.newscientist.com/article/mg21729014.300-greek-economic-crisis-has-cleared-the-air.html

[**] http://pressroom.usc.edu/greek-economic-crisis-leads-to-air-pollution-crisis/

[††] Levoglucosan ($C_6H_{10}O_5$) is an organic compound with six carbon ring structure formed from the pyrolysis of carbohydrates, such as starch and cellulose. As a result, levoglucosan is often used as a chemical tracer for biomass burning in atmospheric chemistry studies, particularly with respect to airborne particulate matter. Along with other tracers such as potassium, oxalate, and gaseous acetonitrile,[2] levoglucosan has been shown to be highly correlated with regional fires. This is because the gas emitted by the pyrolysis of wood (biomass) contains significant amounts of levoglucosan.

Although air quality in Europe is improved over the past decade as emissions from the main air pollutants[‡‡] have declined since 1990, due to the complex links between emissions and air quality[§§], emission reductions do not always produce a corresponding drop in atmospheric concentrations, especially for particulate matter (PM) (Chart 3) and ozone (O_3)[***] (European Environment Agency 2013, 9) (European Environment Agency 2013, 7). Particulate matter (PM), ozone (O3), reactive nitrogen substances and some organic compounds still pose a significant threat for health and the environment. Ambient concentrations of PM_{10} have slightly decreased during 2002-2011, and yet no discernible downward trend has been observed. Despite the fact that PM precursor emissions decreased from 2002 to 2011[†††], 22-44% of the EU urban population, and 41-49% of the urban population in EEA-32 countries were exposed to PM_{10} concentrations in excess of the daily limit value in the same period. In 2011 the EU limit and target values for PM were widely exceeded in Europe, with the PM_{10} 24-hour limit value being exceeded in almost 33% of the EU urban population and 49% of the EEA-32 countries (European Environment Agency 2013, 10).

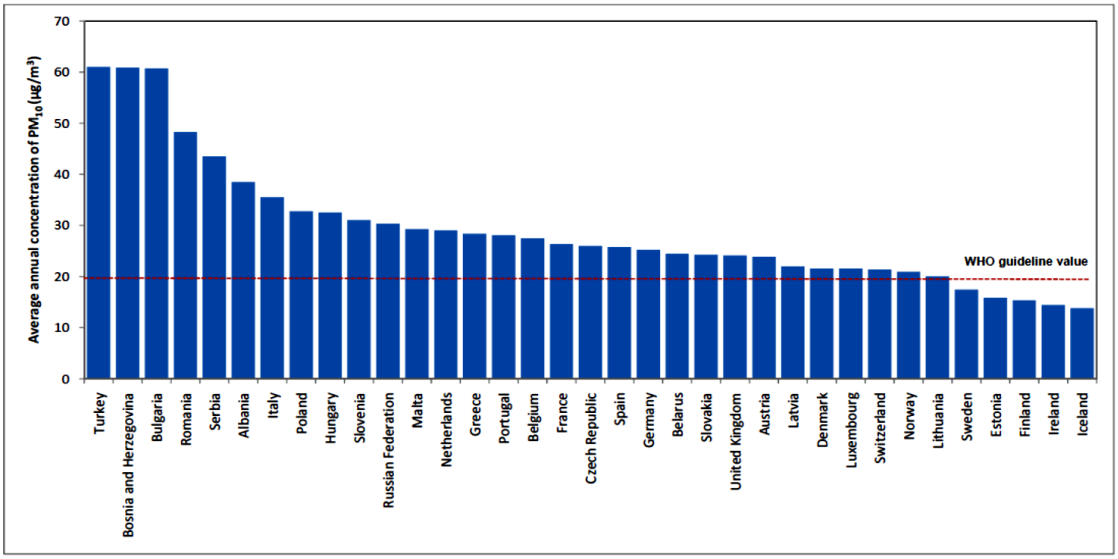


Chart 3 Average annual air concentration of PM10 in large cities in countries in the European Region, last reported data, 2006–2009, from WHO- Regional Office for Europe 2013, The European Health Report 2012, Charting the way to well-being, p.70

Among the main findings for air pollution in the EU is that PM emissions from fuel combustion in the commercial, institutional and household sector has increased by around 7% since 2002 to 2011. This sector is now the most important

[‡‡] Sulphur dioxide (SO_2), carbon monoxide (CO), benzene (C_6H_6), and lead (Pb)
[§§] Such as emission heights, chemical transformations, reactions to sunlight, additional natural and hemispheric contributions and the impact of weather and topography
[***] http://ec.europa.eu/environment/air/quality/standards.htm
[†††] In the EU: sulphur oxides (SOx) emissions fell by 50%, NOx emissions fell by 27%, NH_3 emissions fell by 7%, NMVOCs emissions fell by 28%. In the EEA-32 countries SOx emissions fell by 34%, NOx emissions fell by 23%, NH_3 emissions fell by 5%, NMVOCs emissions fell by 27%. (European Environment Agency 2013, 10)

contributor to total European Union PM Emissions (European Environment Agency 2013, 9).

Population growth, population ageing, declining air quality will take the edge off the benefit of overall health improvements worldwide (OECD 2012, 3). Around 90 % of city dwellers in the European Union (EU) are exposed to one of the most damaging air pollutants at levels deemed harmful to health by the World Health Organization‡‡‡. Regarding the WHO Air Quality Goals (AQG) levels of exposure to PM_{10}, 88% of the EU urban population exposure in 2011 is significantly higher. The non- legally binding WHO guidelines for PM_{10} and $PM_{2,5}$ annual mean concentrations- which are stricter that the limit and target values set by EU legislation- were widely exceeded at the majority of monitoring stations (European Environment Agency 2013, 10).

‡‡‡ http://www.eea.europa.eu/media/newsreleases/air-pollution-still-causing-harm

Data for Greece are illustrated in EEA air pollution fact sheet for 2006-2010 (Table 2). These trends of exposure to PM_{10} concentrations above the limit values (LV) as an annual average and as a 36th maximum daily average of total population in Greece suggest an upward trend (European Environment Agency 2013, 8). For 2011 PM_{10} monitoring stations in the EEA's air quality database-Airbase show a 50% contribution of traffic to the air quality when urban contribution is almost 28%*.

Greece PM_{10}	2006	2007	2008	2009	2010
Annual average					
Population-weighted concentration (μg/m³)	33.6	33.5	39.7	35.3	37.3
Population exposed > ALV (%)	3.6	1.5	37.0	23.4	20.9
36th maximum daily average					
Population-weighted concentration (μg/m³)	54.3	53.0	64.9	54.7	64.8
Population exposed > DLV (%)	78.6	79.5	84.9	38.2	95.7

Table 2 Trends of exposure to PM_{10} of urban population in Greece from 2006-2010. From European Environment Agency, 2013, Air pollution fact sheet 2013-Greece, p. 8

According to the Annual Report for Air Pollution 2012, conducted by Directorate of Air Pollution and Noise Control of the Ministry of Environment, Energy and Climate Change, the temporal evolution of concentrations of particulate matter (PM_{10}) and ($PM_{2,5}$) shows a slight downward trend in prices or stabilization (Directorate of Air Pollution and Noise Control, Ministry of Environment, Energy and Climate Change 2013, 9).

There are many conditions favorable to the overall decreasing or stabilizing trend in air pollutants† in Greece, such as the technological upgrading of the fleet of cars and public means of transport, the application of the measure of emissions control card, the centers for control of various emissions, the use of fuel with better technical specifications , the development of track-guided transport, the facilitating of public means of transport, the penetration of natural gas in the residential, industrial and tertiary sector , the completion of major traffic projects (Directorate of Air Pollution and Noise Control, Ministry of Environment, Energy and Climate Change 2013, 9). Despite the above conditions extraordinary events that tend to form stable environmental conditions because of their frequent manifestation, eventually establish a landscape of detrimental impacts on human health. It is not only the frequency, but the intensity, the extent and the duration of these episodes as well in combination with the concentration of and the exposure to the pollutants that increase the burden-of-disease of Greek population.

* According to current legislation, Member States can subtract contribution from natural sources and from re-suspension due to sanding or salting of roads in winter. These are not taken into account in the above results. Location, type and number or stations are determinative factors of the results.

† Carbon monoxide, sulfur dioxide, benzene, nitrogen monoxide, nitrogen dioxide, , ozone, PM10 and PM2, 5

Greece's profile of environmental burden of disease[‡], as illustrated in the estimation conducted by WHO for a country-by-country analysis of the impact environmental factors have on health (World Health Organization 2009) is indicative about outdoor air in Greece being a risk factor leading to 2.500 deaths/year and 1,2 DALYs/1000 cap/year which contribute to 15% of total environmental burden of disease (18.100 deaths/year and 17 DALYs/year). According to the same data, lung cancer contributes to environmental burden of disease with 1,3 DALYs/1000 cap/ year , respiratory infections with 0,2 DALYs/1000 cap/ year, cardiovascular diseases with 4,5 DALYs/1000 cap/ year, COPD with 0,2 DALYs/1000 cap/ year, asthma with 0,4 DALYs/1000 cap/ year. As the above diseases are considered health end points of PM and air pollutants in general, managing air pollution will result in controlling the above health threats.

3.3.1.b Institutional Framework

1. The WHO air guidelines (AQGs)

The WHO air guidelines (AQGs) are developed to support actions to achieve air quality that protects public health in different contexts and are not legally binding. Air Quality standards that are taken into account for national risk management and environmental policies, are set by each country to protect the public health of their citizens. National Standards may vary according to various considerations about balancing public health with economic, technological, political, and social factors (WHO/SDE/PHE/OEH 2006, 7).

Three critical key findings expressed by WHO should be taken into consideration by governments for the formulation of policy targets. Firstly, guidelines cannot fully protect human health, as research has not identified thresholds below which adverse effects do not occur. Besides, there are health effects linked with air pollution at ever-lower concentrations, as in the case of airborne particulate matter. Last but not least, achieving guideline concentrations for individual pollutants (such as NO_2) may bring broader public health benefits than those anticipated on the basis of the single pollutant's management, due to its associations with other pollutants (WHO/SDE/PHE/OEH 2006, 7).

Regarding the PM, the air quality guidelines in terms of annual mean (Table 3) and 24-hour mean (Table 4) are respectively for PM_{10}: 20 mg/m^3 and 50 mg/m^3 and for $PM_{2,5:}$ 10 mg/m^3 and 25 mg/m^3.

[‡] http://www.who.int/quantifying_ehimpacts/national/countryprofile/greece.pdf?ua=1

Annual mean level	PM_{10} (µg/m³)	$PM_{2.5}$ (µg/m³)	Basis for the selected level
WHO interim target 1 (IT-1)	70	35	These levels are estimated to be associated with about 15% higher long-term mortality than at AQG levels.
WHO interim target 2 (IT-2)	50	25	In addition to other health benefits, these levels lower risk of premature mortality by approximately 6% (2–11%) compared to IT-1.
WHO interim target 3 (IT-3)	30	15	In addition to other health benefits, these levels reduce mortality risk by approximately another 6% (2–11%) compared to IT-2 levels.
WHO air quality guidelines (AQG)	20	10	These are the lowest levels at which total, cardiopulmonary and lung cancer mortality have been shown to increase with more than 95% confidence in response to $PM_{2.5}$ in the ACS study *(323)*. The use of the $PM_{2.5}$ guideline is preferred.

Table 4 Air quality guideline and interim targets for PM:24-hour mean. From WHO Regional Office for Europe, 2006, Air Quality Guidelines, p. 279

2. The European legal framework for Air Quality

The Air Quality Directives[§] 2008/50/EC (Ambient Air Quality Directive (AAQD)) and 2004/107/EC set legally binding limits for ground-level concentrations of outdoor air pollutants. Key elements of EU air quality legislation are:

- EU limits values are set for individual pollutants as concentration thresholds that must not be exceeded[**]. They are legally binding on EU Member States
- Target values are to be attained where possible by taking all necessary measures not entailing disproportionate costs. They are not legally binding on EU Member States.
- Exposure reduction obligation are concentrations that are to be reduced by a given per cent depending on the mean triennial $PM_{2,5}$ urban background concentrations from 2008-2010 to 2018-2020 (European Environment Agency 2013, 7).

Regarding the PM, the air quality limit and target values for PM_{10} and $PM_{2,5}$ that are set in the AAQD (Table 5) are laxer than those in the WHO AQG. Never the less, the short term limit value for PM_{10} (i.e. not more than 35 days per year with a daily average concentration exceeding 50mg/m^3) is the one most often exceeded in

[§] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2011:335:0086:0106:EN:PDF

[**] According to Directive 2008/50/EC the annual limit value (ALV) is 40µ/m^3 and the daily limit value (DLV) is 50µ/m^3, which is not to be exceeded more than 35 times per year[**].

European cities and urban areas (European Environment Agency 2013, 27). Specifically in the period 2009-2011 more than 75% of the EU urban population was exposed to PM concentrations above the EU and WHO reference levels (Table 6).

Size fraction	Averaging period	Value	Comments
PM_{10}, limit value	One day	50 µg/m³	Not to be exceeded on more than 35 days per year. To be met by 1 January 2005
PM_{10}, limit value	Calendar year	40 µg/m³	To be met by 1 January 2005
$PM_{2.5}$, target value	Calendar year	25 µg/m³	To be met by 1 January 2010
$PM_{2.5}$, limit value	Calendar year	25 µg/m³	To be met by 1 January 2015
$PM_{2.5}$, limit value (a)	Calendar year	20 µg/m³	To be met by 1 January 2020
$PM_{2.5}$, exposure concentration obligation (b)		20 µg/m³	2015
$PM_{2.5}$ exposure reduction target (b)	0–20 % reduction in exposure (depending on the average exposure indicator in the reference year) to be met by 2020		

Note: (a) Indicative limit value (Stage 2) to be reviewed by the Commission in 2013 in the light of further information on health and environmental effects, technical feasibility and experience of the target value in Member States.

(b) Based on a three-year average.

Table 5 Air quality limit and target values for PM_{10} and $PM_{2,5}$ as given in the Air Quality Directive. From European Environment Agency, 2013, Air quality in Europe-2013 report, p. 28.

Pollutant	EU reference value	Exposure estimate (%)	WHO AQG	Exposure estimate (%)
$PM_{2.5}$	Year (20)	20–31	Year (10)	91–96
PM_{10}	Day (50)	22–33	Year (20)	85–88
O_3	8-hour (120)	14–18	8-hour (100)	97–98
NO_2	Year (40)	5–13	Year (40)	5–13
BaP	Year (1)	22–31	Year (0.12)	76–94
SO_2	Day (125)	< 1	Day (20)	46–54
CO	8-hour (10)	< 2	8-hour (10)	< 2
Pb	Year (0.5)	< 1	Year (0.5)	< 1
Benzene	Year (5)	< 1	Year (1.7)	12–13
Colour coding:	< 5 %	5–50 %	50–75 %	> 75 %

Table 6 Percentage of the urban population in the EU exposed to air pollutant concentrations above the EU and WHO reference levels (2009-2011). From European Environment Agency, 2013, Air quality in Europe -2013 report, page 6, http://www.eea.europa.eu/publications/air-quality-in-europe-2013

EU is far short of its long term objective, which is to achieve levels of air quality that do not have significant negative impacts on human health and the environment,. The existing air quality standards in the AAQD are insufficient in relation to the WHO air quality guidelines on air pollution.

A new policy aiming to achieve clean air for all in the long term in EU is Clean Air Policy[††], adopted by the European Commission in 18 December 2013. It has a number of components, including: a new Clean Air Programme for Europe, with measures to ensure that existing targets are met in the short term, and new air quality objectives up to 2030; a new National Emission Ceiling Directive (NECD) with stricter national emission ceilings for the six main pollutants (PM, SO_2, NO_x, VOC_s, NH_3 and CH_4); a proposal for a new Directive to reduce pollution from medium-sized combustion installations between 1 and 50MWth[‡‡]; and a ratification proposal for the amended Gothenburg Protocol under the 1979 UNECE[§§] Convention on Long-Range Transboundary Air Pollution (LRTAP)[***]. The new policy proposes stricter emission ceilings in the revised NECD[†††] and tightened standards in the Ambient Air Quality Directive[‡‡‡] will be set at a later stage.

The main health benefits from this package is estimated to 58000 premature deaths that will be avoided. In terms of economic benefits it results to €40-140 billion per year in 2030, when the costs of pollution abatement to implement the package are estimated to reach 3.4 billion per year in 2030. € 3billion are going to be provided in direct economic benefits due to higher productivity of the workforce, lower healthcare costs, higher crop yields, and less damage to buildings. In addition to these an equivalent of around 100,000 additional jobs due to increased productivity and competitiveness because of fewer workdays lost (European Commission 2013, 5).

The main environmental benefits from this package is 123,000 km^2 ecosystems protected from nitrogen pollution, 56,000 km2 Natura 2000 areas protected from nitrogen pollution, 19,000 km2 forest ecosystems protected from acidification (European Commission 2013, 5).

[††] http://ec.europa.eu/environment/air/pdf/clean_air/National%20emissions_EN_annexes.pdf http://ec.europa.eu/environmhttp://exoikonomisi.ypeka.gr/ent/air/clean_air_policy.htm http://ec.europa.eu/environment/air/clean_air_policy.htm

[‡‡] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2013:0920:FIN:EN:pdf

[§§] http://www.unece.org/env/lrtap

[***] http://europa.eu/rapid/press-release_MEMO-13-1169_en.htm

[†††] EU national emission ceilings are upper limits for total emissions of certain air pollutants that Member States will have to respect by a certain date, to push down background concentrations and limit transboundary air pollution. http://europa.eu/rapid/press-release_MEMO-13-1169_en.htm

[‡‡‡] EU air quality standards are local concentration limit values for the air pollutants most harmful to health, as set out in the EU ambient air quality Directive, AAQD (2008.50/EC), which have to be respected everywhere in the EU with a view to provide a general protection for all against harmful air pollution levels. http://europa.eu/rapid/press-release_MEMO-13-1169_en.htm

3. The Greek institutional framework

The General Secretariat for Civil Protection of the Hellenic Ministry of Public Order and Citizen Protection, which is the competent administrative structure for disaster management in Greece [*], and the "protection of life, health and the property of citizens from natural and manmade disasters"[†] has a supportive role in dealing with air pollution episodes. In this case, the leading role belongs to the Ministry of Environment, Energy and Climate Change and the public agencies of Regions of Greece that are competent for the conduct of environmental policies[‡] (General Secretariat of Civil Protection 2013). The above agencies act according to the JMD ΗΠ/14122/549/Ε103/ 11/24.3.11 (GG 488Β/30.3.11).

The JMD ΗΠ/14122/549/Ε103/11/24.3.11[§] (GG 488Β/30.3.11) in compliance with Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 "for air quality and cleaner air for Europe" adopted measures to:

- Avoid, prevent or reduce harmful effects on human health and the environment,
- Assess the quality of air based on common methods and criteria,
- Gather information on air quality, to combat air pollution and nuisance and to monitor long-term trends and improvements resulting from National and Community measures,
- Ensure the availability of such information to the public,
- Maintain or improve ambient air quality,
- Promote greater cooperation with other member States of the EU in regards to reduce air pollution.

It is argued that as the implementation of the above legislation had been insufficient, partial, or misrepresented and thus it had fueled the Greek environmental and health crisis of the last years. Some concerns raised by WWF Hellas[**] stress the fact that; measurements for $PM_{2,5}$ are not published although the measurements and their disclosure is mandatory for all EU states; the data posted on the website of the

[*] http://www.civilprotection.gr/el/%CE%B1%CF%80%CE%BF%CF%83%CF%84%CE%BF%CE%BB%CE%AE (in greek)

[†] According to the principal national legislation for civil protection (Law No 3013/2002, Ministerial Decree No 1299/2003)

[‡] as they are assigned by Law No 3852/2010, article 186, paragraph 6, in accordance with the "Kallikratis plan"

[§] Of the Minister of Interior, Decentralization and Electronic Governance, Finance, Economy-Competitiveness and Shipping, Environment-Energy and Climate Change, Health and Social Solidarity

[**] (in greek) http://www.wwf.gr/news/908-2014-01-09-14-46-31

Ministry of Environment, Energy and Climate Change do not follow full time series and do not cover weekends; there are no air quality management plans conducted; measurements are not conducted all over Greece rather in a few big cities.

The weakness of the administrative capacity for good implementation could be seen as the underlying vulnerability which joined by other social vulnerabilities – social and economic inequalities- allowed for the external stressor- excessive use of inappropriate fuels for household heating- to lead to an environmental and health crisis resulting to uncontrollable social performance and threatening the social coherence, which in this case can quite well be likened to the function of biological homeostasis, as discussed in the previous chapter.

To the above situation there has been a legislative response coming from all the competent ministries, in order to tackle the particular problem. Their approach should be aiming at creating a resilient environment, as discussed in the previous chapter. The legal framework is still expanding and the rising question is whether these efforts, that introduce mainly short-term measures and actions, are in fact building resilience and whether the burden-of-disease estimates are used for the purpose of interventions that reduce air pollution. The legislative regulation that attracted great interest from the public as it was developed under the pressure and on the peak of the recent crisis is the JMD Δ5/ΗΛ/Β/Φ29/οικ.238/3.1.14 (GG 5B/3.1.14) [††] which defined measures with specific financial incentives for vulnerable categories of consumers. These measures have been established in order to cover the additional needs for electricity supply arising from the implementation of the declaration of short term measures for ban of use of fireplaces, stoves, solid fuel and biomass stoves. It is argued that such approaches have mainly short term aiming and they cannot result to a significant reduction of air pollutants and a change of lifestyle and consumer behavior that will protect health and the environment. Regardless the possible positive response of the population, such measures are proved ineffective unless they are implemented along with real cuts in air pollution from the main sources. As a good paradigm under the auspices of Ministry of Environment, Energy and Climate Change, the "Energy Efficiency at Household Buildings" Program[‡‡], gives economic incentives to support better insulation of houses and energy efficiency, thus reduce the energy needs for heating as well as the greenhouse gas emissions.

Several other supportive policies and mechanisms that are enforced during the last months focus on the protection of the environment and the public from the use of solid fuels and the domestic heating appliances:

a) Use of alternative heating appliances (boilers, heaters, stoves, fireplaces) is subjected to compliance with the requirements of the harmonized European

[††] of the Deputy Minister of Finance - Minister and Deputy Minister of Environment, Energy and Climate Change "*Special subsidy for household electricity consumption to address air pollution by particulate matter*"

[‡‡] http://exoikonomisi.ypeka.gr/ (in greek)

standards in accordance with the JMD 6690/15.6.12[§§] of Ministers of Development- Competitiveness and Shipping, Infrastructure- Transport and Networks (GG 1914B/12) "Construction products: features, technical specifications, evaluation of conformity and marking of conformity «CE»[***] (Ministry of the Environment Energy and Climate Change 2013).

b) The 198/30.9.13 Decision of Deputy Minister of Finance approved the 198/11.9.13 Judgment of the Supreme Chemical Council "Solid biomass fuels for non-industrial use – Requirements and test methods", which established standards for solid biomass fuels (pellets, wood briquettes, firewood, etc.) (Ministry of the Environment Energy and Climate Change 2013).

c) The firewood retail sale is controlled by the Service Control Market of General Secretariat for Consumer Affairs and Regional Development Services. The State General Laboratory performs analyzes on these materials (Ministry of the Environment Energy and Climate Change 2013).

d) The Hellenic Environmental Inspectorate (HEI) of the Ministry of Environment, Energy and Climate Change, under the coordination of the General Inspector of Environment conducts audits. During one of them[†††] they seized 5,800 tons of waste timber as it could be used illegally to produce solid fuel for industrial and domestic use[‡‡‡].

More recently the Hellenic Ministry of Health[§§§] issued on 14/1/14 a guiding document which was addressed to several public authorities and institutions, titled "Recommendations for the protection of public health from high levels of air pollution, due to high concentration of particulate matter (PM_{10})"[****] (Ministry of Health, General Directorate of Public Health and Quality of Life 2014) in accordance with the earlier report of the Committee on Air Pollution[††††] and the Joint Ministerial Decision 70601/23.12.2013 (GG 3272B/23.12.13) about short term action plans to tackle air pollution due to particulate matter (Ministry of Health, General Directorate

[§§] http://www.et.gr/idocs-nph/pdfimageSummaryviewer.html?args=sppFfdN7IQP5_cc--m0e1wmmXNVEXA9uzywsSew8mPy8rzSZFxgk-fbyTuXZsV-7kAYi3ORfmarHlTZ0OcIYKyEB-lMvragb75h8iB-tM3_vKMSuwFT8g8jMbcMCublFfxlNP8qam0YY4U4yJlQbZARlUh8ksirspcxkNBX33Y7bUzyco7_PKw.. (in greek)

[***] http://www.ypeka.gr/Default.aspx?tabid=389&sni[524]=2743&language=el-GR (in greek)

[†††] On a ship at the port of Lavrio on 8 and 9 January 2014

[‡‡‡] http://www.ypeka.gr/Default.aspx?tabid=389&sni[524]=2899&language=el-GR (in greek)

[§§§] General Directorate of Public Health and Quality of Life, Directorate of Sanitary Engineering and Environmental Sanitation

[****] http://www.moh.gov.gr/articles/newspaper/egkyklioi/genikh-dieythynsh-dhmosias-ygeias/2171-systaseis-gia-thn-prostasia-ths-dhmosias-ygeias-apo-ypshla-epipeda-atmosfairikhs-rypanshs-logw-aykshmenwn-sygkentrwsewn-aiwroymenwn-swmatidiwn (assessed 26/1/2014)

[††††] "Proposed combined rapid actions to tackle the elevated levels of air pollution", September 2013, http://www.energypress.gr/resource-api/energypress/contentObject/Porisma-Epitrophs-Atmosfairikhs-Rypanshs/content?contentDispositionType=attachment. (accessed 26/1/14)

of Public Health and Quality of Life 2014). This provision aims at defining the following:

- PM_{10} concentration levels to provide information to the population, through precaution recommendations and/or short term measures for reduction of emissions;
- Measures of information and protection of the population, as appropriate to the concentration levels of PM_{10};
- Measures for reduction of PM_{10} emissions from household combustion, industries – craft enterprises and vehicle traffic.

The precaution recommendations and measures for the protection of the population are presented in (Table 7). As appropriate to the concentration levels of PM_{10}, the exceptional measures for the reduction of emissions of air pollutants, due to household combustion (Article 4), industrial and craft enterprises' activities (Article 5), and vehicle traffic (Article 6) are illustrated in Table 2 (Table 8).

Measures according to Article 24 of Directive 2008/50/EC should be in relevance to several factors, such as: existing short term action plans; exceedances of alert values and limit values; methods of risk assessment; forecasting methods; short-term measures applied; implementation strategies; communication strategies; impact assessment. Very important for the successful implementation of the above plans are the evaluation of the risk that short term information/recommendation or alert threshold values or limit will be exceeded; the demonstration that the action plans address the most appropriate sources of emission and that the measures in the action plans will be effective in reducing pollutant concentrations. According to a report on best practices for short-term actions in Europe, (AEA, Environment Agency Austria Umweltbundesamt GmbH 2012, iii) only a few short term action plans in Europe comply with the above conditions.

As in regards to the implementation of the above mentioned Greek environmental legislation for air quality and public health protection there still remain several gaps to bridge, illustrating the weaknesses of the administrative system, starting from the one between research findings and decision making. Even more critical is the recognition that without a political will which uses the burden-of-disease estimates for the purpose of interventions that reduce air pollution, air quality management won't be effective in reducing health risks. For example although the World Health Organization and the EU have adopted the non-legally binding $50mg/m^3$ as a ceiling for short-term measures, the Joint Ministerial Decision 70601/23.12.2013 has set the $101mg/m^3$ for implementing exceptional measures for the reduction of emissions of air pollutants. Then, the implementation of JMD

ΗΠ/14122/549/E103/11/24.3.11[‡‡‡‡] (GG 488B/30.3.11) has various obstacles; the population with health problems is not actually protected against unhealthy air conditions when the measurement results are announced the day after the measurements by the competent agency of Ministry of Environment, Energy and Climate Change[§§§§]; as measures to address the air pollution are based to measurements of pollution, there is the need for better cooperation and coordination among the various stations belonging to different actors (Directorate of Air Pollution and Noise Control, the Hellenic National Meteorological Service and the Universities) in order to create a single network log data.

[‡‡‡‡] Of the Minister of Interior, Decentralization and Electronic Governance, Finance, Economy-Competitiveness and Shipping, Environment-Energy and Climate Change, Health and Social Solidarity
[§§§§] Directorate of Air Pollution and Noise Control of the Ministry of Environment, Energy and Climate Change

24hour concentrations of PM_{10} ($\mu g/m^3$)	Information for the population	
	Recommendations to people with high risk	**Recommendations to general population**
51-75	People with respiratory problems or cardiac patients, and children with respiratory problems should reduce every intense physical activity, particularly the outdoor.	None
76-100	People with respiratory problems or cardiac patients, and children should reduce every intense physical activity, particularly the outdoor. People with asthma may need more frequent inhale of their medicine. People over the age of 65 should moderate their physical activity.	Every person that feels eye irritation, or symptoms of cough, nasal congestion, or sore throat, should reduce physical activity, particularly the outdoor.
101-150	People with respiratory problems or cardiac patients, children and people over the age of 65 should reduce outdoor physical activity and residence time. People with asthma may need more frequent inhale of their medicine.	It is recommended to everyone to avoid physical activity particularly in case of eye irritation, or symptoms of cough, nasal congestion, or sore throat.
>150	People with respiratory problems or cardiac patients, children and people over the age of 65 should avoid every outdoor physical activity. In addition, it is recommended to avoid staying at outdoor places particularly with increased traffic. People with asthma may need more frequent inhale of their medicine. In case of persistent symptoms contact with physician is recommended.	It is recommended to everyone to avoid every kind of outdoor physical activity and to reduce residence time particularly at places with increased traffic.
24hour concentrations of PM_{10} ($\mu g/m^3$)	**Measures for the protection of the population**	
>150	Shutdown of public and private nursery schools, early childhood centers, kindergartens, and schools of primary and secondary education	

Table 7 Information for the population, Joint Ministerial Decision 70601/23.12.2013 (GG 3272B/23.12.13) about short term action plans to tackle air pollution due to particulate matter

24hour concentrations of PM_{10} ($\mu g/m^3$)	Exceptional measures for the reduction of emissions of air pollutants		
	Vehicle traffic	**Industrial – Craft Enterprises**	**Household combustion**
51-75	None	None	None
76-100	None	None	None
101-150	1. Recommendations for the implementation of eco driving and road-use behavior. 2. Recommendations to avoid vehicle traffic through urban areas 3. Ban of use of non catalytic petrol driven private cars in the areas where short term measures are applied 4. Ban of use of petrol driven private cars (with some exceptions) in the areas where short term measures are applied. 5. In accordance with a rotation system use of private use, light petrol driven tracks of gross weight less than 4tn, in the areas where short term measures are applied (with some exceptions). 6. In accordance with a rotation system use of public use, light petrol driven tracks of gross weight less than 4tn, in the areas where short term measures are applied (with some exceptions). 7. In accordance with a rotation system use of	Restriction of 20% of activity (with some exceptions).	1. Recommendations to avoid use of fireplaces, solid fuels and biomass heaters and for use of alternative fuel and energy sources instead of solid fuel and solid biomass fuel. 2. Recommendations for setting the thermostat at 18^o C. 3. Ban of use of incinerators. 4. General ban of open burning.

	private use, heavy petrol driven tracks of gross weight less than 4tn, in the areas where short term measures are applied. 8. In accordance with a rotation system use of public use, heavy petrol driven tracks of gross weight less than 4tn, in the areas where short term measures are applied. 9. Use of real time traffic message boards to inform drivers about traffic ban or rotating traffic in the areas where short term measures are applied.		
>150	1. Recommendations for the implementation of eco driving and road-use behavior. 2. Ban of use of non-catalytic petrol driven and petrol driven private cars in the areas where short term measures are applied. 3. Ban of use of petrol driven private tracks in the areas where short term measures are applied. 4. Ban of use of school busses in the areas where short term measures are applied. 5. Ban of use of petrol driven public tracks in the areas where short term measures are applied. 6. In accordance with a rotation system use of public use, petrol driven TAXIS, in the areas where	Restriction of 30% of activity (with some exceptions).	1. Recommendations to avoid use of fireplaces, solid fuels and biomass heaters and for use of alternative fuel and energy sources instead of solid fuel and solid biomass fuel. 2. Recommendations for setting the thermostat at 18^{o} C. 3. Ban of use of incinerators. 4. General ban of open burning. 5. Shutting down of the central heating system in all public agencies (with several exceptions).

	short term measures are applied. 7. Use of real time traffic message boards to inform drivers about traffic ban or rotating traffic in the areas where short term measures are applied. The above measures are with some exceptions.		

Table 8 Exceptional measures for the reduction of emissions of air pollutants, Joint Ministerial Decision 70601/23.12.2013 (GG 3272B/23.12.13) about short term action plans to tackle air pollution due to particulate matter

Conclusions

This study explored the idea of Sustainable Development and how it has evolved so far, the gaps and the challenges to its implementation in health sector. The answer to the reasonable question whether SD is the panacea that will deal with the contemporary as well as the emerging risks which pose global health risks and may threaten our common future, is that the political and scientific global stage still examine health issues in the context of Rio Declaration, twenty years after it was addressed, as it aims not only at filling the gaps from the SD policies so far addressed, but also at dealing with the unprecedented emerging global risks. Remaining gaps concern the basic questions of equity —fairness, social justice and greater access to a better quality of life, by first and foremost eliminating poverty and hunger. Moreover, SD policies didn't address in a common scheme the issues of environmental protection, economic development and social equity that are the overarching objectives of sustainability. Rio+20 aims at bridging all these gaps.

Furthermore, Rio+20 policy relates very strongly to the environment and health in the era of global, emerging threats. Health was described as a pillar of SD in 1992. In Rio+20 Declaration it is considered as precondition for, outcome of, indicator of SD in all its three dimensions – Environment/Economy/Society. At the same time health is unequivocally the major issue at stake, because it is affected directly and indirectly by the tremendous effects of human influence to the environment. A shift toward a long-term perspective that aims to anticipate the troubles ahead, and far-reaching approaches, which are not disaster or event, but risk and policy driven, characterize the new transformative paradigm introduced by Rio+20. This new deal for SD and human health are further discussed in the next chapter.

A great number of global health challenges are posed by the unsustainable urban planning that leads through several different paths to environmental and health implications and the manifestation of health risks. Unsustainable patterns of development also affect health through a complex relationship with globalization due to the exposure to health impairing conditions and access to health care. Increasing hazard and decreasing resilience makes climate change a global driver, magnifier and multiplier of disaster risk as well as "the biggest global health threat of the 21st century". It works synergistically with urbanization to increase disease burdens, thus addressing them as a common through adaptation and mitigation is extremely important.

The triple threat of urban diseases, which consists of infectious communicable diseases, noncommunicable diseases and injuries and violence, with pre-eminent the preventable environmental causes of ill-health and mortality, led to Rio +20 commitment to promote sustainable development policies aiming to safe and healthy living environment for all. Rio+20 recognized the need of a holistic approach

interpreted in two ways; as the triad of health and SD which shows how health and environment-economy-society relate in order to develop sustainably, and as the triangle of disaster risk management which expresses the need for a more integrated approach to disaster risk management and underlines the importance of addressing disaster risk reduction, resilience and climate change as a common scheme. This is the new deal for Rio+20.

The economic crisis in Greece resulted in serious air pollution episodes during winter. Several social, economic and environmental determinants of ill-health and mortality can be identified, owing to the lifestyle choices made by the exposed population and environmental policies with limited or unsuccessful implementation. Unsustainable urbanization has shaped the shaky ground where social – including health system- investments are vulnerable to the first hazard manifestation. Climate change is already contributing to the burden of disease, by changing the frequency and intensity of weather-related hazards and has undermined the resilience of poorer citizens to absorb loss and recover from disaster impacts.

Applying the HFA in the case of outdoor air pollution in Greece is suggested after examining the nature of the threat to health of exposed population and the set of laws and official policies introduced as a response to the particular crisis. The new context of uncertainties and weaknesses lacks a sense of sustainable direction and drives recovery paths that may lead to more exposure and less resilience, thus even greater vulnerability in an after all unrecovered riskscape.

The Greek environmental legislation for air quality and public health protection has still several remaining gaps to bridge. The weaknesses of the administrative system start from the gap between research findings and decision making. Without a political will which uses the burden-of-disease estimates for the purpose of interventions that reduce air pollution, air quality management won't be effective in reducing health risks. The legal framework is still expanding and the rising question is whether these efforts, that introduce mainly short-term measures and actions, can in fact build resilience. The need for a holistic approach to populations' health risk, through the implementation of the triangle of disaster risk management in the context of Rio+20 and the Hyogo Framework of Action is obvious. The establishment and implementation of a far-aiming institutional framework that acknowledges the value of resilience and of its positive attributes, especially for the poor and vulnerable populations is of the outmost importance.

Bibliography

AEA, Environment Agency Austria Umweltbundesamt GmbH. *Best Practices for Short term action plans.* European Commission, 2012.

Alternate Minister of Economics, Minister and Deputy Minister of Environment, Energy and Climate Change. "Special subsidy for household electricity concumption to tackle the outdoor air pollution from particulate matter (Ειδική επιδότηση οικιακής κατανάλωσης ηλεκτρικού ρεύματος για την αντιμετώπιση ατμοσφαιρικής ρύπανσης από αιωρούμενα σωματίδια)." *Joint ministerial decision (Κοινή Υπουργική Απόφαση) Δ5/ΗΛ/Β/Φ29/οικ.238, ΦΕΚ 5Β/3.1.14.* Athens (Αθήνα), 1 3, 2014.

Alwan, Ala . *Global status report on noncommunicable diseases 2010-Description of the global burden of NCDs, their risk factors and determinants.* Geneva: WHO, 2011.

Atkins, David, and Ernest M Moy. "Left behind: the legacy of hurricane Katrina." *BMJ*, 10 22, 2005: 916-918.

Bartley, Mel, Ingrid Schoon, Richard Mitchell, and David Blane. "Resilience as an asset for healthy development." In *Health assets and the social determinants of health*, by Erio Ziglio and Antony Morgan. WHO, n.d.

Blasiak, Robert, Sana Okayasu, and Ikuko Matsumoto. *Deep roots of community resilience- Our world.* 8 13, 2012. http://ourworld.unu.edu/en/deep-roots-of-community-resilience.

Britton, N. "Toward a re-conceptualization of disaster for the enhancement of social preparation." *Sociology of Disasters*, 1987: 31-55.

Chrousos, George P. "Stress and disorders of teh stress system." *Nature Reviews Endocrinology*, 7 2009: 374-381.

Council of Europe, UN ISDR Regional Office Europe. *Climate Change Adaptation and Disaster Risk Reduction in Europe - A Review or Risk Governance.* Belgium: ISDR, 2011.

Debarati, Guha-Sapir. *Health impacts of floods in Europe. Data gaps and information needs for a spatial perspective.* Brussels: Universitatsklinikum Heidelberg, Centre for Research on the Epidemiology of Disasters -CRED , 2010.

Die Welt. "Smog in Athen nimmt "bedrohlich Dimension" an." *Die Welt*, 2013.

Directorate of Air Pollution and Noise Control, Ministry of Environment, Energy and Climate Change. *Annual Report for Air Pollution 2012.* Athens: Ministry of Environment, Energy and Climate Change, 2013.

Dore, M. H.I., and D. Elkin. "Natural disasters, adaptive capacity and development in the twenty-first century." In *Natural Disaster and Development in a Globalizing World*, by M. Pelling. New York: Routledge, 2003.

Dunleavy, Andrew, Alexandra Lynne, and Lenneke Vaandrager. "Wellbeing for homeless people: a Salutogenic approach." *Health Promotion International*, 9 14, 2012.

EBoDE. *European Perspectives on Environmental Burden of Disease- Estimates for Nine Stressors in Six European Countries.* Helsinki: National Institute for Health and Welfare (THL), 2011.

European Centre for Disease Prevention and Control . *Surveillance Report, Annual epidemiological report- Reporting on 2011 surveillance data and 2012 epidemic intelligence data.* Stockholm: ECDC, 2013.

European Commission Directorate-General for Health and Consumers and the Spanish Ministry of Health and Social Affairs. "Salutogenesis and the Promotion of Positive Mental Health in Older People- Literature Review." *EU Thematic conference "Mental Health and Well-being in Older People - Making it Happen.* Madrid: European Communities, 2010.

European Commission. "MEMO, Questions and answers on the EU Clean Air Policy Package." *European Commission.* December 18, 2013. http://europa.eu/rapid/press-release_MEMO-13-1169_en.htm.

European Environment Agency. "Air pollution fact sheets 2013- Greece." *European Environment Agency.* 2013. http://www.eea.europa.eu/themes/air/air-pollution-country-fact-sheets (accessed 1 2014).

European Environment Agency. *Air Quality in Europe- 2013 report.* Copenhagen: European Enviornment Agency, 2013.

European Forum for Disaster Risk Reduction. *How does Europe link DRR and CCA? Working Paper.* Brussels: UNISDR, 2013.

General Secretariat for Civil Protection (GSCP). *Greece- National progress report on the implementation of the Hyogo Framework for Action (2011-2013).* Prevention Web, 2013.

General Secretariat of Civil Protection. "Document 1498/20.3.13 "Existing legal framework for air pollution"." *General Secretariat of Civil Protection* . 3 20, 2013. www.civilprotection.gr/sites/default/gscp_uploads/PlaisioAtmRipansi_el_GR.pdf.

Guyton, C Arthur, and E Hall Hall. *TEXTBOOK of Medical Physiology.* 11. Philadelphia, Pennsylvania: Elsevier Saunders, 2006.

Holling, C. S. "RESILIENCE AND STABILITY OF ECOLOGICAL SYSTEMS." *Annual Review of Ecology and Systematics*, 1973: 1-23.

IARC . "The carcinogenicity of outdoor air pollution." *The Lancet Oncology*, 12 2013: 1262 - 1263.

Institute for Global Environmental Strategies (IGES). 2013. http://www.iges.or.jp/en/.

International Agency for Research on Cancer, World Health Organization. "IARC:Outdoor air pollution a leading environmental cause of cancer deaths- Press Release No 221." *IARC.* 10 17, 2013. http://www.iarc.fr/en/media-centre/iarcnews/pdf/pr221_E.pdf (accessed 1 2014).

IPCC. *Climate Change 2007: Impacts, Adaptation and Vulnerability- Contribution of Working Group II to the Fourth Assessment Report of the IPCC, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E.Hanson, Eds.* Cambridge, UK: Cambridge Universtiy Press, 2007, 976.

IPCC. *Climate Change 2007: Synthesis Report Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, Pachauri, R.K and Reisinger, A. (eds.)]*. Geneva: IPCC, 2007.

ISDR. *Living with Risk- A global review of disaster reduction initiatives Volume II Annexes.* Geneva: UN, 2004.

—. "Proposed Elements for Consideration in the Post-2015 Framework for Disaster Risk Reduction." The UN Special Representative of the Secretary-General for Disaster Risk Reduction. 12 17, 2013. http://www.preventionweb.net/files/35888_srsgelements.pdf (accessed 1 2014).

Kamal-Chaoui, L., and J. Sanchez-Reaza. "Urban Trends and Policies in OECD Countries." *OECD Regional Development Working Papers*, 2012.

Kipp, Robert. "IGES Proposal for Rio+20 Building resilience and reducing risk from natural disasters: Essentials of 21st century sustainable development." Edited by Institute for Global Environmental Strategies (IGES). 2012.

Lancet and University College London Institute for Global Health Comission. "Managing the health effects of climate change." *www.thelancet.com*, 5 16, 2009: 1693-1733.

Lavell, A., et al. "Climate Change: new dimensions in disaster risk, exposure, vulnerability, and resiliecne." In *Managing the risk of Extreme Events and Disasters to Advance Climate Change Adaptation. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change*

(IPCC), 25-64. Cambridge,UK and New York,NY,USA: Field, C.B.,V. Barros, T.F. Stocker, D.Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley, 2012.

Le Blanc, David. *Back to Our Common Future- Summary for policy makers.* DESA, New York: United Nations, 2012.

Masoura, B., K. Sapountzaki, and M. Katsogiannou. "Terminological comparisons: The example of seismic risk in public administration, science and general language [in greek]." *9th Conference "Hellenic Language and Terminology", 7-9 November 2013.* Athens: Hellenic Society for Terminology - ELETO, 2013.

Masoura, Vasiliki. "Interdisciplinary terminology in the field of natural risk management – The example of seismic risk." *7th Conference "Hellenic Language and Terminology", 7-9 November 2013.* Athens: Hellenic Society for Terminology - ELETO, 2009.

Millennium Ecosystem Assessment. *Ecosystems and Human Well-being: Synthesis.* Washington, DC: Island Press, 2005.

Miller, D. S., and J. D. Rivera. *Huriccane Katrina and the Redefinition of Landscape.* Lanham, MD: Lexington Books, 2008.

Minister of Finance, Minister of Interior, Minister of Development and Competitiveness, Minister of Education and Religious Affairs, Minister of Environment, Energy and Climatic Change, Minister of Health, etc. "Joint Ministerial Decision 70601/23.12.13 (ΦΕΚ 3272B/23.12.13) "Short-term action plans to tackle air pollution due to particulate matter."." *State Printing Office (www.et.gr).* 12 2013. http://www.et.gr/idocs-nph/pdfimageSummaryviewer.html?args=sppFfdN7IQP5_cc--m0e1y6LMIuijLT1a38KcZ2Ws0e8rzSZFxgk-Sb8yVJHdnvZkAYi3ORfmaqS1aSSEa7ywR210wj-yiDf75h8iB-tM3_vKMSuwFT8g8jMbcMCublFfxlNP8qam0adI3c-Bjot4xRpFHQ8StPfUsNmB7ScO-omqU5DWFjsXA.. (accessed 1 2014).

Ministry of Health, General Directorate of Public Health and Quality of Life. *Ministry of Health.* 1 14, 2014. http://www.moh.gov.gr/articles/newspaper/egkyklioi/genikh-dieythynsh-dhmosias-ygeias/2171-systaseis-gia-thn-prostasia-ths-dhmosias-ygeias-apo-ypshla-epipeda-atmosfairikhs-rypanshs-logw-aykshmenwn-sygkentrwsewn-aiwroymenwn-swmatidiwn (accessed 1 2014).

Ministry of the Environment Energy and Climate Change. "Clarifications on the provision of measures to address temporary episodes of particulate matter ("smog episodes")." *Ministry of the Environment Energy and Climate Change.* 11 6, 2013.

http://www.ypeka.gr/Default.aspx?tabid=389&sni[524]=2743&language=el-GR.

OECD. *Environment at a Glance 2013, OECD Indicators.* 2013. http://www.keepeek.com/Digital-Asset-Management/oecd/environment/environment-at-a-glance-2013_9789264185715-en#page1.

OECD Better policies for better lives. n.d. http://www.oecd.org/greengrowth/oecdandrio20.htm.

OECD. "Environmental Oulook to 2050, the consequences of inaction, key findings on Health and Environment." *Organization for Economic Co-operation and Developoment.* 2012. http://www.oecd.org/env/indicators-modelling-outlooks/49928853.pdf (accessed 12 2013).

—. "MEASURING WELL-BEING AND PROGRESS TOWARDS GREEN GROWTH- Measuring a green economy: Insights from Beyond GDP indicators ." June 21, 2012. http://www.oecd.org/greengrowth/OECD%20GG%20Strategy-Indicators.pdf (accessed 1 2014).

Paton, D. "Disaster Resilience: Building capacity to co-exist with natural hazards and their concequences." In *Disaster Resilience: An Integrated Approach*, by D. Paton and D. Johnston, 3-10. Springfield, IL: Charles C. Thomas, 2006.

Pedersen, Mary, et al. "Ambient air pollution and low birthweight: a European cohort study (ESCAPE)." *the Lancet Respiratory Medicine*, 10 15, 2013.

Pelling, Mark. *ADAPTATION TO CLIMATE CHANGE. From resilience to transformation.* London and New York: Routledge, 2011.

Perkins, Robert. "Greek Economic Crisis Leads to Air Pollution Crisis." *Press Room, USCUniversity of Southern California*, 12 19, 2013.

Raaschou-Nielsen, Ole , Zorana J. Andersen, Rob Beelen , Evagelia Samoli, Massimo Stafoggia, and Gudrun Weinmayr. "Air pollution and lung cancer incidence in 17 European cohorts: prospective analyses from the European Study of Cohorts for Air Pollution Effects (ESCAPE)." *The Lancet Oncology*, 8 2013: 813 - 822.

Relief Web Project. "Glossary of Humanitarian Terms." *Refiel Web.* 2008. http://www.who.int/hac/about/reliefweb-aug2008.pdf (accessed 1 2014).

Rosenberg, Jonathan. "Natural Disasters, Climate Change and Recovery: The Sustainability Question in Post-Ivan Grenada." In *Community Disaster Recovery and Resiliency - Exploring Global Opportunities and Challenges*, by

DeMond Shondell Miller and Jason David Rivera. Boca Raton: Auerbach Publications, 2011.

Saffari, Arian, et al. "Increased biomass burning due to the economic crisis in Greece and its adverse impact on winter-time air quality in Thessaloniki." *Environmental Science & Technology*, 11 2013.

Sapountzaki, Kalliopi. "Introduction - Terminology in the field of disaster and risk management: Inderdisciplinary or Babel?" In *Tomorrow at risk. Natural and technological disasters in Europe and Greece [in greek]*, by Kalliopi (ed) Sapountzaki, translated by Καλλιόπη Σαπουντζάκη, 396. Athens: Gutenberg, 2007.

Sapountzaki, Kalliopi, and Anna Papachatzi. "Private Resilience Response against Collective Recovery Interests: The Case of the Mega-Fires of Ilia , Greece, in August 2007." In *Community Disaster Recovery and Resiliency- Exploring Global Opportunities and Challenges*, by DeMond S Miller and Jason D Rivera , 497-523. Boca Rato, FL: Auerbach Publications, 2011.

Schulkin, Jay. *Rethinking Homeostasis: Allostatic Regulation in Physiology and Pahtophysiology.* Massachusetts Institute of Technology, 2003.

Schulte, Patricia M. "What is environmental stress? Insights from fish living in a variable environment." *The Journal of Experimental Biology*, 2014: 23-34.

Smith, Ben J., Kwok Cho Tang, and Don Nutbeam. "WHO Health Promotion Glossary:new terms." *Health Promotion International - Advance Acess*, 2006.

Stakeholder Forum, Natural Resources Defence Council. *Fulfilling the Rio+20 Promises: Reviewing Progress since the UN Conference on Sustainable Development.* London: Natural Resources Defence Council, Stakeholder Forum, 2012.

The High-Level Panel of Eminent Persons on the Post-2015 Development Agenda . *A NEW GLOBAL PARTNERSHIP: ERADICATE POVERTY AND TRANSFORM ECONOMIES THROUGH SUSTAINABLE DEVELOPMENT- The Report of the High-Level Panel of Eminent Persons on the Post-2015 Development Agenda* . New York: United Nations Publications, 2013.

UN Department of Economic and Social Affairs, Population Division. *World Population Prospects - The 2012 Revision- Working Paper No. ESA/P/WP.228.* New York: UN, 2013.

UN Department of Economic and Social Affairs, Population Division. *World Urbanization Prospects, The 2011 Rivision, Highlights.* New York: UN, 2012.

UN Habitat. *Global Report on Human Settlements 2009 - PLANNING Sustainable Cities: Policy Directions- Abridged Edition.* London- Sterling,VA: United Nations Human Settlements Programme [UN Habitat], 2009.

UN HABITAT. *The Challenge of Slums- Global Report on Human Settlements 2003.* London and Sterling: Earthscan Publications Ltd, 2003.

UN ISDR. *HFA Words into Action: A guide for Implementing Hyogo Framework.* Geneva: UN ISDR, 2007.

UN. *Report of the United Nations Conference on Environment and Development, Rio de Janeiro, 3-14 June 1992, Volume I, Resolutions Adopted by Conference.* New York: UN, 1993.

UN. *Report on the United Nations Conference on Sustainable Development, Rio de Janeiro, Brazil, 20-22 June 2012.* New York: United Nations, 2012.

UN. *Risk and poverty in a changing climate.* Summary and Recommendations:2009 Global Assessment Report on Disaster Risk Reduction, UN, 2009.

UN, Human Development Report Team. *Human Development Report 2011, Sustainability and Equity: A Better Future for All (Summary).* New York: UNDP, 2011.

UNISDR. *2009 UNISDR Terminology on Disaster Risk Reduction.* Geneva: UN, 2009.

UNISDR Europe Office. *Overview of National Platforms for Disaster Risk Reduction in Europe- Fact Sheets of European National Platforms.* UNISDR Europe Office, 2013.

UNISDR. *Revealing Risk- Redefining Development GAR 2011 Global assessment report on disaster risk reduction.* UK: UN , 2011.

—. *Towards a post-2015 framework for Disaster Risk Reduction- BUILDING THE RESILIENCE OF NATIONS AND COMMUNITIES TO DISASTERS.* 2013. http://www.preventionweb.net/posthfa/about.

—. *Towards a post-2015 framework for Disaster Risk Reduction- BUILDING THE RESILIENCE OF NATIONS AND COMMUNITIES TO DISASTERS.* 2013. http://www.preventionweb.net/posthfa/proposed-elements.

—. "Towards the Post-2015 Framework for Disaster Risk Reduction- Indicators of success: a new system of indicators to measure progress in disaster risk management." *preventionweb.net.* 11 21, 2013. http://www.preventionweb.net/files/35716_newsystemofprogressindicatorsfordrr.pdf.

UNISDR, EC, OECD. *Peer review Report United Kingdom 2013- Building resilience to disasters: Assessing the implementation of the Hyogo Framework of Action (2005-2015).* Brussels: UNISDR, EC, OECD, 2013.

United Nations. *Global Sustainable Development Report - Executive Summary: Building the Common Future We Want.* New York: United Nations Department of Economic and Social Affairs, Division for Sustainable Development, 2013.

United Nations Office for Disaster Risk Reduction . *Building resilience to disasters in Europe- Connect and Convince to reduce impact from vulnerability- UNISDR Europe Annual Report 2012.* Brussels: UNISDR, 2013.

United Nations Office for Disaster Risk Reduction. *Implementing the Hyogo Framework for Action in Europe- Regional Synthesis Report 2011-2013.* United Nations Office for Disaster Risk Reduction, 2013.

United Nations Office for Disater Risk Reduction. *Hyogo Framework for Action 2005-2015. Building the Resilience of Nations and Communities to Disasters.* Geneva: UN ISDR, 2007.

Vitruvius. "Book 1." In *Ten books on architecture*, by Vitruvious, translated by Morris Hicky Morgan. London: Oxford University Press, 27-36 BC [1914].

Vrekoussis, M., A. Richter, A. Hilboll, J. P. Burrows, E. Gerasopoulos, J. Lelieveld, L. Barrie, C. Zerefos, and N. Mihalopoulos. "Economic crisis detected from space: Air quality observations over Athens/Greece." *Geophysical Research Letters*, 1 31, 2013: 458-463.

WHO. n.d. http://www.who.int/about/definition/en/print.html.

—. *10 facts on sanitation.* 3 2011. http://www.who.int/features/factfiles/sanitation/en/index.html (accessed 1 2014).

—. *Air quality and health, Fact sheet No 313.* 9 2011. http://www.who.int/mediacentre/factsheets/fs313/en/index.html.

—. *Facts and figures on water quality and health.* 2014. http://www.who.int/water_sanitation_health/facts_figures/en/index.html (accessed 1 2014).

—. *Global Health Observatory (GHO).* 2014. http://www.who.int/gho/en/index.html (accessed 1 2014).

—. *Physical Inactivity: A Global Public Health Problem.* 2014. http://www.who.int/dietphysicalactivity/factsheet_inactivity/en/index.html.

WHO Regional Office for Europe. *Air Quality Guidlines, Global update 2005.* Copenhagen: WHO Regional Office for Europe, 2006.

—. *Infectious diseases in a changing climate [Information for public health officials in the WHO European Region].* Copenhagen: WHO Regional Office for Europe, 2013.

WHO- Regional Office for Europe. *The European health report 2012. Charting the way to well-being.* Copenhagen: WHO, 2013.

WHO. *Road traffic injuries.* 3 2013. http://www.who.int/mediacentre/factsheets/fs358/en/index.html.

—. "Sustainable development and human health inextricably tied:WHO." 6 20, 2012. http://www.earthsummit2012.org/news/1148-wold-health-organisation.

WHO. *The International Classification of Functioning, Disability and Health.* Geneva: WHO, 2001.

—. "The top 10 causes of death-Fact sheet N°310." *WHO.* 7 2013. http://who.int/mediacentre/factsheets/fs310/en/.

—. "The WHO Health Promotion Glossary." *WHO.* 2014. http://www.who.int/healthpromotion/about/HPG/en/ (accessed 1 2014).

—. *Violence and Injury Prevention.* 2014. http://www.who.int/violence_injury_prevention/violence/en/.

—. *WHO - Definitions:Emergencies.* 2014. http://www.who.int/hac/about/definitions/en/.

—. "WHO Rio+20 declares health key to sustainable development." *WHO.* 6 22, 2012. http://www.who.int/mediacentre/news/statements/2012/rio20_20120622/en/index.html.

WHO, PAN AMERICAN HEALTH ORGANIZATION . "Workshop on Health and Development in the Context of Rio+20." *Sustainable Development and Environmental Health.* Research Triangle Park, NC: WHO/PAHO, 2011.

WHO, UN-HABITAT. *Hidden cities: unmasking and overcoming health inequities in urban settings.* Geneva: World Health Organization, The WHO Centre for Health Development, Kobe, and United Nations Human Settlements Programme (UN-HABITAT), 2010.

WHO, United Kingdom Health Protection Agency, UNISDR. "Disaster Risk Management for Health - CLIMATE RISK MANAGEMENT." *WHO-Disaster Risk Management for Health Fact Sheets.* Edited by United Kingdom

HPA. 5 2011. http://www.who.int/hac/events/drm_fact_climate_risk_management.pdf (accessed 1 2014).

WHO/CDS/NTD/DCE. *Communicable diseases following natural disasters- Risk assessment and priority interventions.* Geneva: WHO, 2006.

WHO/HPR/HEP. *Health promotion glossary.* Geneva: WHO, 1998.

WHO/HSE/PHE. "Health Indicators of disaster risk management in the Context of the Rio+20 UN Conference on Sustainable Development - Initial findings from a WHO Expert Consultation: 17-18 May 2012." Geneva: WHO, 2012.

—. "Health indicators of sustainable agriculture, food and nutrition security in the context of the Rio+20 UN Confernece on Sustainable Development- Initial findings for a WHO Expert Consulation:17-18 May 2012." Geneva: WHO, 2012.

—. "Health indicators of sustainable cities in the Context of the Rio+20 UN Conference on Sustainable Development-Initial findings for a WHO Expert Consultation:17-18 May 2012." 2012.

WHO/HSE/PHE. *Health Indicators of sustainable energy in the Context of Rio+20 UN Conference on Sustainable Development- Initial findings for a WHO Expert Consulation:17-18 May 2012.* Geneva: WHO, 2012.

—. "Health indicators of sustainable jobs in the Context of Rio+20 UN Conference on Sustainable Development-Initial findings from a WHO Expert Consultaion:17-18 May 2012." Geneva: WHO, 2012.

—. "Health Indicators of sustainable water in the Context of the Rio+20 UN Conference on Sustainable Development- Initial findings from a WHO Expert Consulation: 17-18 May 2012." Geneva: WHO, 2012.

WHO/SDE/HDE. *Health and Sustainable Development - Meeting of Senior Officials and Ministers of Health.* Summary Report, Johannesburg, South Africa: World Health Organization, Department of Health- Republic of South Africa, Southern African Development Community, 2002.

WHO/SDE/PHE/OEH. *WHO Air quality guidlines for particulate matter, ozone, nitrogen dioxide and sulfur dioxide- Global update 2005- Summary of risk assessment.* Geneva: World Health Organization, 2006.

WHO-Division of mental health and prevention of substance abuse. *WHOQOL Measuring Quality of Life.* Geneva: WHO, 1997.

WHO-Regional Office for Europe. *Health 2020- A European Policy framework and strategy for the 21st century.* Copenhagen: WHO, 2013.

World Health Organization. "Country profiles of environmental burden of disease-Greece." *Quantifying environmental health impacts.* 2009. http://www.who.int/quantifying_ehimpacts/national/countryprofile/greece.pdf?ua=1.

Υπουργείο Υγείας, Γενική Διεύθυνση Δημόσιας Υγείας και Ποιότητας Ζωής. "Συστάσεις για την προστασία της δημόσιας υγείας από υψηλά επίπεδα ατμοσφαιρικής ρύπανσης, λόγω αυξημένων συγκεντρώσεων αιωρούμενων σωματιδίων." *Υπουργείο Υγείας.* 1 2014. http://www.moh.gov.gr/articles/newspaper/egkyklioi/genikh-dieythynsh-dhmosias-ygeias/2171-systaseis-gia-thn-prostasia-ths-dhmosias-ygeias-apo-ypshla-epipeda-atmosfairikhs-rypanshs-logw-aykshmenwn-sygkentrwsewn-aiwroymenwn-swmatidiwn (accessed 1 2014).