MANAGING CHEMICALS IN A CHANGING CLIMATE TO PROTECT HEALTH

The emerging and unprecedented public health threat of accelerating climate change may significantly alter global and local development, use, distribution, and degradation of chemicals in ways that could affect human health. Little has been published to date addressing issues of climate change and chemical safety. In this brochure we explore how climate change may alter human exposure to chemicals, identify who may be at particular risk of harm, and suggest actions that can be taken now to reduce adverse health impacts.

IFCS CHILDREN & CHEMICAL SAFETY CHAMPIONS
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CLIMATE CHANGE MAY ALTER HUMAN CHEMICAL EXPOSURES

...BY CHANGING HOW CHEMICALS MOVE AND TRANSFORM IN THE ENVIRONMENT

Storms have been shown to overwhelm water treatment plants, breach animal waste lagoons and flood warehouses and toxic waste sites causing large scale high dose chemical exposures.
(Photo WHO)

250 million people in Africa are expected to experience increased water stress by 2020 due to climate change. If that water is further threatened by chemical pollution, human health is also threatened.
(Photo Virot Pierre, WHO)

The physical changes in temperature, wind, and rainfall caused by climate change will affect the distribution and break-down of chemicals in complex ways. The effect on human exposure will vary widely according to the properties of specific chemicals and chemical combinations, soil and water conditions, wind patterns, topography, land use, level of development, and human population characteristics. Some examples of how these interactions may affect human exposures are listed below.

- **Extreme precipitation, storms and floods threaten water quality** by increasing urban and agricultural run-off of petrochemicals, industrial chemicals, chemical waste, pesticides and fertilizers into surface waters or enhanced through-put of supersaturated soil into ground water; flooding of warehouses and old stockpiles of chemicals such as paints, solvents and pesticides will lead to potentially dangerous exposure situations.
- **Drought threatens water quality** by concentration of non-volatile chemicals and toxic metals. When rain comes, parched and cracked soil may permit rapid transit of chemicals into deep groundwater stores.
- **Increased temperatures** will cause volatile chemicals to disperse more quickly in the air and some chemicals will degrade more quickly potentially creating local hot spots of exposure. Evaporation will be enhanced leaving non-volatile chemicals to concentrate in water bodies. Global movement of persistent chemicals will be modified with changes in global water and air currents, and population exposures will also change.

...BY CHANGING WHERE AND HOW CHEMICALS ARE USED.

Increased frequency of pesticides use could lead to more rapid development of pest resistance, change to more toxic alternatives, and altered human exposures. (Photo Lilian Corra)

New technology brings unknown risks and requires careful planning to minimize dangerous human and environmental exposures. (Photo WHO)

The risk of Dengue fever is predicted to spread to 5–6 billion people by 2080, compared to the current 1.5 billion. (Photo CDC)

Chemicals have been powerful tools supporting improvements in health and lifestyle in the past and can be critical tools in the global response to climate change. As the world warms, chemical use patterns will likely change in several sectors and affect human exposure levels.

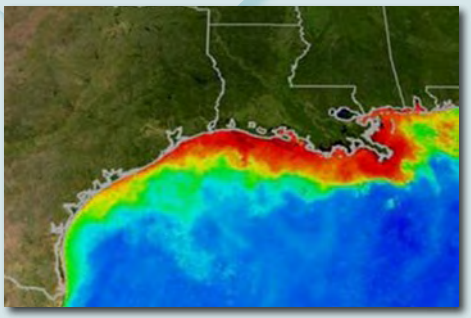
- **Agricultural chemicals.** Water stress, changing agricultural growth zones, spread of agricultural pests, and falling crop yields predicted with climate change may require changes in crop choice, and lead to a perceived or actual need to use more, different, or new chemicals to combat pests. Pesticides may lose effectiveness or be more rapidly broken down in warmer temperatures which could lead to more frequent use and more human exposure.

- **Control of infectious disease.** Increases in vector-borne diseases anticipated with climate change could stimulate more widespread use of a variety of pesticides to control insect, rodent and other disease vectors. Pharmaceutical use to treat these diseases is also likely to increase and further threaten water quality by stressing waste water treatment and downstream drinking water.

- **Alternative energy sources** developed and disseminated to stabilize the climate have the potential to cause large changes in chemical use patterns. For example, the change to biofuels and use of waste as fuels could result in new sources of chemical contamination on a large scale.

CLIMATE CHANGE MAY MAKE SOME CHEMICALS MORE DANGEROUS

- **Ecosystem services.** Studies show that some plant and animal species are more vulnerable to heat-related harm if they have prior exposure to various chemicals. Thus, it is possible that adverse chemical impact on the ecosystems that provide us with food and fiber could be greater in a warmer global environment than previously experienced even without greater chemical contamination.
- **Increased toxicity.** Under experimental conditions, some chemicals are toxic at lower doses in warmer temperatures. It is not clear that this relationship will dominate in the complex world of multiple stressors, but it does support the argument to minimize all chemical exposures as we seek to meet the challenges of a warming world.



The Dead-Zone in the Gulf of Mexico is caused by massive run-off of fertilizers and other human chemicals. (Photo NASA)

SOME GROUPS ARE MORE VULNERABLE
...BECAUSE OF INHERENT CHARACTERISTICS

Both age and general health affect any individual's ability to withstand harm from a variety of chemical exposures. Some groups at increased risk are:

- **Foetuses** are susceptible to permanent harms from even brief exposures in utero as might happen after a water contamination event such as a flood, or a high dose exposure from pesticide spraying.
- **Children** of all ages because of their physical, physiologic and cognitive immaturity can suffer unique and lifelong harm from some chemical exposures.

(Photo Pierre Virot, WHO)

- **Elderly people** may have lost the physical ability to avoid exposure and/or the physiologic capacity to withstand exposures that in younger years may have been relatively non-toxic.
- **Medical illness** can compromise protective and adaptive systems that prevent harm from chemical exposure.

(Photo Pierre Virot, WHO)

...BECAUSE OF CIRCUMSTANCES

Just as climate change will affect different parts of the globe differently, climate change-related chemical exposures may pose disproportionate threats to populations in high risk groups.

- **Poverty** limits adaptive responses to both climate change and chemical exposures.
- **Malnutrition**, particularly in the very young, may compound and worsen effects from any toxic chemical exposure.
- **Geography** is a major determinate of which health threats from climate change are most likely, and places entire populations at increased risk. For example, low lying coastal communities are more susceptible to floods and storms which may be complicated by chemical contamination of drinking water, fields, food crops, and living spaces.
- **Occupations** that involve the use of chemicals, such as agricultural work, may be increasingly risky because of increased chemical use, change in chemicals used and rapid development of new chemicals.
- **Public health infrastructure**, including the health care systems, as well as chemical safety laws, regulations, surveillance and enforcement, are critical to minimizing injury and illness related to climate change and chemical exposures. In those areas where these basic services are lacking, whole populations are at increased risk.

Flood in Bangladesh, 2006
(Photo WHO)

NGOs try to fill the gap, but demand will increase as climate change accelerates. (Photo WHO)

OPEN QUESTIONS

We will need all tools – including existing and new chemicals as well as non-chemical alternatives – to respond to climate change effectively. Protecting health, and particularly the health of those who are most vulnerable, must be a central part of all climate adaptive strategies including chemical use and management. As climate change accelerates and we feel the urgent need to both reduce emissions and respond to public health threats, it is critical that we not loose sight of the need to strengthen and improve systems to ensure chemical safety. When considering any climate-related problems, a number of questions relevant to chemical use should be answered.

- Will using a chemical solve this problem?
  - What is known about toxicity and exposure to the most vulnerable humans?
  - What is known about potential harm to ecosystem services?
- Are there non-chemical solutions for this problem?
- Are there multiple chemicals that could be used to solve this problem?
  - Is there equivalent information on toxicity and exposure for each alternative?
  - Which is least toxic?
- What are the relative toxicities and efficacies of the viable solutions?
- What is unique about the location, geography, topography, level of development, or population characteristics which will affect movement and breakdown of the chemical under considerations?
  - What are the critical human exposures likely to be?
- Can chemical use be minimized or eliminated over time through alternative management strategies?
- Will use of this chemical create new or persistent problems for human health or ecosystem integrity?
  - Do we have adequate chemical safety and management systems in place?
- Will the changing climate increase or decrease human exposure, or make this chemical more or less effective or toxic over time?

(Photo Harry van de Wulp/FAO)

...AND A WAY FORWARD

The Dubai Declaration on International Chemicals Management and the accompanying Over Arching Policy Strategy (February 2006) identify key elements of chemical safety which will be increasingly important within the context of global climate change. The Declaration stresses the need to protect vulnerable populations (including children and unborn children), promote green chemistry, and operate within a context of transparency, partnership and accountability among all sectors of society. In particular, there is a call for public access to appropriate information and knowledge on chemicals throughout their life cycle, including the risks that they pose to human health and the environment. Risk reduction to minimize significant adverse effects on human health and the environment is the first strategic objective, and pollution prevention, precaution, life-cycle analysis, and promotion of environmentally sound and safer chemical and non-chemical alternatives are all enumerated as strategies. Additional areas of action include optimization of knowledge and information, governance, and capacity building and technical cooperation. As work progresses to improve chemical management from the local to international level, the changes in chemical risk associated with accelerating global climate change must be placed permanently on the agenda.

In the past, many chemicals have been used without sufficient knowledge and consideration of the cost to human health and ecosystem function. Even now, capacities and capabilities of many countries to protect their citizens from the potential adverse effects of chemicals and soundly manage the use of chemicals are inadequate; facing the new and expanded problems posed by climate change these countries most certainly will be additionally challenged. **Information** and **training** will be needed to ensure the sound management and use of newly developed chemicals, or existing chemicals used in new locations or applications. **Targeted research** and application of a **precautionary approach** are essential to protect human health and ecosystem integrity from harm as we strive to protect the future.

(Photo Harry van de Wulp/FAO)

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Design: S. Ewart, WHO/GRA