Water-Energy-Food Security:
What are the potential contributions of the mining industry?

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What is Water-Energy-Food (WEF) Security?

The concept of water-energy-food security gained prominence during the global food crises of 2008 and 2011, and an ongoing series of energy and water shortages in countries around the world. These events demonstrated the necessity of coordinated action to address water, energy and food securities and their interlinked causes. As well, they highlighted that a deterioration in the ability of water, energy and food systems to provide for the basic needs of a population can lead to adverse socioeconomic, livelihoods and human well-being effects.

Population growth and economic prosperity are increasing the demand for natural resources in unprecedented ways, posing the risk that intense pressures on the natural system could threaten water, energy and food (WEF) securities. At IISD, we define the WEF nexus as comprising elements of quality, quantity and access to the its key components

WEF Security in a Mining Context

Metals demand is expected to grow 250 per cent between 2005 and 2030, according to estimates,[1] while global ore extraction is expected increase 37 per cent between 2010 and 2020, from 8 billion tonnes to 11 billion tonnes a year.[2] With the growing importance of the mining industry in many developing countries, there is a need to better understand WEF in the context of mining. Mining issues are context-specific, as in the case of development, but often come down to water quality and quantity issues downstream of mining sites, competition for access to land for food, markets, production and access to reliable and cost-effective energy. To explore WEF in the context of mining, IISD examines the key linkages between all three components and mining development to ensure multiple benefits and avoid the risks of disaggregated planning.

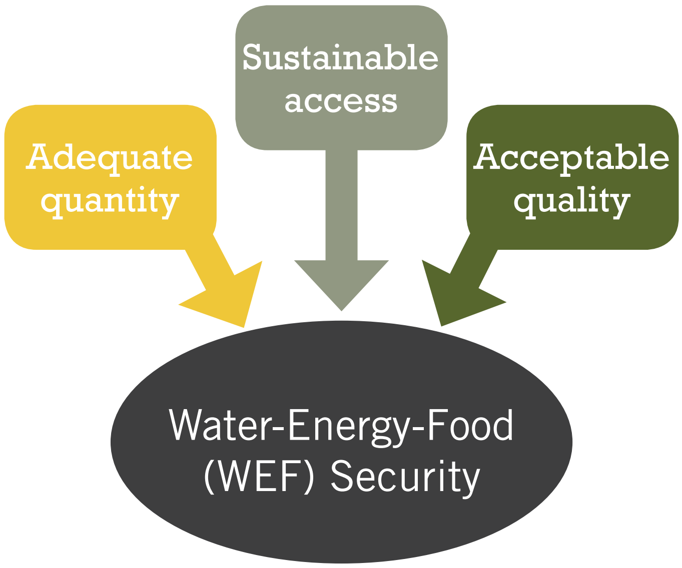

Figure 1. The WEF Nexus

[1] Lee, Preston, Kooroshy, Bailey and Lahn. (2012): http://www.chathamhouse.org/sites/files/chathamhouse/public/Research/Energy,%20Environment%20and%20Development/1212r_resourcesfutures.pdf
[2] Ellen MacArthur Foundation (2011): www.thecirculareconomy.org/

Indicators and Analytics to Understand WEF in the Context of Mining

IISD's process for understanding WEF in the context of specific mining developments incorporates both participatory and analytical approaches (Figure 2) for:

- Highlighting specific relationships between WEF security and mining operations.
- Identifying a set of indicators to measure key aspects of WEF including local livelihoods that enable access to food or energy.
- Analyzing nature and magnitudes of these relationships to assist decision making.
- Operationalizing WEF by adjusting (or designing) policies and programs in the context of the mining development keeping in mind future challenges and opportunities.

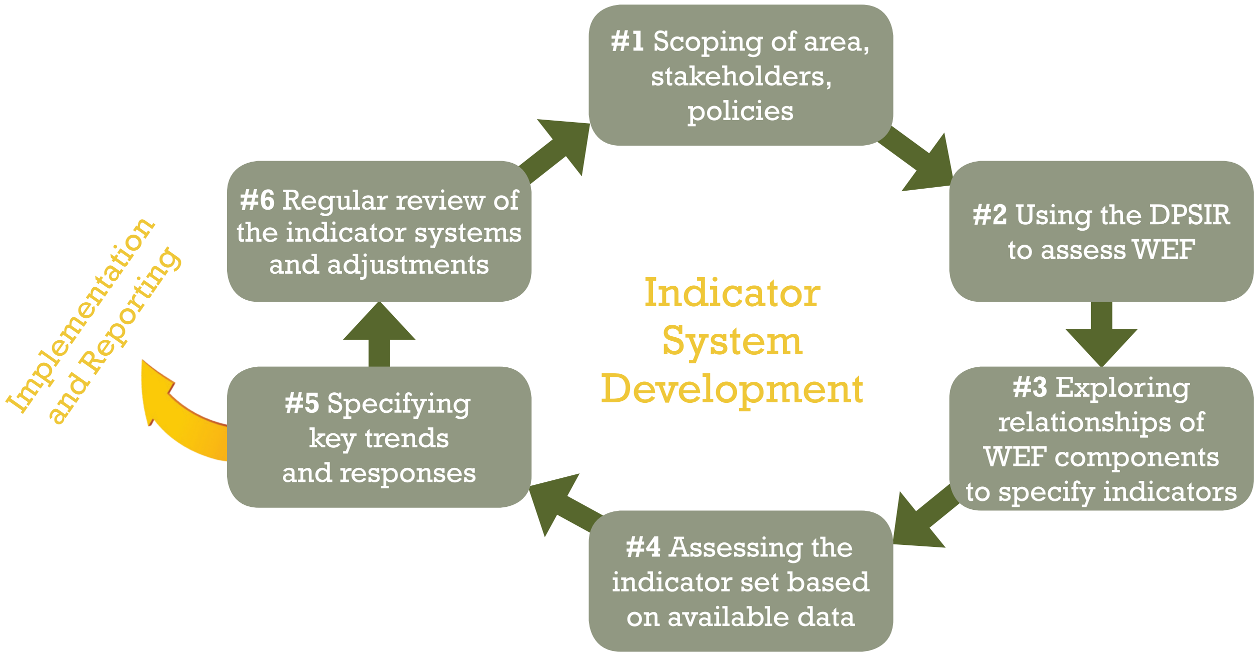

FIgure 2. Overview of the methodological approach

Analytical approaches like hydrological modelling can help understand the magnitude of WEF linkages with mining development. Hydrological analyses can provide decision-makers and stakeholders with an overview of hydrological processes as well as a means of quantifying current conditions and predicting future impacts. Furthermore, linking water quantity/quality outputs to the energy and food systems allows for prediction on how interlinked WEF systems will respond. The hydrological analyses selection will depend on the questions being addressed and available data and resources. For application in the mining context, the hydrological analyses typically make use of a simple mass balance approach that allows users to predict WEF security impacts associated with mining development.

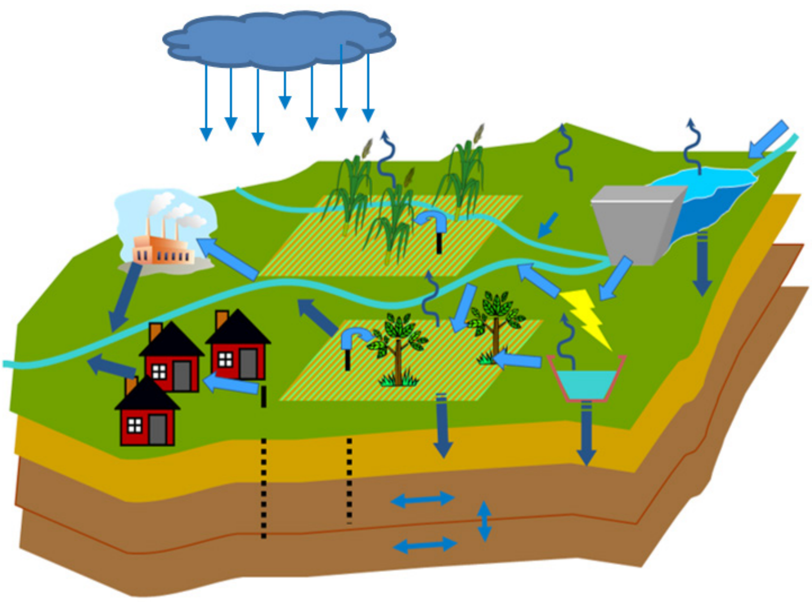

Figure 3. Illustrative visual of hydrological assessment

The **Driver-Pressure-State-Impact-Response (DPSIR)** framework was developed to assist users and decision-makers to explore cause-and-effect relationships between human activities, their effects on ecosystems and human systems, and the resulting effects on specific aspects of human well-being and development. The DPSIR framework has been used by multiple governmental and non-governmental agencies such as the United Nations Environment Programme (UNEP) and the European Environment Agency (EEA).

Example of a WEF Indicator System

Indicators can help us understand and clearly articulate the cause-and-effect relationships between WEF and mining development, including key social, economic and environmental components. Key indicators are prioritized based on analytical and participatory processes to understanء what is truly important and urgent in the region affected by mining. Our criteria for indicator selection are:

- The relevance of the data to assessing state or trends and informing policy action.
- The usefulness of the measure in accounting for the multiple degrees of causation across water, energy and food consumption and production systems.
- The significance of the indicator in determining ultimate WEF security impacts.

PRESSURES Mining derivatives relevant for WEF	STATES-AND-TRENDS Changes in systems relevant for WEF	IMPACTS WEF security and livelihoods	Indicators to Measure WEF Security
Environmental Leaching of chemicals and hard metals into water	Environment Presence of toxins in water Threat status of species Fish stock health, density and diversity	Acceptable quality Drinking water safety Food safety	Mercury concentration in fish and other staple foods Chemical residues in food and water Fish stocks (marine trophic index) Generation of hazardous waste Percentage of households using bottled water or Percentage of households using low-quality water
Environmental Water withdrawal	Environment Availability of water	Adequate quantity Inadequate food/energy produced Undernutrition Malnutrition	Proportion of total groundwater and surface water withdrawn for mining and community use Percentage of crop production depending on irrigation Staple crop yields (Crop yield gap—actual yield as percentage of attainable yield) Percentage of population below minimum level of energy/caloric consumption Proportion of population with shortfalls of any of the micronutrients (iron, zinc, iodine, vitamin A and B12, folate)
Environmental Land use and disturbance	Environment Erosion and soil quality Land under industrial use	Sustainable access Lower food/energy production due to land-use limitations Land for subsistence and market production	Land-use change by land-use categories Changes in the distribution of land access and user rights for substance and market production and fuel wood Land degradation (share of land that is no longer able to sustain crop production, pasture or forests)
Social Poor occupational health and safety	Society Occupational diseases Workplace accidents	Sustainable access Disposable income Self-production	Percentage of households relying on water, energy and food self-production Rates of injury, occupational diseases, work-related fatalities Number of compensated occupational diseases Prevalence of HIV/AIDS Gross national income (GNI) per capita Index of decent work
Economic Employment, salary	Economy Unemployment rate Net savings Debt ratio	Sustainable access Disposable income	Share of women/indigenous in employment Household debt level Percentage of income used to pay for food/energy/water

Current Application in Suriname

Gold mining has a long history in Suriname, dating back to the early 18th century when a Dutch mineral exploration and mining company established itself in Suriname's interior. Today, the Rosebel Gold Mine, now owned by IamGold and the Suriname Government, is the only large-scale gold mining project in Suriname, but two other mining developments—the Maripaston Gold Mine, and the Merian Gold Project—are slated to begin exploration in the near future.

IISD is collaborating with national and subnational stakeholders in Suriname, including the government, the state-owned mining company Grassalco and local research partners, to help ensure that the Maripaston Gold Mine project will optimize its contribution to water-energy-food security regionally and nationally. One of the main issues is to ensure that the mining development is not at odds with the interests and wellbeing of communities in the downstream and surrounding area of the mine. Numerous indigenous and maroon communities live the immediate vicinity of the Maripaston concession and downstream waterways. In addition small-scale mining is an important activity in the concession. A water-energy-food sensitive approach to mining development is being explored as a way to safeguard the wellbeing and livelihoods of these communities.

The outcomes of the application in Suriname include:

- Stakeholder workshops conducted with government, mining company and others and continued engagement leading to an in-depth understanding of the consequences of (and opportunities for) mining operations' contributions to WEF security at the community level.
- Hydrological modelling to improve understanding of the interactions between mining operations and water, energy and food access, quality and quantity.
- A set of indicators under development to monitor changes in the level of WEF security as well as the effectiveness of proposed interventions to improve them.
- A data set based on monitoring efforts available in the region and the country to support the indicator system.
- Guidance on monitoring for key WEF indicators.
- Recommended adjustments and additional actions to improve WEF security including local livelihoods based on the trends identified in the indicator system.
- Model indicator set applicable to other mining communities in other countries supported by a resource book, indicator development tool and conceptual model.

International Institute for Sustainable Development (IISD), 161 Portage Avenue East, 6th Floor, Winnipeg, Manitoba, Canada, R3B 0Y4

Dimple Roy
droy@iisd.ca

Livia Bizikova
lbizikova@iisd.ca

Gabriel A. Huppé
ghuppe@iisd.ca