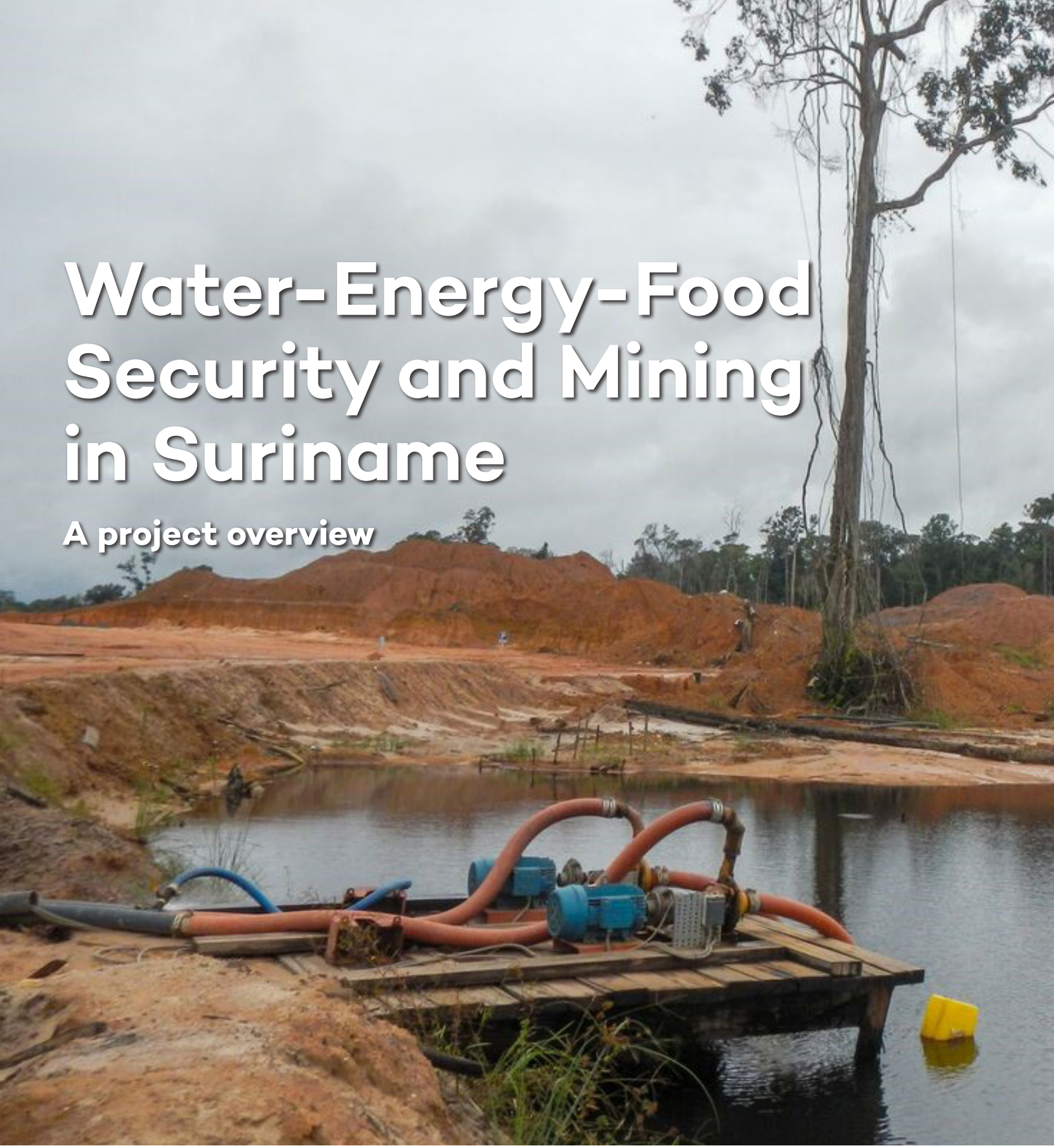

Water-Energy-Food Security and Mining in Suriname

A project overview

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September 2015

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FOREWORD

Suriname is situated on the northern coast of South America (2° – 4° N Latitude, 54° – 58° W Longitude) and borders French Guiana to the east, Guiana to the west, Brazil to the south, and the Atlantic Ocean to the north. The climate is tropical with an average temperature between 21°C and 32° C. The total area is 163,270 km2 with a population of approximately 534,000.

Suriname is located within a central part of the Guiana shield and is composed primarily (80 per cent) of Precambrian, Cretaceous (unexposed) to crystalline rocks. The crystalline basement was formed during the Trans-Amazonian Orogenic Cycle, 1.9–2.2 billion years ago. Within this shield, the Greenstone Belt occurs more or less in the northeastern part of Suriname. This belt is of major economic importance for its primary gold deposits, base metal occurrences and placer deposits.

The mining sector is by far the largest contributor to Suriname's economy, not only in terms of its contribution to government revenues, but also in relation to the country's overall economy. Additional benefits include net export earnings, infrastructure development, employment and spin-off economic activities. The resource sector focuses on oil, gold, bauxite and (of less importance) construction materials. The export value of mining commodities increased from USD 1.2 billion to USD 2.5 billion from 2007 to 2013, which represents almost 40 per cent of Suriname's GDP. Employment growth in recent years has been driven by the private sector, mainly mining. Worth mentioning is that between 20,000 and 30,000 persons are active in artisanal and small-scale mining (ASM) (both formal and informal).

The intensive scale of legal and illegal gold extraction activities by both the local population and foreigners, along with the significant misuse of unrecovered mercury, has led to the salinization of rivers and creeks. Other consequences of the gold industry include the serious disruption of the physical landscape, social conflicts and crime. The economic benefits of small-scale gold mining remains significant, but so does the seriousness of the social and environmental consequences and therefore there is a need for clear and unambiguous deterrents to the negative consequences.

The environmental impacts of the mining sector must be considered because of the resulting destruction of the physical, social and cultural environment. In addition to short-term damage, the long-term feasibility of the mining sector becomes questionable if impacts are not managed. In addition, the effect of large-scale projects on the social environment must not be neglected. Most of the mining activities in Suriname are within the Greenstone Belt, where most of the country's indigenous people live. Friction between mining activities and traditional living patterns regularly leads to conflicts. Mechanisms need to be developed and ways have to be found to better understand the impacts and implications and improve overall sustainability in the mining sector.

As a member country of the Intergovernmental Forum on Mining, Minerals, Metals and Sustainable Development (IGF), Suriname is working together with the International Institute for Sustainable Development (IISD), a Canadian NGO supported in this initiative by the Canadian Department of Foreign Affairs, Trade and Development (DFATD). During the 2013 IGF Annual General Meeting held in Geneva, Switzerland a two-year project was initiated called "Best Practice and Guidance for Natural and Social Capital Investments for Water-Energy-Food Security in a Mining Context."

The goal of the project was to develop a generic framework for understanding the links between mining and relevant environmental and social factors contributing to water-energy-food (WEF) security.

Understanding the benefits and impacts of development on WEF security offers a tremendous opportunity for directing investments for advancing sustainable development and human well-being. In Suriname, IISD looked at the impacts of mining on WEF security at the local and national levels. In 2014 and 2015, two workshops were also organized (one in each year), in collaboration with the State Mining Company of Suriname (N.V. Grassalco) and the Anton de Kom University of Suriname. The two workshops provided identified key aspects of WEF security relevant for the mining operations in the country and offered a three-day course with guidance on practical aspects of understanding, monitoring and incorporating WEF security considerations into related decision making and programming. The focus also was to understand the importance and key elements of WEF security and to learn about WEF security monitoring and the use of indicators for this purpose. A hands-on training was given to the participants to use a simple Excel-based tool to create better understanding of community and mining linkages with focus on WEF security and to identify monitoring indicators and actions to improve WEF security at the community level. As part of this course an overview of the key aspects of a hydrologic monitoring framework to address water quality, quantity and access issues most relevant for WEF security was presented to and discussed with the participants. The attendance of this workshop, the intense input by the participants (a good mixture of disciplines and experience levels) and presenters, and the good discussions made this workshop successful. Participants also gave good feedback and opportunities for future assessments.

I am hopeful that this WEF Security Tool will be part not only of a collaborative discussion, but also of collaborative actions in developing sustainable livelihood for communities throughout Suriname.

Glenn M. Gemerts

Chair of the Intergovernmental Forum (IGF) on Mining, Minerals, Metals and Sustainable Development
Policy Advisor of the State Mining Company of Suriname, N.V. Grassalco.

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1.0 INTRODUCTION

With the growing importance of mining as a major driver in many countries' economic development, there is increasing interest in better understanding the contributions of mining to the overall environmental and social conditions of the regions where these investments take place. While progress has been made in integrating sustainable development into mining contexts, there is still considerable need to better understand and optimize the impacts and benefits of mining operations on communities. Linking sustainability in specific and tangible ways to the well-being of communities, regions and nations will help make the case for such planning in the context of development in general, or specifically for mining development. Water-energy-food (WEF) security has been recently introduced as a tangible means to account for community well-being and help operationalize sustainable development in a practical and actionable manner (Hoff, 2011). The WEF security concept gained prominence amidst the food crises of 2008 and 2011 and ongoing water shortages in countries around the world. It is increasingly recognized that current and intensifying resource pressures can, by way of a deterioration in water, energy and food production and consumption systems, hamper human and economic development, create social and geopolitical tensions, and cause further environmental degradation (World Economic Forum, 2011; European Report on Development, 2012).

WEF security constitutes critical components of human well-being and includes aspects of supply, demand and access to all three. It is crucial to ensure that people have sustained access to good quality and affordable energy, water and food. Large-scale development efforts such as mining, agriculture or industrial development impact WEF security both positively and negatively. These developments are often driven by a need for more reliable food, energy or water or their components and can provide significant opportunities to improve WEF. On the other hand, focusing on enhancing one of these aspects may mean that such development causes unintended long-term consequences for other critical components of regional well-being. It is for this reason that IISD has been focusing on integrating WEF security into development decisions.

IISD's WEF work in the context of mining development considers cumulative impacts and aims at finding solutions across sectors and priorities based on as full an understanding of a region or context as possible. Looking at the interlinkages between the three WEF systems provide decision makers an opportunity to optimize across these multiple systems and minimize unintended consequences on related issues. In Suriname, mining constitutes a significant portion of the country's GDP and is seen to affect not only national, but also regional and community well-being through positive and negative changes in land use and food systems, water availability, quality and access, and infrastructure systems.

A central premise of our work on this issue is that development investments, including those to support large-scale agriculture and mining must support WEF security in the region, especially among vulnerable communities and stakeholders. Our work on WEF security unpacks the underlying social, environmental and economic determinants of security and includes these in a WEF tool to assess, analyze and provide guidance on investments and programming to optimize across these three sectors. A combination of assessments and discussions in Suriname were aimed at understanding this process in general and for the country more specifically.

ABOUT THIS PROJECT

The Intergovernmental Forum on Mining, Minerals, Metals and Sustainable Development (IGF) is a multilateral agency with approximately 50 member countries working toward incorporating principles of sustainable development in mining. The IGF has developed the mining policy framework (MPF), "a document of best practices to promote good governance in the mining section" (www.miningpolicyframework.org) including thematic areas on socioeconomic benefit optimization, post-mining transition, environmental management legal and policy environmental, small-scale mining and financial benefit optimization.

IISD has developed a water-energy-food security (WEF) framework for agricultural watersheds and proposed adapting it for mining watersheds and contexts. After some initial research, IISD presented this idea to the Department of Foreign Affairs, Trade and Development (DFATD) and IGF member countries and received strong interest from Suriname. With positive feedback from DFATD, it was agreed at the October 2013 IGF Annual Meeting in Geneva to conduct an assessment in Suriname to help mining operations and subnational decision makers understand the linkages between mining and relevant environmental and social systems contributing to WEF security in the subnational region.

To this end, the WEF project was made up of the following main components:

Task 1: WEF and mining review: This task included a comprehensive review of literature and best practice relating to mining and sustainable development and aimed to provide guidance on practices and indicators to monitor WEF in the context of mining.

Task 2: WEFsat-mining tool development and status assessment: This task was aimed at developing a methodology to understand the WEF status in a region in the context of mining and to test this methodology in other contexts in the future.

Task 3: Hydrologic Assessment Guidance: A hydrologic monitoring framework to provide guidance on monitoring and reporting on water quantity and quality systems as a key integrator of WEF systems complementing monitoring plans for the region.

Task 4: Capacity building and training: Ensuring that all analyses were shared with local stakeholders and engagement with various WEF and mining stakeholders was used to build local understanding and capacity on integrated management of interrelated systems.

A summary of project tasks, outputs and outcomes is attached in Appendix 1 to this document.

TASK 1: REVIEW OF LINKAGES BETWEEN WEF AND MINING POLICY AND PRACTICE

As the need for mineral resources increases, so too does the ability of mining to influence social, economic and environmental systems. In light of the close connection between mining development and neighbouring systems, WEFsat-Mining provides a useful means of developing collaborations between companies, surrounding communities and local organizations. Mining developments have historically been simplistically framed as important contributors to economic growth; however, with greater understanding of the potentially significant destructive effects on the environment, the last several decades have seen the emergence of collaborative approaches to mining developments built upon a greater understanding of the diverse benefits and impacts of mining. Many of these efforts were framed in the context of promoting sustainable development to ensure a more balanced approach when planning mining operations and structuring relationships with surrounding communities. A series of initiatives formed the basis for a shared strategy and collective action around mining's contribution to sustainable development for both policy-makers and mining companies.

These initiatives (and others in the mining sector and related to improved sustainability) are summarized in Figure 1 below and described further in IISD's Water-Energy-Food Resource Book for Mining.

Table 1. *Existing frameworks in which indicator systems have been developed*

PRINCIPLES	GUIDELINES	STANDARDS
MORE INTERPRETIVE **LESS GUIDANCE** **LITTLE COMPLIANCE**		**MORE PRESCRIPTIVE** **MORE GUIDANCE** **STRICTER COMPLIANCE**
1. Centre for Science in Public Participation (CSP2) Framework for Responsible Mining 2. Azapagic's (2002) Mining and Sustainable Development Indicators	3. Global Reporting Initiative (GRI) Guidelines and Mining and Metals Sector Supplement 4. Prospectors and Developers Association of Canada (PDAC) e3Plus Framework*	5. Initiative for Responsible Mining Assurance (IRMA) Standard for Responsible Mining 6. Mining Association of Canada's (MAC) Towards Sustainable Mining 7. Mining Certification Evaluation Project (MCEP)
* is currently exploring options to certify operations (to become a standard)		

Source: Authors' research

These sustainability frameworks and reporting systems provide a good basis for WEF assessment. Many of the impacts, monitoring needs and elements of the reporting systems are determinants of WEF security, either directly or indirectly. Those approaches focused on the broader sustainability benefits and impacts of mining operations can be further developed and complemented to account for the situation in the surrounding communities and explore impacts of mining operations in the context of their impacts and potential benefits (see Table 2). These inputs, determinants and indicators connecting WEF and sustainability in mining create the basis of the WEFsat-Mining tool that was developed and tested in Suriname during the course of this project.

Table 2. Illustrative examples of the linkages between select mining sustainability impacts and WEF security in Suriname from background review and the Suriname assessment

SUSTAINABILITY IMPACTS OF MINING PRODUCTION SELECTED FROM THE GLOBAL REPORTING INITIATIVE:	WATER	ENERGY	FOOD	DETAILS ABOUT THE NATURE OF THE IMPACTS
ENVIRONMENT				
Total water use	o	o	•	Access to water for agriculture and other uses may be diminished, although in study communities, surface water levels were unaffected.
Land in indigenous territory	•		•	Access to critical resources may be limited.
Major impacts on biodiversity in terrestrial, freshwater and marine environments	•		•	Some populations may rely on surrounding fauna/flora for subsistence, incomes and livelihoods. Bushmeat dependence is high, for e.g. in interior Suriname.
Different types waste and their destination	•		•	Quality of water, and food, through food chain effects, can be affected by mine waste.
Significant discharges to water	•		•	Quality of water, and food, through food chain effects, can be affected by liquid effluents. Artisanal miners used mercury to precipitate gold and this has been known to impact water quality in the region and downstream.
Significant spills of chemicals, oils, and fuels	•	o	•	Quality of water, and food, through food chain effects, can be affected by significant spills. Mercury in water has led to mercury in fish—a staple food in Suriname.
SOCIAL				
Standard injury, lost day, absentee rates and number of work-related fatalities	•	•	•	Access to WEF may be reduced due to decreased ability for self-production, lost income, and employability/productivity.
Average hours of training per year per employee by category of employee	o	o	o	Access to WEF may be improved due to increased ability for self-production, increased income, and employability/ productivity.
Policies/ procedures/programs to manage impacts on communities in areas affected by activities	•	•	•	Generalized effect on quality, quantity and access due to wide-ranging relevance of measures.
Resettlement activities	•	•	•	Access to WEF may be reduced due to foregone ability to access traditional livelihood and resources.
Process for identifying local communities' land and customary rights and grievance mechanisms used to resolve any disputes	•	•	•	Access to WEF may be safeguarded by protecting land rights due to maintained ability to access traditional livelihood and income resources.
ECONOMIC				
Workforce status (employee/non-employee), types of contract (indefinite or permanent/fixed term or temporary)	o	•	•	Employment enhances financial access to WEF.
Net employment creation and average turnover	o	•	•	Employment enhances financial access to WEF.
Policy and procedures for consultation & negotiation with employees over changes in the operations	o	o	o	Continued financial and physical access to WEF by promoting a decent income and safeguarding the health of workers.
Strength of relationship between mining's sustainability impacts and WEF: • Strong linkage; o Weak linkage				

TASK 2: THE WATER-ENERGY-FOOD SECURITY ASSESSMENT TOOL (WEFsat-MINING)

Based on background research and initial input from two field trips to Suriname in addition to the workshops, a WEF assessment methodology and tool were developed. It was clear that in order to make decisions that optimize the benefits of mining development and WEF security in the region, we must understand the complex and interlinked systems involved. First, we must understand the state of WEF in the regional communities. Then we must understand the positive and negative implications of mining. We can look at the impacts of mining on each element of WEF, the interactions between these elements—as well as their impacts on local resources—and finally how this all changes over the mine's life cycle. To address this complexity, we developed a WEF Security tool (WEFsat-Mining) to help decision makers at a variety of levels (and involved in any aspect of mining or regional sustainability) to work through each element of WEF linkages between them and identify monitoring and indicator systems to keep track of changes over time.

This work articulated WEF security as a combination not only of the three sectors relevant for human security, but also as a function of access, availability, supporting resources, and supporting policies. This tool builds on this framework for mining development and operationalizes it for practical assessment and guidance through a combination of analytical and deliberative means (Figure 1).

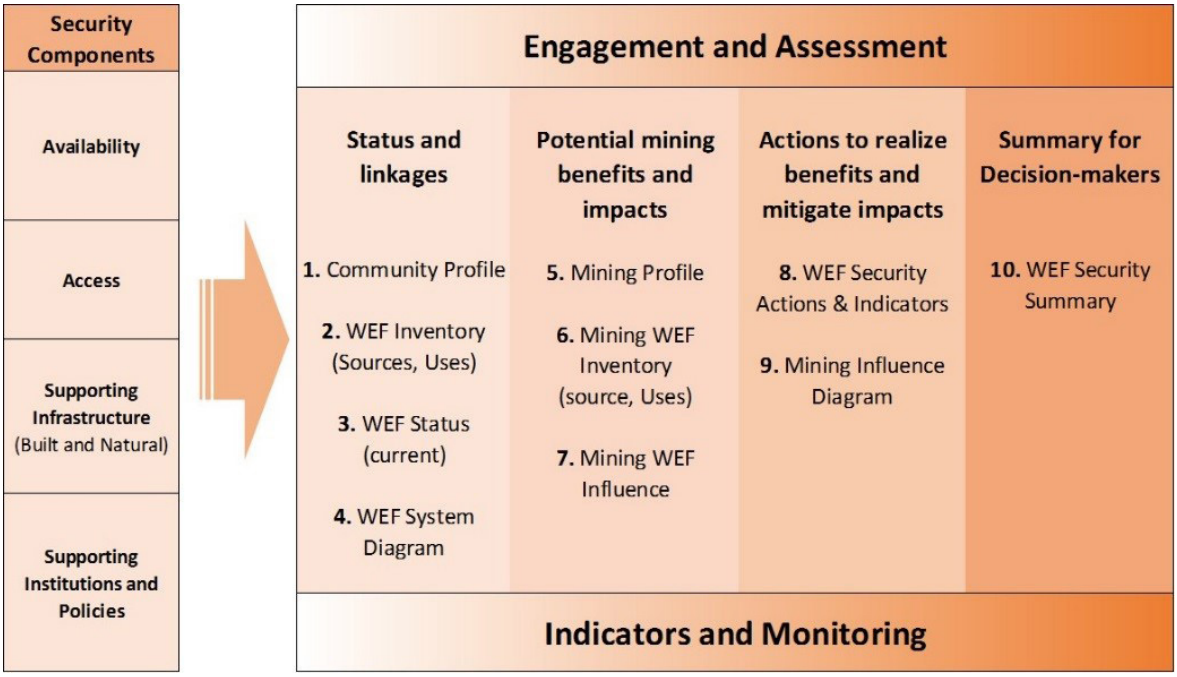

Figure 1 IISD's WEF Security Analysis Framework Applied to the Assessment of Potential Mining Benefits and Impacts

WEFsat-Mining guides users through a series of steps to look at existing WEF security status in the community or region. It identifies specific mining development-related use or impacts on various aspects of WEF, followed by an identification of impacts and benefits from the combination of WEF and mining development, finally leading to a summary and recommendations on potential win-win-win options. The steps of WEFsat-Mining and examples of the Excel sheets are described below.

Box 1. Overview of the WEFsat-Mining worksheets

STATUS AND LINKAGES

Worksheet #1 – Community Profile: To identify and describe the communities situated within the water-energy-food areas of the existing or proposed mining operation.

Worksheet #2 – WEF Inventory: To identify the sources and uses of water, energy and food in the communities and the linkages among them (i.e., electricity used to power water pumps used to irrigate crops).

Worksheet #3 – WEF Status: To describe the current status of the WEF Security components relevant to each water, energy and food source (i.e., availability, access, supporting infrastructure, supporting institutions, policy).

Worksheet #4 – WEF System Diagram: A systems mapping palette to enable a facilitator to work with stakeholders to visually draw the existing sources and uses of water, energy, and food and linkages.

POTENTIAL MINING BENEFITS AND IMPACTS

Worksheet #5 – Mining Profile: To describe the existing or proposed mining development at two specific points in time: full operations and full closure. The temporal perspective is important as the potential benefits and impacts of mining may be different during operations and after the mine closes.

Worksheet #6 – Mining WEF Inventory: To describe any new water, energy and food sources introduced by the mine, as well as the new uses resulting from the mine.

Worksheet #7 – Mining WEF Influence: To identify the benefits and impacts of mining (during operations and closure) on the availability and accessibility of key WEF sources and the supporting infrastructure (both built and natural) and supporting institutions and policies.

ACTIONS AND INDICATORS

Worksheet #8 – WEF Security Actions and Indicators: This worksheet compiles all of the potential benefits and impacts of mining and enables stakeholders to identify actions to realize benefits and mitigate impacts of mining.

Worksheet #9 – Mining Influence Diagram: This worksheet provides a canvas to depict the specific influences of mining development on the original WEF Security system.

SUMMARY FOR DECISION MAKERS

Worksheet #10 – Summary for Decision Makers: This worksheet creates a summary of the previous sections.

Defining WEF Securities

A central focus of the WEF nexus is ensuring that people have access to their basic needs by ensuring food, water and energy security. Over their life cycle, mining operations influence the diverse elements of WEF in a number of ways. These impacts include the immediate effects of the operations directly related to the activities required to explore and exploit mineral deposits. These include spills, effluents to water, water withdrawal, land and biodiversity disturbance for tailings, energy consumption, emissions to air and impacts of mercury and cyanide use, and acid mine drainage. There are also social and economic impacts such as employment, procurement and supplier opportunities, and training and education options. Most of these activities lead to social,

economic and environmental impacts that need to be identified, assessed and measured to mitigate them and/or improve the negative trends that need to be identified. For example, a deterioration in the environment tends to lead in a reduction in adequate quantity and acceptable quality of water, energy and food. In aggregate, greater WEF security leads to improved human well-being, livelihoods and socioeconomic development. Finally, the impacts of mining operations on WEF security that result from these mining-induced changes in the environmental, social and economic systems are examined.

IISD's WEF framework builds on previous work by IISD on WEF security and a framework and guidance provided in the context of agricultural development. The framework covers availability and access to water, energy and food, then needed supporting infrastructure and policies and institutions necessary to ensure availability and access (Figure 2).

Specifically, the framework begins with an analysis of how water, energy and food are made *available* to households and communities. This requires consideration of five aspects, including: (a) sources and production (i.e., surface and groundwater, sources of energy and food production); (b) treatment of water, conversion of energy, and processing of food; (c) storage of water, energy and food supplies; (d) modes of distribution of water, energy and food supplies through pipelines, roads and electrical networks; and (e) markets for water, energy and food.

Central to the analysis framework is an understanding of how households (and communities of households) gain access to water, energy and food. Is it mostly through their own purchasing power (i.e., earned income), as is typically the case in higher-income households and countries, or is access gained through a combination of purchasing power (income, remittances from family members in other countries, credit), aid, self-production, and barter, as is often the situation in lower-income households and countries?

It is then necessary to understand the types of *supporting infrastructure* that are relied on to ensure the access and availability of water, energy and food. Supporting infrastructure are of two types: (a) built infrastructure such as roads and pipelines, including communication, transportation and waste/sanitation systems; and (b) natural infrastructure, including the ecosystem goods and services associated with erosion control, storm protection, water purification, biological control, air quality maintenance, and pollination.

Finally, *supporting policies and institutions* have impacts in terms of ensuring WEF securities by ensuring access to land, water and energy, by making sure that institutions to manage the resource are in place and that laws and regulations are enforced to ensure such things as safe water.

Table 3. IISD's Water-Energy-Food Security Analysis Framework

FRAMEWORK FOR ASSESSING WATER, ENERGY AND FOOD SECURITY	
SECURITY CATEGORY	**SECURITY COMPONENTS TO BE ASSESSED FOR WATER, ENERGY AND FOOD SOURCES**
Availability	**Uses** **Processing** **Storage** **Distribution** **Markets**
Access	**Purchasing Power** (livelihood income, remittances, credit) **Aid** (direct provision, safety nets, subsidies) **Self-production** (water wells, off-grid power, individual/community gardens) **Barter**
Supporting Infrastructure	**Built Infrastructure** (transportation, communication, waste removal) **Natural Infrastructure** (ecosystem services such as: erosion control, storm protection, water purification, biological control, air quality maintenance, pollination)
Supporting Institutions and Policies	**Institutions** (utility boards, user associations and resource co-ops, education and training, safety oversight, law enforcement and security) **Policies & Plans** (resource use, climate change adaptation, disaster recovery, risk management, research, development [R&D], and innovation)

Source: Bizikova et al. (2013)

EXAMPLES OF WEF LINKAGES IN SURINAME

For Suriname, the WEF benefits and impacts from mining were explored through two workshops held in Paramaribo in July, 2014 and June, 2015. Our literature review and workshops confirmed that linkages between mining and WEF depend on the specific situation in the communities and on the character of the mining operations. As listed earlier, the status of WEF security in the communities can be directly linked to mining operations such as the types of processing and transportation methods and the use of local resources such as water, land and infrastructure during the operations. Similarly depending on the community context, such as major types of livelihoods, ways of accessing food and energy the impacts of mining can be very diverse. These linkages were specifically explored for mining in interior Suriname and the outcomes of two participatory workshops are synthesized in Table 4.

Table 4. Linkages of mining with regional WEF, Suriname. [red = negative, green = positive and grey = unknown relation. The length of the bar indicates the strength; longer bar = stronger relationship])

WATER		
Pollution of water (surface, river, ground)	Caused mercury and by sediment in suspension	
Household use of water has negative impacts on water	Overuse of local water resources and causing local water pollution	
Polluted water impacts biodiversity	Change in flora and fauna, biodiversity loss has both intrinsic impacts as well as in local food source	
Health – direct impacts of pollution	Mostly related to mercury Diseases (skin, birth defects, nerve damage, heart)	
FOOD		
Western diet consumption is increasing, resulting in less investments (spending)	People consume and different foods	
Access to reliable and healthy food	Due to changing lifestyles, impacts of local resources and changing habits the quality of diet can decrease	
Food safety (there is a need to have access to non- contaminated food)	High energy needs to conserve good food; local food sources can be contained by pollutants such as mercury	
Mining activities can make land unsuitable for agriculture activities	Need to understand and balance land use	
ENERGY		
High demand (mining operations)	Diesel consumption could increase, which can impact prices for diesel for local communities	
Air pollution	Increased greenhouse gases and other emission especially increased energy generation and traffic	
Oil spills (from oil for energy production) (Diesel and lubricants)	Local water and soil pollution as well as pollution in other parts of the watershed	

The first workshop in 2014 was used to identify a number of relationships between the mining operations and community livelihoods across all WEF elements, specifically:

- Water pollution and extensive water extraction by the operations negatively impact water availability and water quality for local communities in the vicinity and downstream communities.
- Food access limitation due to impacts on land use and limited space for agriculture, biodiversity and habit destruction—again impacting local food sources.
- Energy access might be likely impacted by increased fuel prices (caused by use in mining operations) and pollution related to energy generation and transport; also increased access to energy and other systems due to better infrastructure development and maintenance.

The participants also began to explore the linkages between WEF elements, for example:

- Increased energy and transportation can lead to more pollution of water and soil which then impacts water and food quality.
- Increased use of diesel can lead to increase prices which then impacts local energy affordability as well as food storage and thus food quality and availability.

It was also listed that there could be impacts by the communities on local resources, and their practices can lead to water pollution, overhunting of important species for food and moving toward unhealthy diets.

Finally, the participants begin to outline a number of actions by which mining operations can contribute to improving WEF security. These included supporting mining companies improvement of energy security by working with the communities to create local renewable energy systems, using the increased trade to provide access to water storage and cleaning technologies, and engaging communities in shared water-management planning and implementation.

PRELIMINARY WEF SECURITY ASSESSMENT IN SURINAME

This input from the first workshop provided critical insights into the development of WEFsat-Mining and its use. The steps articulated in the tool (Figure 1) were subsequently used in the second workshop to work through aspects of WEF security and to identify actions and indicators to help improve these in Suriname. There are a number ways to ensure food, water and energy security based on the outcomes of the workshop, which explored key aspects of WEF availability, access, supporting infrastructure and institutions.

WEF SECURITY AT THE COMMUNITY LEVEL

Participants in the second workshop identified or confirmed a number of potential means of food, water and energy availability.

- Water: The collected information indicates that local water mostly comes from surface sources and from rainwater with no processing; water storage is used to prepare for drier seasons.
- Energy: Energy is mostly produced by diesel generators provided by the government as well as small generators and lamps.
- Food: Food is acquired from local sources, and some key diet sources are imported from further away than other local communities (for an overview see Table 3).

Table 5. Case study examples of availability of WEF

	WATER	ENERGY	FOOD
AVAILABILITY			
Uses	Drinking, washing, cooking, 70% domestic (cooking, washing); 30% rainwater (drinking)	Pumping water, food preparation, etc.	Nutrition, livestock
Processing	No processing of surface water; pumping of groundwater, pumping for use of surface water. Rainwater harvesting	Generators use diesel to produce energy, small-scale use of biomass and propane	Cassava processing facility Self-producing, local producing, import
Distribution	No law for allocation of water	Centralized generator with grid from the government Additional individual generators, biomass and propane	Cars, trucks, boats
Storage	Rainwater stored in tanks, barrels, cistern		Refrigeration Traditional food conservation (smoking)
Markets	Tanker drinking water during dry season (drinking water)	Buying generators and fuel propane	Cassava bread, podosiri, bushmeat, dosi, kwak

The next step identified linkages between these elements, e.g., the importance of diesel fuel for drinking water. Workshop participants identified and confirmed a number of linkages between water, energy and food aspects and common elements for all three such as transportation by both road and water systems. These relationships between the WEF elements are illustrated in Figure 2.

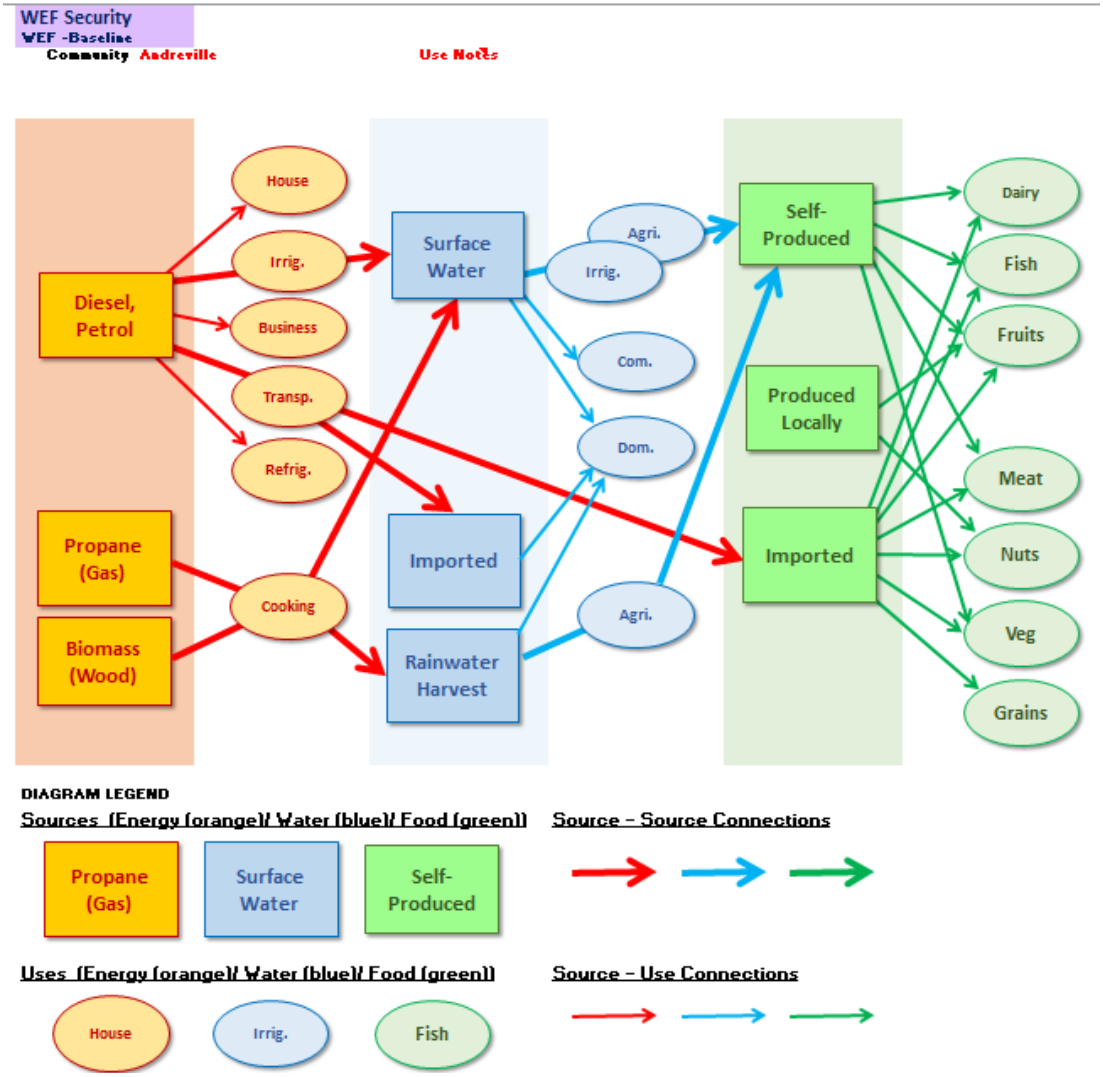

Figure 2. WEF systems map with sources and uses for an illustrative rural community in central Suriname.

In terms of access to WEF elements, there is a considerable dependence on services and subsidies provided by the government in Suriname. This includes government-supplied diesel as energy for domestic use, and supply of water pumps so groundwater can be pumped. Food is acquired through local production and hunting (overview of the access to WEF resources is presented in Table 3). Local access to WEF resources in the interior communities of Suriname depends minimally on built infrastructure. There is access to energy grid systems only in more northern communities in the country, closer to Paramaribo and coastal areas. In the interior there is a much stronger reliance on natural infrastructure which provides important support, such as waterways, wildlife corridors, forestry and biodiversity resources. Thus there is a need to protect natural resources so they can provide the needed services that communities depend on.

Table 6. Access and supporting infrastructure for WEF in illustrative interior communities, Suriname

	WATER	ENERGY	FOOD
ACCESS			
Purchasing power	Rain and surface water, government-provided water pump	Free diesel from government-subsidies Small purchase for batteries, gas lamp, Fuelwood	Cassava, banana Fishing and hunting may require purchase of diesel, batteries, outboard motors
Aid	Subsidized	Subsidized	Subsidized
Self-production	Rain water collection		Agriculture; hunting, fishing, chicken, livestock farming
SUPPORTING INFRASTRUCTURE			
Transportation	Boats	Boat/airstrip (diesel)	Airstrip; rivers for imported foods
Communications	UHF radio; cell phones;	Local grid with energy generators	
Waste, sanitation	Latrines;	Excavator (diesel operated)	Produced locally
Erosion control	Wetlands; riparian buffers		Shifting cultivation
Water purification	Reverse osmosis (solar); boiling water (biomass)		
Biological control	Wetlands as water source, flood protection and biodiversity source		Wildlife corridors (self-produced)

Illustrative impacts of mining operations on WEF using information from Grassalco mine site in Suriname

After understanding basic trends in the communities based on the WEFsat-Mining framework, we reviewed the character of the mining operations. For a typical mine in central Suriname, while the mine is active, the mine processes could likely entail open pit excavations, ore processing, tailing piles, and storage piles of ore, waste rock, and tailings (Figure 3). Processing involve gravity methods (other mines in the region use mercury but Grassalco does not). Operations will occur year round and will be staffed by 50 employees living on-site with roughly 5 per cent from the local communities. The footprint of operations will not overlap with the community's, but can have an impact on its water supply, hunting area and habitat for local species and perhaps improve or compete with its energy supply. Existing land types within the mine footprint include forest, riparian, and riverine lands. Supporting the mine will be a new road to bring in supplies, transport staff, and ship products.

- Water used in the mining and processing will be from creek flow, with augmentation from groundwater during dry periods. Waste discharged from the mineral processing will be settled out in tailings piles, then released to the creek via a pipe system. No additional processing of the effluent to remove mercury and suspended sediments will occur. Water for ingestion will be imported via the road while cleaning and sanitation water will use the creek. Septic systems will be established for human waste.
- Power for the operations, processing, and domestic use will be produced by diesel generators. The diesel fuel will be trucked in via the new road. Propane will be brought in for cooking. Food will be largely imported with minor contribution from the surrounding communities.

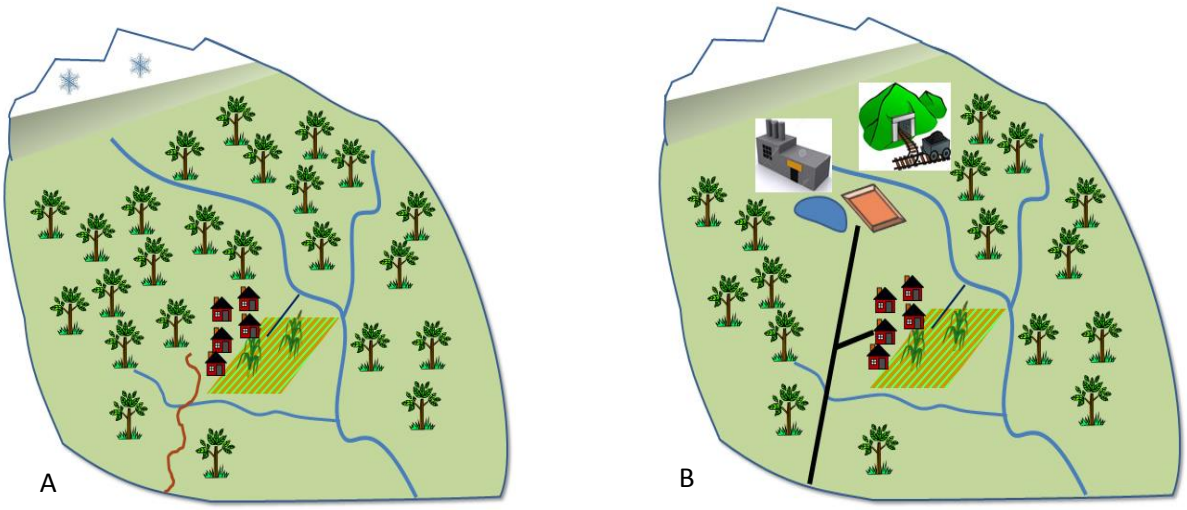

Figure 3. These figures represent the pre-mining situation (A) and the situation during operational mining in a tributary of the watershed (B).

Potential WEF actions

The next step of the WEFsat-Mining framework overlays aspects of community WEF security and the types of mining operations to provide a better understanding of benefits and impacts of mining on WEF security. This next step identifies how operations can reduce their impacts and, where possible, improve conditions in the communities. Actions critical for improving combined securities are given priority as recommendations. For example, improving access and sustainability of energy systems has an overall positive impact on the ability to access and use clean water and prepare food. Also, improved transportation systems are a critical intervention for all three securities in a variety of ways. However, actions for maintaining or improving any one security is also considered as an important step. For example, ensuring access to land for growing food and maintaining high levels of self-production, access to markets to buy and sell food, etc. are critical parts, not just of food security, but of improving the purchasing power to improve other securities. Effective actions should aim to maintain and improve WEF security, including those that improve natural and built infrastructure and provide relevant skills and institutions (for potential actions see Table 7).

Table 7. Example of prioritization of WEF interventions based on WEF assessment and mine development analysis in an illustrative outcomes of WEFsat-Mining

KEY WEF ACTIONS	
Supporting infrastructure	**Potential WEF actions** The next step of the WEFsat-Mining framework overlays aspects of community WEF security and the types of mining operations to provide a better understanding of benefits and impacts of mining on WEF security. This next step identifies how operations can reduce their impacts and, where possible, improve conditions in the communities. Actions critical for improving combined securities are given priority as recommendations. For example, improving access and sustainability of energy systems has an overall positive impact on the ability to access and use clean water and prepare food. Also, improved transportation systems are a critical intervention for all three securities in a variety of ways. However, actions for maintaining or improving any one security is also considered as an important step. For example, ensuring access to land for growing food and maintaining high levels of self-production, access to markets to buy and sell food, etc. are critical parts, not just of food security, but of improving the purchasing power to improve other securities. Effective actions should aim to maintain and improve WEF security, including those that improve natural and built infrastructure and provide relevant skills and institutions (for potential actions see Table 4).
Supporting institutions, services	Developing schemes of participatory resource management Training support on changing planting practices to reduce erosion

TASK 3: WATER MONITORING FRAMEWORK AS THE BASIS FOR WEF SECURITY

A key component of managing WEF is understanding the component systems, how they are functioning, and how they respond to development, climate and other pressures. To effectively manage WEF security for a community or region, one needs to monitor and understand each of the three systems. Understanding each system accurately in turn relies on monitoring and reporting of system parameters. Watershed management involves managing the land area, water systems, and freshwater ecosystems to protect and improve water quality and quantity in order to support ecological, social and economic systems within a watershed. Water managers are concerned with both the quantity and quality of water as it moves through the cycle and how policies, projects, and infrastructure operations can be operated to improve human well-being. Better understanding of a basin's hydrologic cycle as well as human and ecosystem use of water greatly improves planning efforts, reduces risk and cost in design and operation of infrastructure (e.g., reservoirs), decreases damages associated with flooding and drought, and improves policies for managing the water resources in a basin. Thus, a critical need for good watershed management is comprehensive and context-specific monitoring system that characterizes the delivery timing, storage, and quality of water in a watershed and its interplay with social, economic, and ecological systems.

Hydrologic Information Systems (HISs) support hydrologic monitoring through the measurement, compilation, processing, storage, and dissemination of physical systems such as hydrologic data and information. This is necessary for informed decision making and monitoring the impacts of actions, and understanding hydrologic trends and interplay with ecological, social, and economic systems in a watershed. HIS design is based on the specific needs of a region or watershed. These systems monitor the quantity and quality of water in the atmosphere (hydro-meteorological—e.g., precipitation, evapotranspiration), surface water (hydrological), and ground water (hydrogeological). Continuously collected field measurements are evaluated either as is or statistically converted to indicators (e.g. maximum/minimum values, frequency of occurrence, trends, seasonality) depending on the question being addressed and the analysis being done. Depending on needs, well-targeted monitoring data can be converted to indicators to support trend analysis and water-management decisions.

HIS data supports a wide gamut of water projects, including long-term planning, infrastructure design, real-time operations and research. Based on information collected at project interviews, workshops and a review of region-specific literature, elements of an HIS in Suriname could include:

- *Sediment* – Rivers in Suriname carry large amounts of sediment due to high flows and speed during certain parts of the year. Increased sediment loading to creeks and rivers associated with changes in land use creates a risk to human and ecological health as well as infrastructure. Increased turbidity reduces access to clean drinking water and can be expensive to clean to an acceptable standard in terms of time and cost. Many Surinamese rely on hunting and fishing for nutrition and their livelihood; however, increased sedimentation affects ecosystem well-being and puts at risk food species as well as the individuals that rely on them. This includes both riverine and coastal species. Mining development can increase sediment loading in river systems and soil erosion. This can impact food security and damage infrastructure by wearing on pipes and structures and increased flooding risk by aggradation in the river channel. Benefit: Knowledge of sediment loading in Suriname's rivers and creeks can be

used to inform and plan for WEF security and other aspects of human well-being through design, policy creation, planning, and water-management regulations.

- *Water quantity* – Mercury use associated with gold mining has degraded Surinamese rivers and creeks. Benefit: Monitoring for excess quantities of Mercury or other deleterious substances can ensure water quality, and enhance design, policy creation, planning, and water-management regulations.
- *Flooding* – Suriname's rivers are large and have high water quantities, particularly in the rainy season. Parts of Suriname are thus flood-prone, a phenomenon often increased by mining and related infrastructure development. Flood planning and real-time warning systems can help mitigate the threat of flooding. Analytical techniques can be applied to determine the extent of flooding, which can then be used to create flood maps for planning. The use of real-time rainfall, water level, and discharge measurements can be used in a flood forecasting systems to provide managers and citizens early warning on when flooding will occur. Benefit: Flood maps can be used in developing emergency response plans, land-use planning, and informing the public on risks developing in the flood plain. This would help to ensure personal safety, but also optimize agricultural production, livestock etc., thereby impacting WEF security in a region.
- *Design/Risk Assessment* – When designing water resources structures or policies, a key element is knowledge of water levels, discharge, and quality. Lack of hydrologic data can increase risk or costs unnecessarily. Under-predicting peak discharges creates risk in flooding damage to property and structures assumed to be away from the flooding. Inability to predict low flow conditions can lead to operational failure of structures based on a higher flow design. To guard against failure, building in a safety factor to account for the uncertainty leads to expensive overdesign of structures. Benefit: Less risk and more cost effective design, policy-making, and resource management. Reducing infrastructure risk also contributes to improved WEF security by supporting access to key resources.
- *General Awareness (benefits)* – Aside from the data used to address the above water resource issues, use of hydro-meteorological data can be used for general knowledge, science, and research. The uses of the hydro-meteorological data are extensive, but may not be realized at the onset of data collection.
- *Monitoring mines* – Mines use water in mineral extraction, processing of ore, controlling dust, storage of ore/waste, and general operation. These uses, along with alterations to the environment, have both positive and negative effects on the quantity and quality of water systems in the watershed. During and following operations, mines can: lower groundwater levels through dewatering open pits and underground workings; increase water flow in local tributaries through the discharge of pumped water or processing effluent; dewater streams by diverting water for mineral extraction, processing, and operations; lower groundwater by pumping aquifers to support mineral extraction, processing, and operations; create ponds through tailings impoundment development; change river flows downstream of reservoirs developed for water supply; and reroute and obstruct streams and rivers. In regards to water quality, mine operations can increase release of metals and acid rock drainage to surface and groundwater systems, increase sedimentation to surface water systems, and impact aquatic life through increased mortality, health, and reproductive problems as well as a reduction in the number of species present. These impacts on natural and anthropogenic uses of water can increase insecurity in water and related systems (such as food and energy) on which local

communities rely. Benefit: monitoring water quantity and quality before, during, and after mining activities is crucial to assessing and, if required, mitigating the negative effects of mining as well as managing the system to ensure WEF security in the region or downstream.

Monitoring is key for assessing the status and trends in water quality and quantity in a watershed and its effects on the social, economic, and ecological systems that influence people lives. Effective HIS monitoring and reporting provides transparent and useful data and information for monitoring the physical state of watersheds, as well as understanding WEF security in the context of mining and other anthropogenic activities.

TASK 4: TRAINING AND CAPACITY BUILDING IN SURINAME

A key component of this work was building regional capacity to clearly understand linkages between mining and regional WEF security and conducting an assessment while providing guidance to actions and monitoring systems nationally.

Two workshops were organized by IISD and project partners in Paramaribo, Suriname as part of this project, with specific intentions of engaging regional stakeholders, improving their understanding of the WEF system and its security implications, collaboratively understanding the WEF interface with mining (benefits and impacts) and providing guidance and training on WEF assessments and decision making in the context of mining.

The first workshop (in 2014) focused on uncovering the state of WEF security in the context of mining and inputs for a regionally appropriate (but replicable) methodology or tool for WEF security assessment. This workshop convened a variety of stakeholders to introduce the concept and issues relating to WEF security and elicit input into a regional assessment using local information, input and data.

After another couple of project meetings and project research trips, a final three-day workshop was held in June 2015 to present WEFsat-Mining, develop capacity and understanding on underlying concepts, provide training on its use in a variety of contexts, and use the tool to develop a shared understanding of WEF security in the interior regions of Suriname. The final session of the workshop focused on hydrologic monitoring systems of specific interest and value in the Suriname context where local and national water managers (as well as mining companies) are attempting to understand water quantity, quality and other related issues in the absence of consolidated data and information to this end.

One of the key benefits of the workshops based on feedback was exposure to integrated thinking as demonstrated by WEFsat-Mining and training on its use. Participants appreciated not just the substantive knowledge gained from explanations of WEF systems (and all their aspects) and coordinated decision making but also learning through the participatory nature of the workshop that encourage sharing of perspectives and explicitly encouraged stakeholders with differing viewpoints and priorities to converse and understand each others' views in an effort to make decisions. Many workshop participants found the tool and the processes involved very complementary to their understanding of an economic and social impact assessment (ESIA) and felt that they could see themselves using the tool to fulfill an ESIA or conduct related analyses.

Discussions at the workshop ranged from specific to general and reinforced the need to understand WEF systems from a more holistic and integrated point of view. Some underlying systems (such as transportation and markets) came up repeatedly in discussions related to different components of WEF security. Another underlying theme throughout the workshop was the need for more monitoring, data and reporting, as very little systematic data collection and reporting currently exists in the country. Hence, some of the focus of the workshop

and tool was intentionally placed on enhancing monitoring systems to create and manage indicators for WEF system understanding and management over time. Inputs from the workshop are also captured in a version of WEFsat illustrating the use of the tool in a particular (typical, but hypothetical) context.

CONCLUSIONS AND RECOMMENDATIONS

In a country such as Suriname, where mining plays a significant role in the national economy and where its impacts and implications are not well known, the water-energy-food security lens—and methodologies and capacities to assess its interlinked systems—is of significant relevance. While a realistic assessment was not feasible due to limitations of data and project timeline, a generic case study looking at information gleaned from expert interviews and two workshops indicated that the state-owned Grassalco mining development in the Maripaston region and other national mining developments (as well as government agencies, NGOs and other involved in environmental management, economic development and community well-being) would benefit from an understanding of WEF security. IISD's WEFsat-Mining, discussed in the previous chapters, provides a useful means of understanding the links between regional security and mining development and would be a worthwhile investment of time for decision makers and planners in the country.

Based on a variety of conversations around the application of the tool in the Suriname context and insights gathered from a generalized case study, we also provide some more specific recommendations for improving WEF security in the context of mining in Suriname.

- Water security, food security and energy security are key components of regional and national well-being: prioritizing and operationalizing WEF security is thus a way to implement win-win-win policies and mechanisms and minimize unintended consequences from otherwise siloed approaches. This means that decisions makers can use this approach to identify and prioritize those actions that will improve or at least maintain aspects of water, energy and food security and take steps to mitigate risks associated with these. A WEF approach will also help highlight serious risks associated with any one of these securities where mining development is concerned. For example, in Suriname there is an understanding that mining, especially small-scale mining, impacts water quality, particularly in the form of mercury loading into streams and rivers. This has led to a number of campaigns on mercury reduction, with an emphasis on outreach and education, but has not yet translated into specific government or private sector policy on water quality management through monitoring, reduced use or inputs of toxic or other deleterious substances into water systems.
- Energy use in Suriname is varied, and much of the country outside the capital Paramaribo is not serviced by an energy grid. Many of the rural communities in the interior of the country rely on diesel generators with free fuel supply from the government. Energy is in turn linked to pumping groundwater and surface water for a variety of uses (e.g., food preparation and refrigeration) ensuring energy security in the context of WEF, means looking at overall sustainability, impacts and risks to increase diversification. Reducing reliance on only "imported" energy supplies is an important component of regional WEF security. Since current energy is largely non-renewable and has impacts on water quality, it is also important to look at diversified, renewable sources of energy for areas of the country.
- Food security in interior communities such as in the Maripaston region includes primary production and import of food, as well as a reliance on hunting for meat. One must look

at the correlation between food security and its reliance on regional water systems for drinking, food production and preparation and imported energy systems for preparation and refrigeration, etc. Our study uncovered the need for better systems to improve food self-sufficiency through capacity building and appropriate technology, such as through development of food cooperatives, greenhouses or other means to improve productivity, and variability. Dependence on regional ecosystems such as forests and bushmeat for food also means that overall ecosystem management and ensuring habitat for wildlife is important for continued food security. A relation with climate systems and how this affects rainfall and water systems (as well as subsistence farming, and/or wildlife growth and movement patterns) may be an important aspect to consider.

Based on the WEF framework, improvements in WEF security cannot target only the availability of its three elements, but also underlying factors such as purchasing power, infrastructure (including natural infrastructure), institutions, as well as policies and plans. Based on this integrated way of viewing a region and its interlinked securities, and through our interviews and workshops, we started to identify a few underlying system elements with implications for two or more of the WEF system components:

- Communities in the vicinity of mining development have the potential to improve purchasing power through employment on the mine sites. However, mine sites such as Grassalco's at Maripaston must prioritize hiring of local people and building capacity and skills where needed. A local hiring policy would be a positive step toward improving this underlying component of WEF security.
- Similarly, a mine site has the potential to create local markets for goods and services. An example of this in the Maripaston context would be food. This could include locally grown vegetables, livestock, and bushmeat. An assured and local market would enable the community to improve its production and marketing systems, thereby improving overall well-being.
- Another key underlying factor that came up repeatedly in our discussions was infrastructure. This included the roads and the waterways for transportation of everything from diesel to food and drinking water. A negative implication of improved transportation infrastructure and access was the proliferation of illegal miners and loggers who are now able to access more areas. Development of checkpoints or other mechanisms to reduce use for illegal purposes might be a valuable government input for this purpose.

A discussion point and recommendation that came up repeatedly through interviews and workshops was the need for more systematic data and information on these systems so that decision making can be more informed and less ad hoc. It was clear that a systematic WEF understanding requires some detailed understanding of component systems, underlying systems and mining development. Investing in data collection is a first crucial step in ensuring that these decisions are well-informed in the future.

- Indicators are a means of compiling data into useful information for any particular context or goal. Developing context-specific WEF indicators for Suriname or regions in Suriname will require more data and inputs from informed stakeholders including government, communities, NGOs, mining companies, academics and others. A collaborative process to fine-tune these from those in WEFsat-Mining will also improve general collaboration and potentially buy-in to the overall WEF process and its implementation.

- On water (hydrologic) monitoring, Suriname has already begun using methods to ensure that data from monitoring stations can be accessed remotely. However, improved and reliable monitoring technologies, quality assurance processes, development of indicators, and reporting systems that are transparent and allow other stakeholders to view and use these data would be a tremendous opportunity for government investment to ensure that water and interrelated WEF systems are monitored and managed appropriately over time based on clear, spatially and temporally explicit data.

Based on the experience of the capacity-building workshop as well as other interactions, it is clear that WEF assessment and related monitoring needs are complex undertakings that requires skills and knowledge about the communities and mining operations; they depend on data availability and quality and build on the existing relationship with the communities. All these areas include relatively different types of skills and knowledge and different groups of stakeholders at the table: there is thus a need for relevant capacity and skills development. This includes:

- Improved capacity for WEF assessment, data collection and management, analyses, and decision making. Such capacity development efforts must be built where there is already interest and skills. For example, students of the environment at the Anton de Kom University are learning about environmental impact assessments and found that the WEF assessment process is a useful complement to connect impacts to well-being. Building such knowledge into formal curricula or informal training might be one way to ensure that existing tools are being used in the best possible manner. Another example is that the public works department has been attempting to resurrect water monitoring stations that existed in the country until the 1980s, when a civil war decimated such programs. While there are some skills and infrastructure, ensuring that these are augmented and matched with government and private sector capabilities to monitor water quantity, flood protection and water quality in light of climate change, mining and other development, would be critical to understanding and managing water in the country in the context of WEF security.
- Working with communities through organizations that are already in the business of empowering community members to better manage their security, livelihoods and food systems. Providing such groups with the WEF assessment framework and also enabling them to build relevant capacity within the communities can help ensure that people in these regions are providing inputs into processes and decisions that impact them directly.

Finally, mining companies play a critical role in ensuring that regional WEF security is maintained or enhanced. They have the opportunity to enable regional economic development (including skills development and local procurement), lead on watershed management and water monitoring, and implement and showcase WEF aspects as part of their corporate social responsibility and to enhance their overall social/environmental licence to operate.

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APPENDICES

Appendix 1: Summary of tasks, outputs and outcomes of this project

PROJECT / TASKS	OUTPUTS / DELIVERABLES	IMMEDIATE OUTCOMES / RESULTS	INTERMEDIATE OUTCOMES
1. Water-energy-food resource book for mining	Literature review and report on water-energy-food resource book for mining providing a summary and best practice review of sustainability monitoring and reporting in the context of mining and recommendations and a framework for monitoring and reporting of WEF in the context of mining.	Summary of initiatives on sustainability reporting and mining, and a report on WEF monitoring, reporting, and decision making in the context of mining.	Increased understanding of WEF, the linkages between the three interlinked systems, with mining development, the need for better monitoring, indicators and reporting.
2. WEFsat-Mining	An Excel-based WEF assessment tool for mining development looking at existing WEF security status, mining development implications, and ways to prioritize actions and indicators for maximizing benefits of mining while minimizing negative impacts.	Increased understanding among key stakeholders the WEF project on WEF assessment steps, use of WEFsat-Mining and its benefits and preliminary understanding of areas of maximizing benefits in Suriname. An increased understanding and dialogue among those involved in otherwise discrete water, energy, food decision-making processes on synergies and conflicts between their sectors and potential solutions.	Improved understanding of WEF assessments and mining processes, with a greater understanding for the need for such analyses in decision making. An understanding of how WEF assessment processes can be conbined with regulatory and other needs in the region, such as ESIAs, as well as the need for monitoring and reporting for making long-term decisions.
3. Hydrologic monitoring systems	Developed guidance for developing and effectively using a hydrologic information system (HIS) to understand impacts and benefits of mining. An HIS system includes monitoring, analyzing and reporting data on interlinked parameters related to surface water, ground water and water quality.	A better understanding of water monitoring best practice including sampling techniques, equipment choices, reporting and use in decision making with specific insights for Suriname.	Better understanding of water quantity and quality monitoring in the context of better WEF monitoring, also providing insights into overall WEF system monitoring and the need and value of monitoring, reporting and transparency for effective decision making.
4. Training and Capacity building in Suriname	Conducted a three-day capacity building workshop with mining companies, government agencies, NGOs, academics, students to improve understanding of WEF and linkages with mining development. WEF assessments in the context of mining using the WEFsat-Mining tool as well as understanding the need, elements and use of hydrologic monitoring and reporting.	Improved understanding of WEF assessments, application of WEFsat-Mining and HIS design and application.	Improved understanding on linkages and issues underlying WEF security.

Appendix 2: First Workshop Agenda, July 16, 2014

Workshop Agenda

9:00 – 9:30	**Registration**
9:30 – 10:00	**Welcome and Introductions** *Welcome speech by the Grassalco Surinam* *Welcoming words by IISD (Livia Bizikova)* *Roundtable Introductions*
10:00 – 12:30	**Overview of project, key goals and approaches in the planned project key projects and initiatives in the region** *(Grassalco and IISD)* *Assessment of specific aspects of the mining efforts in the context of key WEF dimension (group; plenary discussion)*
12:30 – 13:30	Lunch
13:00 – 14:30	**Key indicators/data to monitor the trends in the context of key mining and WEF aspects** *Group work and Plenary* *Brief plenary (the most relevant and available data and indicators)*
14:30	**Summary of next steps and closing**

Appendix 3: Training Workshop Agenda, June 1-3, 2015

Water-Energy-Food Security in the Context of Mining

1-3 June 2015

Institute for Graduate Studies and Research (IGSR)

Anton de Kom University of Surinam, Campus Leysweg,

Paramaribo, Suriname

Register at: https://www.surveymonkey.com/r/WEFWorkshopSuriname

Day 1: June 1, 2015

TIME	AGENDA ITEM
8:00 – 8:30am	**Registration** (Breakfast provided)
8:30 – 9:00 am	**Welcome and Overview of Workshop objectives** - Welcome Address (IGRS, Grassalco) - Presentation #0 Overview of objectives and agenda (Dimple Roy, IISD) - Warm-up Exercise
9:00 – 9:45	**Introduction to an Integrated View of Water, Energy and Food (WEF) Security** - Presentation #1 (Dimple Roy) - Q&A and Plenary Discussion
9:45 – 10:30	**Introduction to Indicators and Monitoring for WEF Security** - Presentation #2 (Gabriel Huppé) - Q&A and Plenary Discussion
10:30 – 10:45	Break (Snacks provided)
10:45 – 12:15 pm	**WEF Session 1a: Assessing the Status of WEF Security and Linkages** - Presentation #3: Creating an inventory of community water-energy-food sources and uses with the WEF Security Tool (Dr. Carter Borden) - System Mapping Exercise - Plenary Discussion
12:15– 13:30	Lunch (Lunch provided)
13:30 – 15:00	**WEF Session 1b: Assessing the Status of WEF Security and Linkages** - Presentation #4: Assessing the availability, accessibility, supporting infrastructure (built and natural) and supporting policies for key water, energy and food sources in a community (Dimple Roy) - Breakout Group Work - Select Group Reporting and Plenary
15:00 – 15:15	Break (Snacks provided)
15:15 – 16:45	**WEF Session 2: Assessing the Potential Benefits and Impacts of Mining on WEF Security** - Presentation #5: Potential benefits and impacts of mining on WEF Security (Dr. Carter Borden) - Breakout Group Work - Select Group Reporting and Plenary
16:45 – 17:00	**Day 1 Closing** - Participants Feedback - Overview of Day 2 Objectives
Evening	Optional Dinner Excursion

Day 2: June 2, 2015

TIME	AGENDA ITEM
8:30 –9:00 am	**Day 2 Objectives and Re-cap of Day 1** - Warm-up Exercise - Review of Day 1 group work - Overview of Day 2 objectives (Dr. Carter Borden)
9:00 – 10:15 am	**WEF Session 3: Identifying Actions for WEF Security** - Presentation #6: Identifying actions for realizing potential benefits and mitigating impacts of mining on WEF Security (Dr. Carter Borden) - Breakout Groups - Select Group Reporting and Plenary
10:15 – 10.30	Break (Snacks provided)
10:30 – noon	**WEF Session 4: Identifying Indicators for WEF Security in a Mining Context** - Presentation #7: Identifying indicators for tracking the status of WEF Security, the potential benefits and impacts of mining, and actions for WEF security (Gabriel Huppé) - Breakout Groups - Select Group Reporting and Plenary
12:00 – 13:00	Lunch (Lunch provided)
13:00 – 14:30	**WEF Session 5: Preparing a WEF Security Summary for Decision makers** -Presentation #7: Creating a summary for decision makers using the WEF Security Tool (Dimple Roy) -Individual Work -Select Group Reporting and Plenary
14:30 – 14:45	Break (snacks provided)
14:45 – 16:15	**Monitoring Water Quality and Quantity in the Context of WEF Security** - Presentation #8: Overview Hydrometeorologic Monitoring Systems (HMS) (Dr. Carter Borden) - HMS Water Quantity/Quality Exercise - Plenary Discussion
16:15 – 16:45	**Day 2 Closing** - Evaluation - Next steps
End	

Day 3: June 3, 2015

TIME	AGENDA ITEM
8:30 – 10:15 am	**Monitoring Water Quality and Quantity in the Context of WEF Security** - Overview Hydrometeorologic Monitoring System (HMS) Presentation - HMS Equipment Presentation - HMS Water Quantity Exercise
10:15 – 10:30	Break (Snacks provided)
10:30 – noon	**Monitoring Water Quality and Quantity in the Context of WEF Security** - Water Quality Monitoring Overview Presentation - HMS Water Quality Exercise - Wrap-up
12:00	Lunch (Lunch provided)

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