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IEA Bioenergy

THE BIOENERGY AND WATER NEXUS

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The present publication is an excerpt of the larger report 'The bioenergy and water nexus'. It highlights key findings from the report, and should be read in conjunction with the full report.

We encourage reader to refer to the full report, which is available as a downloadable pdf on www.unep.fr/energy/bioenergy.

ABOUT

IEA BIOENERGY TASK 43

IEA Bioenergy

IEA Bioenergy Task 43 – Biomass Feedstocks for Energy Markets – is part of the Implementing Agreement on Bioenergy, which forms part of a programme on international energy technology collaboration undertaken under the auspices of the International Energy Agency, IEA.

Task 43 seeks to promote sound bioenergy development that is driven by well-informed decisions in business, governments and elsewhere. This is achieved by providing to relevant actors timely and topical analyses, syntheses and conclusions on all fields related to biomass feedstocks, including biomass markets and the socio-economic and environmental consequences of feedstock production. Task 43 currently (Jan 2011) has 14 participating countries: Australia, Canada, Denmark, European Commission, Finland, Germany, Ireland, Italy, Netherlands, New Zealand, Norway, Sweden, UK, and USA.

OEKO-INSTITUT

Öko-Institut e.V.
Institut für angewandte Ökologie
Institute for Applied Ecology

Oeko-Institut – the Institute for applied ecology - is a leading non-profit European research and consultancy organization working for a sustainable future. Founded in 1977, it develops principles and strategies for realizing the vision of sustainable development globally, nationally and locally. It employs a staff of more than 125 at its Freiburg, Darmstadt and Berlin offices. Oeko-Institut provides research and consultancy for decision-makers in politics, industry and civil society. Its key clients are ministries and federal agencies, industrial enterprises, the European Union and UN organizations. In addition, the institute is commissioned by non-governmental a and environmental associations.

UNITED NATIONS ENVIRONMENT PROGRAMME

UNEP

UNEP is the United Nations system's designated entity for addressing environmental issues at the global and regional level. UNEP's mission is to provide leadership and encourage partnership in caring for the environment by inspiring, informing, and enabling nations and peoples to improve their quality of life without compromising that of future generations. In 2008, UNEP's new Medium Term Strategy was adopted along 6 strategic priorities: climate change, disasters and conflicts, ecosystem management, environmental governance, harmful substances and hazardous waste, and resource efficiency. In the first and the last two of these priority areas, UNEP's Division of Technology, Industry and Economics (DTIE) plays a leading role. DTIE helps governments, local authorities and decision-makers in business and industry to develop and implement policies and practices focusing on sustainable development. To work towards Climate Change Mitigation, UNEP promotes policies that place energy and transport within the broader sustainable development context and steers project developers and the investment community towards greater engagement in renewable energy and energy efficiency. UNEP has an active programme on bioenergy, an issue that cuts across several of the priority areas. It provides scientific assessments on a variety of environmental issues related to bioenergy, tools helping decision-makers to promote sustainable bioenergy development, and ad hoc advisory services to governments.

PREFACE

Energy and water are key to development: they were prerequisites for the first industrial revolution and they will be key to a new kind of 21st century development path that echoes to the risks but also opportunities of modern times.

UNEP's report, "*Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication*", estimates that investing 2% of global GDP into ten key sectors - amongst which energy and water are central – can catalyze this transition if supported by forward-looking national and international public policymaking.

Good public policy however requires good scientific and analytical evidence on the risks and the opportunities of different kinds of technologies and development choices.

This new report, building on the work of various new initiatives including UNEP's International Resource Panel, provides recommendations and outlines options in respect to bioenergy in support of a Green Economy transition.

The first point is that all forms of energy have, to a greater or lesser extent, an impact on water resources. Fossil fuel and nuclear power stations for example require a significant quantity of water for cooling.

Bioenergy's water demands are in large part linked with the growing and processing of feedstocks such as crops which in turn has important implications for sustainable agriculture, land use and food production.

Indeed land use has in large part been the key area of debate in respect to bioenergy with implications for not only food security but also biodiversity and the impact such energy may have on aggravating or cutting greenhouse has emissions.

Current and future planning in respect to bioenergy also needs to reflect increasing and competing needs for the same raw materials for uses such as food, fodder and fibre as the world population climbs to around nine billion over the next 40 years.

This may argue against bioenergy developments. But there are circumstances, outlined in this report, where well-planned deployments might actually improve agricultural practices including promoting improved water efficiency and more sustainable fertilizer use.

Meanwhile combining food and bioenergy production systems can deliver win wins in terms of energy and food security with benefits in terms of livelihoods, employment and greenhouse gas emissions.

On the Road to Rio and the UN Conference on Sustainable Development 2012, understanding the risks and harnessing the opportunities by seeing bioenergy as part of a far bigger sustainability picture will prove critical to governments seeking to achieve broad and multiple goals including sustainable energy for all, food security and access to clean water.

Achim Steiner,
UN Under-Secretary General and
Executive Director, UN Environment Programme (UNEP)

INTRODUCTION

THE BIOENERGY AND WATER NEXUS IS COMPLEX

BIOENERGY PRODUCTION[1] AND USE HAVE BOTH POSITIVE AND NEGATIVE ENVIRONMENTAL AND SOCIO-ECONOMIC CONSEQUENCES, INCLUDING THOSE PERTAINING TO WATER

WATER IS ALREADY A SCARCE RESOURCE IN MANY PARTS OF THE WORLD. THE EXPANSION AND INTENSIFICATION OF BIOENERGY PRODUCTION COULD ADD TO EXISTING PRESSURES. THEREFORE, WATER RESOURCES MANAGEMENT AND ADEQUATE POLICIES AND STRATEGIES ARE NEEDED TO HELP ENSURE SUSTAINABILITY AND BALANCE DIFFERENT TYPES OF USE IN THE SHORT AND LONGER TERM.

1 The term 'bioenergy production' is used here to capture the various ways of producing biomass and converting it to solid, liquid and gaseous fuels, and to electricity. However, it is recognized that this term is not doing justice to the first law of thermodynamics (energy can be neither created nor destroyed, but only change forms).

Bioenergy and water are inextricably linked. Water quantity and quality have been identified as emerging issues of concern in the bioenergy field. Water availability will undoubtedly affect the extent to which bioenergy can contribute to the overall energy mix.

Freshwater[2] shortages have already begun to constrain socio-economic development in some regions. Among other global trends, population growth and related increases in demand for agricultural and forestry products to provide food, fodder, fibre and fuel will put further pressures on water resources. In addition, the share of the population at risk of water stress is projected to expand greatly due to climate change (water stress index at the watershed level is presented in Figure 1.1). The most recent *Global Environment Outlook* (GEO4) estimates that by 2025 two-thirds of the global population will live in areas experiencing water stress, i.e. where periodic or limited water shortages can be expected[i].

Bioenergy production – in particular, the production of biofuels for transport – has expanded rapidly in recent years, driven by concerns about climate change, oil price volatility and dependency on imports for energy security, as well as options for rural development and income generation. Agriculture accounts for about 70% of global freshwater withdrawals from rivers, lakes and aquifers. Since bioenergy is largely dependent on biomass production, expected growth trends will lead to increasing competition and pressures on water resources. These pressures may be partially attenuated by advances in technology and the use of different feedstocks[ii].

This report primarily addresses the following questions:

- HOW are the production and use of bioenergy products likely to influence the future state of water resources?
- HOW can society mitigate negative impacts and guide development towards sustainable use of these resources, including groundwater, rivers, and riparian and wetland systems?

In considering the ways bioenergy feedstock production and conversion can impact water resources, the report looks at ways to assess effects at different spatial and temporal scales. A number of indicators and assessment tools exist. They are being used to include the water perspective in analyses and assist strategy development and land use planning. Ideally, such indicators and assessment tools will help not only to reduce risks and avoid undesirable development, but also to identify opportunities and synergies. They should form the scientific basis for policy instruments.

Bioenergy is not the only part of the energy sector that has impacts on water resources. Energy and water are deeply inter-related, although different energy sources have different “water footprints” and other characteristics that need to be assessed.

Furthermore, the concerns raised in this report are not unique to bioenergy, but are examples of larger, systemic issues in agriculture, industry, land use and natural resource management. As a rapidly growing sector, however, bioenergy can serve as a high-profile leverage point to raise awareness of water-related issues and to stimulate the implementation of best management practices where this might not otherwise occur. Bioenergy also offers synergy options with other sectors, which need to be further explored.

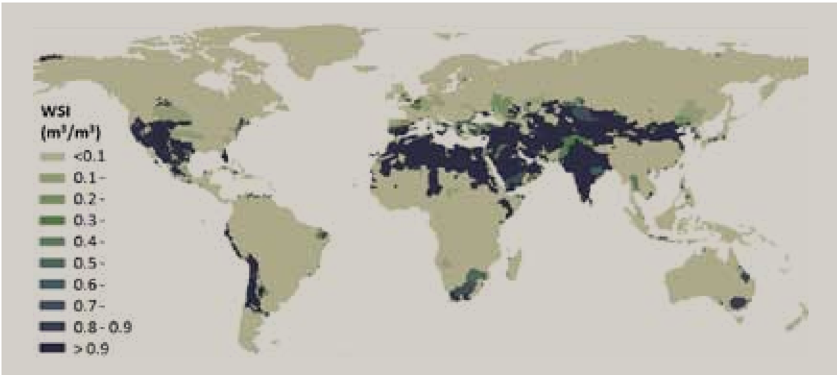
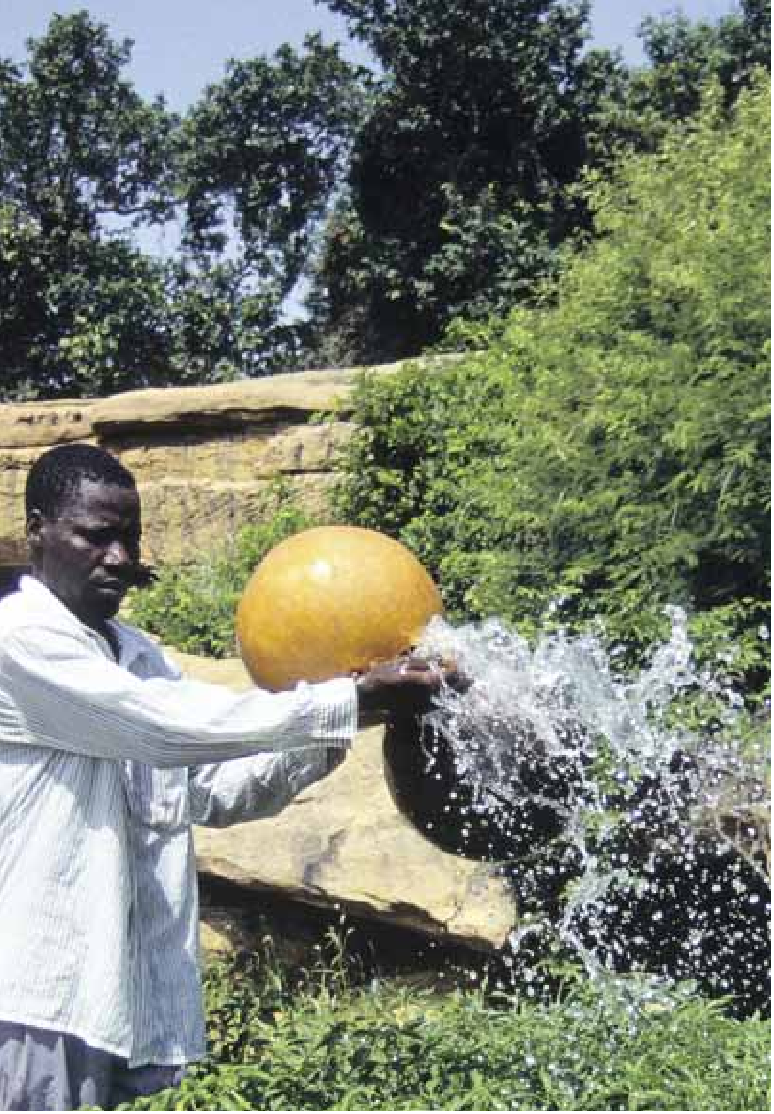


Figure 1.1: Characterization of water stress index at the watershed level per m^3 water consumed[iii]

2 Only freshwater resources are considered in the report. The term water resource(s) may refer to a watercourse, surface water, estuary or aquifer, including the physical or structural aquatic habitats (both instream and riparian), the water, the aquatic biota, and the physical, chemical and ecological processes that link habitats, water and biota.



WATER USE FOR BIOENERGY NEEDS TO BE EVALUATED AT DIFFERENT SCALES

DIFFERENT BIOENERGY PRODUCTS ARE NOT CREATED EQUAL, AND THIS IS ALSO TRUE FOR THEIR USE OF WATER. INVENTORYING THE WATER REQUIREMENTS OF A BIOENERGY PRODUCT CAN SERVE AS A BASIS FOR WATER RESOURCES MANAGEMENT AND PLANNING. INVENTORIES CAN BE CREATED USING WATER USE INDICATORS, WHICH ALLOW ESTIMATING THE VOLUMES PER TYPE OF WATER ABSTRACTED, CONSUMED AND ALTERED THROUGHOUT THE ENTIRE PRODUCTION CYCLE. THE RELEVANCE OF EACH INDICATOR IS DETERMINED BY LOCAL OR REGIONAL CONDITIONS, AND PLANNING NEEDS TO CONSIDER HISTORIC AS WELL AS ALTERNATIVE FUTURE LAND USE IN AN AREA.