



WEFsat-Mining Tool User Guidance Manual

Water, Energy, and Food security analysis tool for Mining

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INTERNATIONAL INSTITUTE FOR SUSTAINABLE DEVELOPMENT

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WEFsat-Mining Tool User Guidance Manual
Water, Energy, and Food security analysis tool for Mining

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1. INTRODUCTION

PURPOSE

The purpose of the Water, Energy and Food security analysis tool for mining ([WEFsat-Mining](#)) is to help identify the potential benefits and impacts of mining on community-level water, energy and food (WEF) security to find the most effective ways of managing across these interlinked sectors. Users of the tool can explore specific actions for realizing benefits and mitigating actions as well as select and develop indicators for tracking the status of WEF security and the progress of critical actions. Users familiar with environmental and social impact assessment methods will find WEFsat-Mining intuitive and a welcome addition to their toolkit for understanding key relationships in achieving sustainable development.

CONTEXT

The Intergovernmental Forum on Mining, Minerals, Metals and Sustainable Development, a network of governments, industry and various interest groups in 48 countries, put forth its Mining Policy Framework (MPF) in 2014. The MPF calls for an optimal conversion of natural capital into human capital, the management of the natural resource base within ecosystems and continuous planning for the post-mining transition, among other aspects.

Concurrently, the World Economic Forum has consistently ranked WEF security issues among the top global risks facing governments and businesses around the world, noting that “any strategy that focuses on one part of the water-energy-food nexus without considering its interconnections risks serious unintended consequences” (World Economic Forum, 2011). WEFsat-Mining is designed to help advance the

understanding of both the risks and benefits of mining operations on the interrelated issue of WEF security as key aspects of human security and sustainable development.

Population growth and economic prosperity are increasing the demand for minerals and other natural resources in unprecedented ways, placing intense localized pressures on ecosystem goods and services, including water, energy and food production and supply. Prominent events such as the global food crises of 2008 and 2011, and an ongoing series of energy and water shortages in countries around the world have demonstrated the need for coordinated action to address WEF security and their interlinked causes. As well, they have highlighted that a deterioration in the ability of WEF systems to provide for the basic needs of a population can lead to adverse socioeconomic, livelihood and human well-being effects.

Mining development creates both pressures and opportunities for WEF security in a community or a cluster of communities in the vicinity of the mine site. Communities in developing countries benefit from mining developments in many ways, such as livelihood opportunities, but at the same time are also threatened by the negative impacts of mining on basic necessities such as food, water, energy and shelter. The well-being of these communities thus depends upon the ability of community members to sustain or improve their way of life and standard of living amid the introduction of mining developments in their region. For mining companies, this means ensuring that the environment is sufficiently protected to allow these communities continued environmental goods and services such as clean water, plentiful fauna and flora, and quality food that is safe for human consumption. However, it also means that the financial benefits of mining are fairly distributed, that local people can partake in

economic and employment opportunities, that local communities are empowered to participate in decisions that affect their well-being, and that infrastructural developments (e.g., roads, bridges and water supply) are optimized with the needs of local populations in mind so as to maximize mutually beneficial outcomes. From a sustainable development perspective, it means balancing the expectations and needs of the mining company and its neighbours to ensure the long-term sustainability of linked social, economic and environmental systems affecting overall well-being.

PART 1: WEFsat-MINING AT A GLANCE

WHAT IS WEFsat-MINING?

WEFsat-Mining is IISD's tool to understand the interface of WEF and mining that draws on the IISD Water-Energy-Food (WEF) Security Framework (Bizikova et al., 2013). This framework was designed to support practical planning and decision-support processes for landscape investment and risk management in the agricultural sector. Informed by a comprehensive literature review, this framework enables a place-based analysis of four main components that focus the obvious and underlying factors affecting a community's ability to be WEF secure: *access, availability, supporting resources and supporting policies*, and each in the context of a region's water, energy and food supply (Bizikova et al., 2013). WEFsat-Mining seeks to facilitate the operationalization of this framework in the context of mining with a focus on understanding and managing the benefits and impacts of mining on community-level WEF security.

The framework (Figure 1) begins with an analysis of how water, energy and food are **available** to households and communities in the study context. This requires consideration of five aspects: (a) sources and production (i.e., surface and groundwater, sources of energy and food production); (b) water treatment, energy conversion and food processing; (c) storage of water, energy and food supplies; (d) modes of distribution of water, energy and food supplies; and (e) markets (both formal and informal) 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 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 is of two types: (a) built infrastructure, referring to manmade systems 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.

The final component of the analysis framework requires identification of **institutions and policies** that directly and indirectly support the natural and built infrastructure needed to ensure access and availability of WEF sources in a community and region. This component is further broken down into two categories, namely: (a) supporting institutions, including utility boards, user associations and resource co-ops, education and training, safety oversight, law enforcement and security; (b) supporting policies and plans relating to resource use, climate change adaptation, disaster recovery and risk management, and research and development (R&D) and innovation.

FRAMEWORK FOR ASSESSING WATER, ENERGY AND FOOD SECURITY			
SECURITY CATEGORY	WATER SOURCES	ENERGY SOURCES	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)		

Table 1. IISD's Water-Energy-Food Security Analysis Framework.
Source: IISD (2015)

WHAT ARE THE STEPS IN USING WEFsat-MINING?

The WEF security analysis tool for mining (WEFsat-Mining) is a Microsoft (MS) Excel-based tool designed to help identify the potential benefits and impacts that a proposed or existing mining operation has on WEF security.

The **first step** of WEFsat-Mining assesses the current status of each of the framework components for the community (or aggregation of communities) in question and how they are connected. The **second step** involves identifying all of the possible benefits and impacts that each

of the mining components (e.g., mine operations, ore processing, general operations) might have on each of the WEF security components and their combination. This necessitates the identification of all the individual mining components comprising the proposed or existing mining development during operation and closure phases. After gaining an understanding of the potential mining benefits and impacts on each of the WEF security components, the **third step** of the assessment includes identifying specific actions that are necessary to help realize the potential benefits associated with mining's influence, or mitigate the potential impacts as well as indicators for tracking the status of WEF security

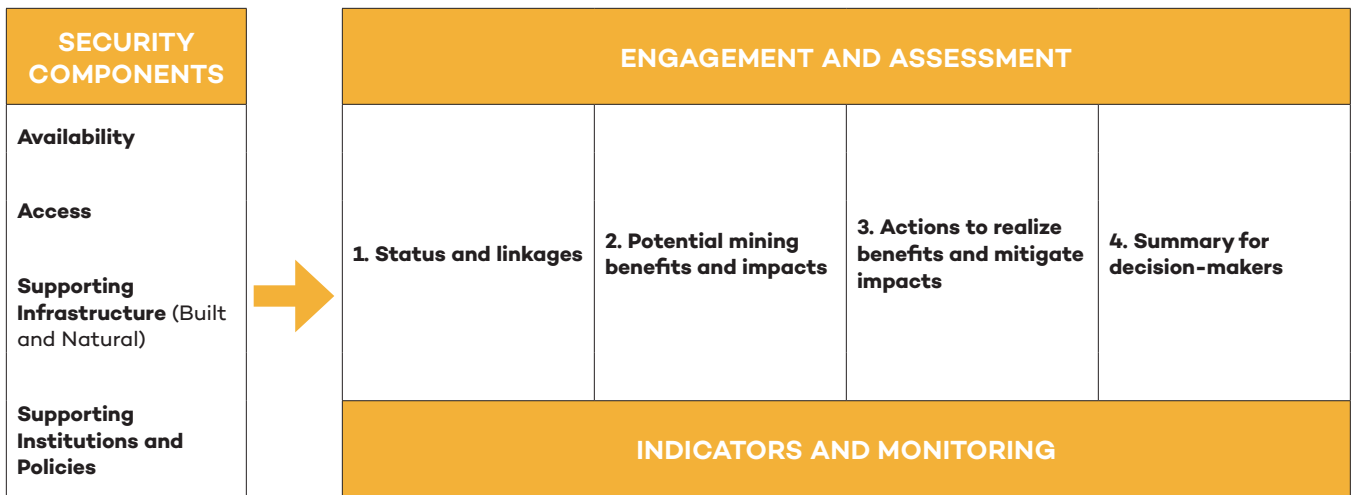


Figure 1. IISD's WEF Security Analysis Framework Applied to the Assessment of Potential Mining Benefits and Impacts

and progress toward key actions. Finally, **step four** attempts to summarize all of this information for decision-makers.

Addressing the assessment questions is only possible through iterative deliberation with persons who are involved in implementing mining operations and are involved in any capacity in securing water, energy and food in their vicinity. The deliberative process using WEFsat-Mining is typically a combination of one-on-one meetings, virtual correspondence and multi-person workshop settings. Given this, using WEFsat-Mining in a deliberative process and setting should be led by a facilitator trained in the use of WEFsat-Mining. For information about training opportunities, contact the International Institute for Sustainable Development (IISD) at info@iisd.ca.

HOW TO USE WEFsat-MINING?

WEFsat-Mining engages stakeholders in an assessment of: (i) the current status (and linkages) of the availability of and access to water, energy and food, and the array of infrastructure (built and natural) and policies that support their use; (ii) the potential benefits and impacts of mining on these WEF security components; and (iii) the actions necessary to realize potential benefits and mitigate impacts. The tool also helps users identify indicators that can be used to track the status and trends of WEF security components and the potential mining benefits and impacts, along with progress toward key actions.

WEFsat-Mining consists of 10 worksheets to facilitate a comprehensive assessment of WEF security in the context of a specific community or collection of communities, as influenced by an existing or proposed mining operation (Figure 2).

A summary of each of the 10 worksheets is provided below.

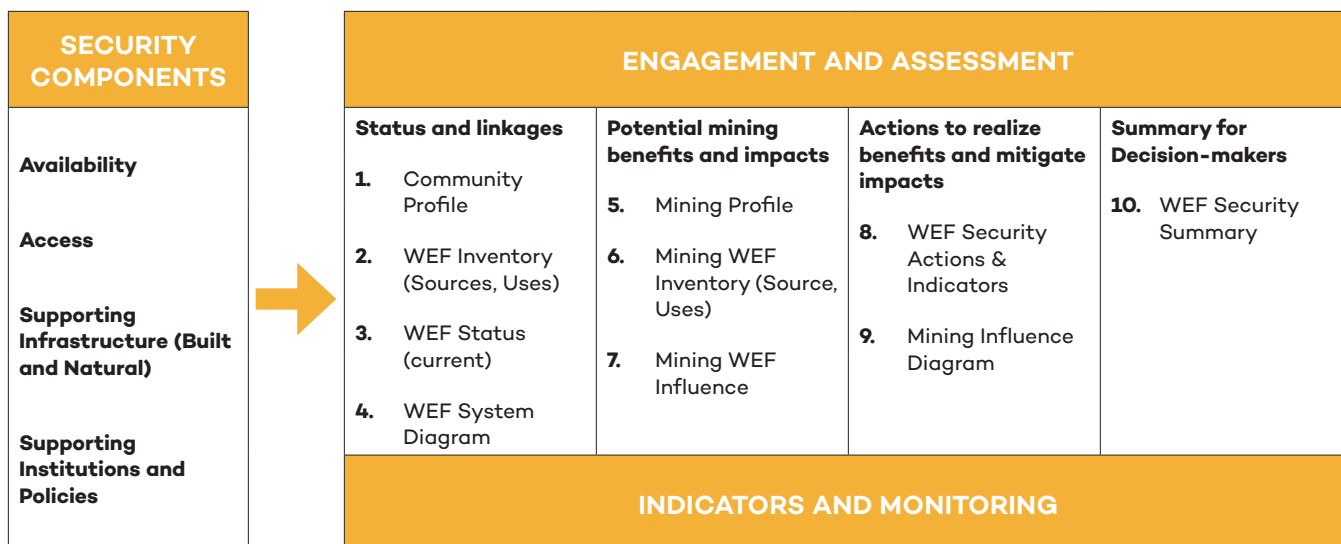


Figure 2. The WEFsat-Mining Methodology

Step 1: Status and Linkages

Users describe the current status of WEF systems in terms of the characteristics of the various affected communities, how these communities make use of different energy sources and how the WEF systems are interlinked in this context.

- **Worksheet #1** – Community Profile: To identify and describe the communities that are situated within the WEF systems 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 that are used to irrigate crops).
- **Worksheet #3** – WEF Status: To describe the current status of the WEF security components relevant to each WEF source (i.e., availability, access, supporting infrastructure [built and natural], and supporting institutions and policy).

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

Step 2: Potential Mining Benefits and Impacts

Users describe the influence of different mining activities and processes at the operations and closure phases of the mine on the WEF system in the communities.

- **Worksheet #5** – Mining Profile: To describe the characteristics of 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 potential benefits and impacts of mining (during both operations and closure) on the availability and accessibility of key sources of water, energy and food, as well as the supporting infrastructure (both built and natural) and supporting institutions and policies.

Step 3: Actions and Indicators

Users identify actions to address the impacts and benefits of mining to preserve and improve WEF security, and indicators to assess and track progress in the WEF system.

- **Worksheet #8** – WEF Security Actions and Indicators: This worksheet compiles all of the potential benefits and impacts of mining in one place and enables stakeholders to work together to identify key actions to help realize potential benefits and mitigate impacts of mining. This sheet also provides menus of possible indicators that could be used to track the status and trends of the WEF security components as well as the potential mining benefits and impacts, and progress toward necessary actions.
- **Worksheet #9** – Mining Influence Diagram: This worksheet is the same as the WEF System Diagram Worksheet #4 and provides a canvas to incorporate and visually depict the specific influences of mining development on the original WEF security system.

Step 4: Summary for Decision-Makers

Users identify and summarize the key insights uncovered throughout the use of the tool with regards to each component of WEF security.

- **Worksheet #10** – Summary for Decision-Makers: This worksheet compiles the information from the previous worksheets into a summary format. Show and hide buttons enable users to select which information to display.

Part 2 of this *User Guidance Manual* takes users step-by-step through each of these worksheets.

WHAT RESOURCES ARE REQUIRED TO APPLY WEFsat-MINING?

The resources required to use WEFsat-Mining vary according to the objectives and capabilities of the users. Depending on the availability of information and experts on a range of topics and motivation, such an analysis will take between two to six weeks to conduct all the steps in a deliberative manner, which includes some time for preparation, stakeholder consultations, data entry into the tool and data analysis. Costs will vary accordingly and are generally related to project team meetings and stakeholder consultations.

PART 2: WEFsat-MINING STEP-BY-STEP

GENERAL

Installing WEFsat-Mining on a computer:

- Download the MS Excel-based tool from the IISD website [here](#). Note: the WEFsat-Mining tool has been constructed in MS Excel v2010. Users of MS Excel for iOs systems and Open Office should use with care, as the tool has not been tested on these platforms.

Navigating through WEFsat-Mining:

- The tabs at the bottom of the Excel workbook can be navigated in sequential fashion to take users through the necessary components of the tool. The colours of these tabs are associated with each of the four steps of the tool, to which individual worksheets belong.

Entering and updating information:

- WEFsat-Mining is **flexible**; you can navigate back and forth among the different pages at any point in the process to revise, update and change information as needed.
- While the application does not have a word limit for the information to be entered in the different boxes, the user should be as **specific** as possible and use **precise, concise sentences**, as the information you insert will be automatically transferred across different worksheets.

Getting help and guidance:

- The **User Guidance Notes** found near the top of each worksheet provide guidance on how to fill in individual sections of the tool. Click on the **User Guidance Notes**, and a comment box will appear containing information of use to those seeking further clarification.

Example workbook:

- An example MS Excel workbook has been created entitled WEFsat-Mining *Example Workbook.xlsx* [here](#). This workbook presents a fictitious set of communities and mining development in order to demonstrate the type of content that is input and produced by the tool.

STEP 1: UNDERSTANDING COMMUNITY WEF STATUS AND LINKAGES

In this first step, users describe the current status of WEF systems in terms of the characteristics of the various affected communities; how these communities make use of different water, energy and food sources; and how the WEF systems are interlinked in this context.

WORKSHEET #1 - COMMUNITY PROFILE

Objective. To identify and describe the communities that are situated within the WEF sheds of the existing or proposed mining operation. Up to five communities can be profiled, with an average profile calculated in the last column. Aside from the community names, this profile information is not directly linked to the other worksheets as input, but is necessary to be able to properly address the rest of the analysis questions in the tool.

Process. Enter some basic information about the communities you wish to examine through the lens of WEF security (Table 1). This information includes:

- *General*: Information about the demographics and location of the communities.
- *Livelihoods*: Information about the reliance on mining employment versus other sources of income in the community.
- *Land Use and Food Consumption*: Information about the use of land and the sources of food that communities depend on.
- *Water Use*: Information about the sources of water that communities depend on.
- *Energy Use*: Information about access to the electric grid and sources of self-produced electricity.

WEF Security Tool for Mining Community Profiles

User Guidance Notes

Community Name	Communities			
	1	2	3	4
Community Name	Community A	Community B	Community C	Community D
General				
Cultural Identifier	A	A	B	B
Population:	500	Unknown	100	200
Location (i.e., within or outside a watershed):	in watershed	in watershed	in watershed	outside watershed
Livelihoods				
% working in the mine:	5	10	5	10
% working in mine-related services:	2	6	3	5
Primary source of livelihood income:	Government	Agriculture	Mine	Agriculture
Secondary source of livelihood income:	Service	Service	Agriculture	Mine
% livelihood income from remittances:	10	20	10	30
Average household income (country \$):	500	1000	800	800
Land Use and Food Consumption				
Land area (km ²):	20	5	50	100
Food consumption from local sources (%):	55	50	40	35
Food consumption from imports (%):	25	10	20	10
Food consumption from subsistence (%):	20	40	40	55
Total food consumption (should total 100 from rows 21-23):	100	100	100	100
Water Use				
Average household water use (lpd):	15	10	10	10
Surface water source (%):	80	15	70	60
Groundwater source (%):	15	80	25	35
Other sources (%):	5	5	5	5
Total water sources (should total 100 from rows 27-29):	100	100	100	100
Energy Use				
Households connected to electricity grid (%):	40	0	0	20

Figure 3. Worksheet #1: Community Profile

WORKSHEET #2 – WEF INVENTORY

Objective. 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 that are used to irrigate crops). This worksheet thus creates a baseline inventory of existing WEF sources and uses in the community(ies) of interest AND identifies the key links between these WEF sources and uses.

Process. Use the column group hide/unhide tabs at the top of the worksheet to hide or show the *Inventory* and *Connections* information. To expose columns, select the “+” above the columns and to hide columns, select the “-” at the top of the page (Figure 4). Start by displaying only the *Inventory* information and, when finished, unhide and complete the *Connections* information.

From the drop-down menu in cell C3, select a specific community or the average community described in Worksheet #1. The questions in this and the remaining worksheet must be addressed from the perspective of either a specific community within the mine’s WEF shed or an average representation of several communities.

Completing the Inventories

Starting with the Water Section, follow this procedure:

- 1. Rank Use:** in Cell C8 is the relative quantity of water for each of the *Uses*. Rank each of the *Uses* by either an integer (1, 2, 3, with 1 being the highest use) or the percentage of the total water used in the community (e.g., irrigation uses 75%, domestic 20% and agriculture 5%).
- 2. Percentage of Sources:** Fill in the percentage that each *Source* supplies each *Use*. The percentage of all the *Sources* should total 100% at the bottom of each *Use* column to ensure all the *Sources* have been identified. *Sources* that are significant (i.e., greater than 5% by default) will be labelled with

a “Y” in the Relevant column (column L).

Note: effort should be given to provide an accurate percentage of each *Source*, but these numbers are not linked to other parts of the tool, so approximate or best guesses are sufficient. The information provides context for addressing the questions in the remaining sheets.

- 3. Use Descriptions:** For each *Source* manually fill in the *Use Description* in column M.
- 4. Repeat steps 1–3** for the Energy and Food sections.

Completing the Connections

For *Sources* that are flagged as significant in the *Relevant* column (column L), identify and describe the relevant connections to the other *Sources* using the following steps:

- 5. Identifying Source connections:** Select the *Source Code* of the other sources that are connected. Drop-down menus in columns S, V and Y contain the *Source Codes*. If multiple sources support the active *Source* choose the dominant *Source* and list the others in the description cell. Comments contained in the header titled *Key* at the top of the column contain a list of *Source Codes*.
- 6. Identify the connection direction:** From the drop-down menu, choose 1 (enabling, an upward arrow) if the connected *Source* helps to make the source available, or -1 (consuming, downward arrow) if the connected *Source* actually results in some consumption of the active *Source*. A value of zero denotes no connection and is represented by a circle. Comments associated with the header titled *Key* at the top of the column describe what the numerical values represent.
- 7. Description:** For each connection, provide a narrative to elaborate the nature of the connection.

For more detailed guidance on how to use the WEF Inventory worksheet, refer to the comments in the tool's *User Guidance Notes* cell located near the top of the worksheet.

WEF Security Tool for Mining
 WEF Use-Source Baseline

Community Selection: **Community A**
 User Guidance Notes

INVENTORY											CONNECTIO		
WATER		Uses (%)								Relevant	Use Description	Water Source Code	Connection Direction
Sources (%)	Rank Use	Agriculture (non-irrigation)	Commercial	Domestic Use	Energy	Industrial	Irrigation	Transport	Other				
Surface Water	W.1	60%	60%	30%	0%	0%	70%	0%	0%	Y	Agriculture, commercial, domestic, irrigation		●
Groundwater	W.2	40%	40%	45%	0%	0%	30%	0%	0%	Y	Agriculture, commercial, domestic, irrigation		●
Storage Water	W.3	0%	0%	0%	0%	0%	0%	0%	0%	N			●
Rain Water Harvest	W.4	0%	0%	25%	0%	0%	0%	0%	0%	Y	Domestic		●
Imported	W.5	0%	0%	0%	0%	0%	0%	0%	0%	N			●
Other	W.6	0%	0%	0%	0%	0%	0%	0%	0%	N			●
Total Score		100%	100%	100%	0%	0%	100%	0%	0%				

ENERGY											Relevant	Use Description	Water Source Code	Connection Direction
Sources (%)	Rank Use	Cooking	Household (e.g., Lighting)	Irrigation	Commercial	Refrigeration/Storage	Transportation	Industrial	Other	Key				
		4	5	3	1	6	2							

Figure 4. Worksheet #2: WEF Inventory Base

WORKSHEET #3 – WEF STATUS-BASE

Objective. To describe the current status of the WEF security components relevant to each WEF source (i.e., availability, access, supporting infrastructure [built and natural], and supporting institutions and policy).

Process. For each relevant WEF source identified in Worksheet #2, input descriptions for the current state of each of the WEF security components in column A (see the Introduction Worksheet for definitions).

To facilitate the completion of the worksheet, hide Sources that are not significant. Sources that were identified as relevant in Worksheet #2 have a “Y” flag beside the Source name in row 7. All other Sources on this sheet—those with an “N” flag—can be hidden by selecting the columns and right-clicking the Hide tab. This cleans up the view of the sheet to include only those columns that require input.

For each relevant Source column, identify the status of the WEF components (rows) as follows:

- Flag the importance of the WEF component.** Flag the importance of each WEF component to the Source using the drop-down menus in columns D, U, etc., as either a “0” (component not important for this source); “1” (somewhat important); “2” (important); or “3” (component very important to this source). The flag in column B reveals the maximum importance for all Sources for that specific WEF component row (rows can be hidden to show only those with a specific relevance threshold).
- Describe the status of the WEF component.** In the adjacent cell, input text to describe the current state of the component in qualitative and/or quantitative terms.
- Repeat steps 1 and 2 for all relevant Source columns.**

WEF Security		WEF Status - Baseline		Community A		User Guidance Notes		WEF SECURITY CRITERIA	
Availability		Y	Y	N	Y	N	N	Y	
Source	Source Description	Surface Water	Groundwater	Storage Water	Rain Water Harvest	Imported	Other	Biomass (Wood, cattle dung)	
	Diversion from local freshwater tributaries for irrigation (primarily gravity fed).	Shallow groundwater use (< 20 m)			Household rainwater barrels and tanks			Primarily wood and cattle dung	
	Agriculture, commercial, domestic, irrigation	Agriculture, commercial, domestic, irrigation	0	0	Domestic	0	0	Cooking (wood, dung)	
Markets	3	0 No water use charges	0 No water use charges	0	0 No water-use charges	0	0	0 No market	
Purchasing power (livelihood)	3	0 Water currently not priced.	0 Water currently not priced.	0	0 Household storage barrels	0	0	0	
Aid (direct provision, safety nets, subsidies)	3	3 Government currently pays for all surface water services and infrastructure	3 Combination of government and direct foreign aid pays for all ground water services and infrastructure	0	0 No aid for rainwater harvesting	0	0	0	
Self-production (water wells, off-grid power, individual/community gardens)	3	0 Surface water from river accessed directly by local residents	0 Groundwater wells are centralized within community access points. No individual wells	0	3 Rainwater harvesting is self-production method	0	0	0	
Barter	3	0 Surface water not traded	0 Groundwater not traded	0	0 Storage barrels are typically traded locally in return for food or other self-produced commodity	0	0	0	
Built Infrastructure	0	0	0	0	0	0	0	0	
Transportation	3	0 Surface water not transported	2 Some transport of	0	0	0	0	2 Trucks used to move	
Communication	3	3 Smart phones used for weather	0	0	0	0	0	0	
Waste removal/disposal	3	3 Untreated sewage disposed in river	3 Household outhouses in use with no septic tanks in use.	0	0	0	0	0	
Natural Infrastructure	0	0	0	0	0	0	0	0	

Figure 5. Worksheet #3: WEF Status-Base

WORKSHEET #4 – WEF SYSTEM DIAGRAM

Objective. A systems-mapping palette to enable a facilitator to work with stakeholders to visually and collaboratively draw the existing sources and uses of water, energy and food and their linkages.

Process. Based on the results from the WEF Inventory Base (Worksheet #2), use the shapes in the palette (columns W-AK) to draw a systems diagram of the community's WEF Sources and

Uses, including their connections (Figure 6). The figure below shows an illustrative diagram, but every use will differ.

To use the *Palette*, copy the shapes and drag them onto the drawing space.

Note on participatory engagement: in a participatory setting, this diagram can be used as the starting point for filling out Worksheet #2.

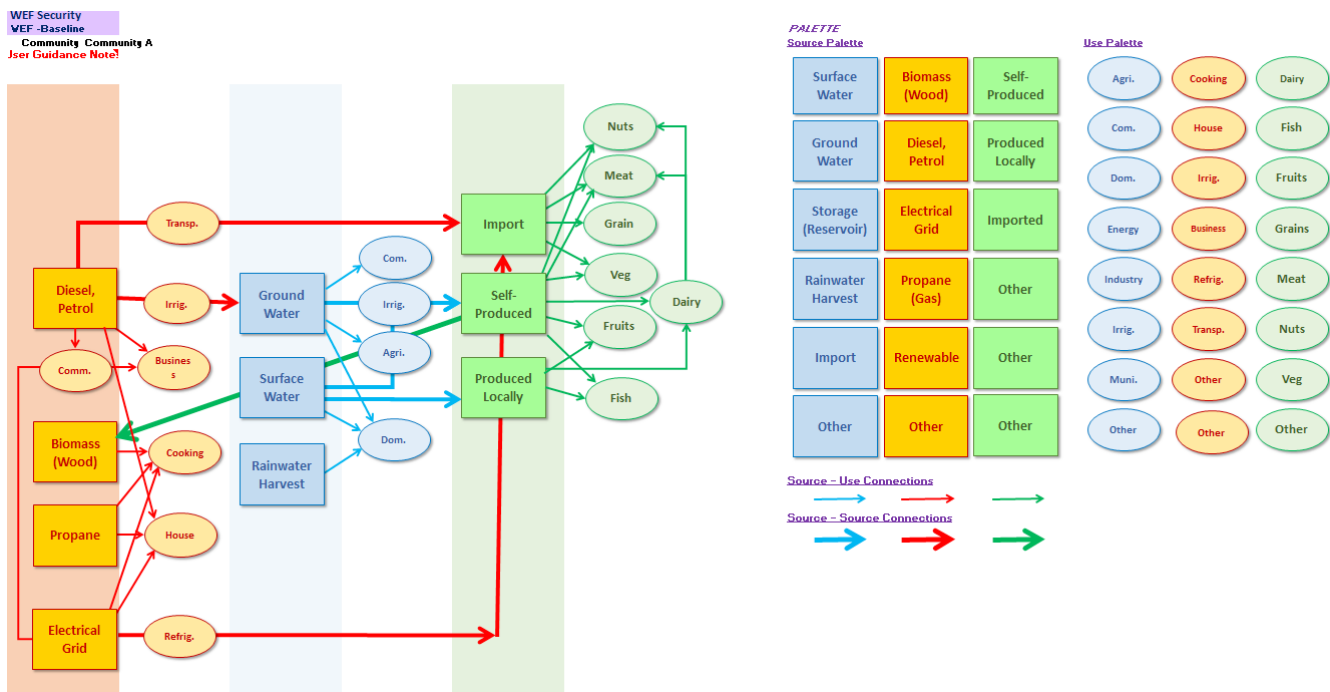


Figure 6. Worksheet #4: WEF Diagram Base

STEP 2: IDENTIFYING POTENTIAL MINING BENEFITS AND IMPACTS

In this second step, users describe the influence of different mining activities and processes at the operations and closure phases of the mine on the WEF system in the communities.

WORKSHEET #5 – MINING PROFILE

Objective. To describe the characteristics of 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. This profile information is not directly linked to the other worksheets as input, but is necessary to be able to properly address the rest of the analysis questions in the tool.

Process. Enter some basic information about the mining project you wish to examine through the lens of WEF security (Figure 7). This information includes:

- *General:* Information about the high-level parameters of the mine, including the type of ore, mining method and the stage of mining.
- *Mine personnel:* Information about the level of mine employment and representation of employees.
- *Land use:* Information about the mine's use of land and type of land disturbed.
- *Water use:* Information about the mine's use of surface water and groundwater.
- *Energy use:* Information about the mine's electricity production and demand by primary and secondary sources.
- *Food use:* Information about the level of food production and demand associated with the mine.
- *Waste:* Information about the mine's production of different wastes, including water effluents, leach piles, tailing piles, waste rock and process waste.

General							
Name of Mine Operation:		ABC Mine					
Company:		ABC Mining Company					
Primary Ore Type Being Mined:		Copper					
Primary Mining Method:		Open Pit					
Year started:		2015					
Previously mined?:		Y					
Current Stage of Mining:		Development					
Full Operation			Closure				
Mine Personnel		Description	Quantity	Unit	Description	Quantity	Unit
Number of employees:			50	per		3	per
% of employees that are local:			5	%		100	%
Average salary of local employees:			5000	USD/yr		5000	USD/yr
Land use		Description	Quantity	Unit	Description	Quantity	Unit
Roads:			10	km		3	km
Total mine footprint:			20	km ²		1	km ²
Land type disturbed 1:		Riparian	5	km ²	Riparian	1	km ²
2:		Forest	10	km ²	Forest	8	km ²
3:		Riverine	5	km ²	Riverine	1	km ²
Water use:		Description	Quantity	Unit	Description	Quantity	Unit
Surface water use:		Treated water from waste piles and tailing disposed of in creeks that flow to river	300	M3/yr	Treated water from waste piles and tailing disposed of in creeks that flow to river	100	M3/yr
Groundwater use:		Mine dewatering; drinking and sanitation	360000	M3/yr	None	0	M3/yr
Energy use:		Description	Quantity	Unit	Description	Quantity	Unit
Primary electricity source:		Grid			Grid		
Secondary electricity source:		Diesel generator			Solar		
Total electricity use:			15000	kWh	Grid less onsite solar	150	kWh
Total electricity generated:			1000	kWh	Solar	100	kWh
Food use:		Description	Quantity	Unit	Description	Quantity	Unit
Food produced onsite:		None	0	%	Garden on reclaimed land	50	%
Food purchased locally:		From central market	75	%	From central market	50	%
Food imported:		Water, meat, fruit	25	%	None	0	%
Waste		Description	Quantity	Unit	Description	Quantity	Unit
Mine Pit							
Water sent from mine dewatering to surface water:			0	M3/yr		0	km ³
Water sent from mine dewatering to groundwater:			3600000	M3/yr		0	M3/yr
Leach Piles:							
Volume:			1250	m ³		0	m ³
Area:			250	m ²		0	m ²
Constituents of Concern:		Cyanide			Cyanide (disposed in tailings facility)		
Tailings Piles:							
Volume:			312500	m ³		312500	m ³
Area:			62500	km ²		62500	km ²
Constituents of Concern:		Mercury			Mercury		
Tailings water effluent to surface water:				m ³ /yr			m ³ /yr
Tailings water seepage to groundwater:			100	cm/yr		10	cm/yr
Waste Rock Piles:							
Volume:			1250000	m ³		1250000	m ³
Area:			250000	m ²	50% of ARD waste rock reclaimed	100000	m ²
Constituents of Concern:		Acid, arsenic			Acid, arsenic		

Figure 7. Worksheet #5: Mine Profile

WORKSHEET #6 – WEF INVENTORY MINE

Objective. To describe any new WEF sources introduced by the mine, as well as the new uses resulting from the mine. The purpose of this worksheet is to understand how the mining development might change the existing sources of water, energy and food, how these are used by the community and their connections.

Process. Assess Changes in the Source/Use INVENTORY

Begin by flagging any change in *Source* or use using the drop down menus in rows 8, 20 and 32 and adding a text description of the changes in column E (Figure 8). Changes can also be made to the percentages in the *Source/Use* tables as necessary. These steps are described in detail below:

1. **Change in Sources:** Indicate the expected change of a *Source* in column D. A drop-down menu is activated when the cell is selected. Options in the drop-down menu are described in the red comment tab and include: -2 (↓) = definite decrease in source availability, -1 (↘) = slight to uncertain decrease in source availability, 0 (o) = no change in availability, 1 (↗) = slight to uncertain increase in availability, and 2 (↑) = definite increase in availability. Note: *Sources* can be created or eliminated with the introduction of mining, and these should be reflected in the table.
2. **Change in Uses:** Indicate the expected change in the *Use* in rows 9, 21 and 33. Options in the drop-down menu are described in the red comment tab and include: -2 (↓) = definite decrease in use, -1 (↘) = slight to uncertain decrease in use, 0 (o) = no change in use, 1 (↗) = slight to uncertain increase in use, and 2 (↑) = definite increase in use. Note: mining can be introduced as a *Use* for instances where the mine is within or directly adjacent to the community.
3. **Change in the Source-Use Percentages:** Adjust the percentage that each *Source* supplies each *Use* to reflect the expected change due to mining. The percentage of all the *Sources* should total 100% at the bottom of each *Use* column to ensure all the sources have been identified. *Sources* that are relevant will be labeled with a “Y” in the column titled *Relevant*. Note: effort should be made to provide an accurate percentage of *Source*, but these numbers are not linked to other part of the tool, so approximate or best guesses from knowledgeable stakeholders is sufficient. The information provides context for addressing the questions in the worksheets #7 and #8.
4. **Listing Use Categories:** For each *Source*, manually update the *Use Description* in column P.

Assessing Changes in Connections

5. **Change in Connection:** Next, flag any changes in the connections among WEF sources using the drop-down menus in columns V, Z and AD and manually change the connection descriptions accordingly.

The *Source* to *Source* connections follow the same logic as in *Worksheet #2*, and initial connections and directions are directly linked to *Worksheet #2*. Use the drop-down menus to select the expected change in the original *Source* to *Source* connection. Options are -2 (↓) = definite decrease in source availability, -1 (↘) = slight to uncertain decrease in source availability, 0 (o) = no change in availability, 1 (↗) = slight to uncertain increase in availability, and 2 (↑) = definite increase in availability.

Note: *Source* to *Source* connections can be created or eliminated with the introduction of mining and should be reflected in the table. New or eliminated connections should be identified by editing the *Source Code* and *Prior Connection Direction* columns. Comments associated with the header titled *Key* at the top of the column contain a list of *Source Codes*.

Page Display Guidance: Use the column group hide/unhide tabs at the top of the worksheet to hide or show the *Inventory* and *Connections* information. To expose columns, select the “+” above the columns and to hide columns, select the “-“. For ease, start by displaying only the *Inventory* information and when finished, unhide and complete the *Connections* information.

Additional Info: In the *Source-Use Inventory Percentages*, there is a threshold for minimum significance below which the source will not be consider relevant for the use. Thresholds for each WEF system can be set in the *Properties* sheet that is normally hidden. Default thresholds for each WEF system are set at 5%. See the *Properties* Tab section on how to edit these thresholds.

WEF Security																				
Use-Source Mining																				
Community A																				
User Guidance Notes																				
INVENTORY																				
WATER																				
Sources	Change of Source	Change Description	Uses (%)										Relevant	Use Description	CONNECTIONS					
			Agriculture (non-irrigation)	Commercial	Domestic Use	Energy	Industrial	Irrigation	Transport	Other	Mining	Water Source Code Key			Prior Connection Direction Key	Change in Connection				
Surface Water	W.1	●	60%	60%	30%	0%	0%	70%	0%	0%	0%	0%	0%	0%	Y	Agriculture, commercial, domestic, irrigation	0	●	●	0
Groundwater	W.2	↓	40%	40%	25%	0%	0%	30%	0%	0%	0%	0%	0%	Y	Agriculture, commercial, domestic, irrigation	0	●	●	0	
Storage Water	W.3	●	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	N	0	0	●	●	0	
Rainwater Harvest	W.4	●	0%	0%	25%	0%	0%	0%	0%	0%	0%	0%	0%	Y	Domestic	0	●	●	0	
Imported	W.5	↗	0%	0%	20%	0%	0%	0%	0%	0%	0%	0%	0%	Y	Domestic	0	●	●	0	
Other	W.6	●	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	N	0	0	●	●	0	
Total Score			100%	100%	100%	0%	0%	100%	0%	0%	0%	0%	0%							

Figure 8. Worksheet #6: WEF Inventory-Mine

WORKSHEET #7 – MINING WEF INFLUENCE

Objective. To identify the potential benefits and impacts of mining (during both operations and closure stages) on the availability and accessibility of key sources of water, energy and food as well as the supporting infrastructure (both built and natural) and supporting institutions and policies.

Process. The sheet is in the same format as Worksheet #3, but columns have been added to record the change in the WEF security component (Figure 8).

Warning: do not add rows or columns to the worksheet. The code used to load and save data to the WEF-SC/active *Source Category* matrices references particular cells. Adding columns or rows will alter the worksheet and render it unusable.

Hide Inactive/Unhide Active Source Categories

The first step is to hide *Source* columns that were not flagged as relevant. New *Sources* that were identified as relevant in Worksheet #6 have a “Y” flag beside the source name row. All other sources on this sheet (those with an “N” flag) can be hidden by selecting the columns and right-clicking

the *Hide* tab. This limits the view in the sheet to include only those *Sources* that require input. Once hidden, column and row headers can be hidden under the *View Menu* to produce a cleaner looking page.

Assess the Potential Benefits and Impacts of Mining on the WEF Security Components

The steps for describing the potential benefits and impacts of mining on the WEF security components are:

1. **Select Mining Stage and Aspect and Load Data:** Under the worksheet title, select the *Mining Stage* (B4) and *Process* (B5) to be assessed. Drop-down menus in the cells guide the selection process. A description of the mining aspect is presented in the cell below the selected process. Once the mining stage and aspect have been selected, click the *Upload Data* button to load the relevant information into the worksheet. A prompt appears asking “Apply Data Filters?” Answer “yes” if you want the default filters applied—this automatically removes WEF security components that typically are not relevant for the specific mining aspect.

2. **Describe the Change in Use and Source:** For each *Source*, describe the anticipated change of the *Source* due to mining (row 12) and the change in *Use* due to mining (row 11).
3. **Describe the Potential Benefits and Impacts:** For each *Source*, describe the potential benefit or impact on the WEF security component due to mining. The first column is the *Baseline* value from Worksheet #3 and need not be edited. The second column indicates the relative change in the WEF security component. Options are provided in the drop-down menu and include: -2 (↓) = definite decrease in Source availability, -1 (↘) = slight decrease in source availability, 0 (○) = no change in availability, 1 (↗) = slight increase in availability, and 2 (↑) = definite increase in availability. Provide a description of the change in the column to the right. Note: the default comment is the original WEF Status from Worksheet #3. When the description cell is edited, the text becomes red to indicate that it has been altered from the Baseline, indicating a change due to mining.
4. **Save Edits:** When you are done describing potential benefits and impacts, click the *Save Data* button. A prompt appears asking “Apply Data Filters?” Answer yes if you want the default filters applied—this automatically removes WEF security components that typically are not relevant for the specific mining aspect.

Note: save your work frequently! It is mandatory to save the edits before proceeding, as the results will not be carried forward to Worksheet # 8 and will be overwritten when loading the next *Upload Data* button or *Reset Data* is prompted.

5. **Repeat Steps 1–4 for Each Mining Stage and Process.**

Resetting Data: The data for a particular mining stage and aspect can be reset to *Baseline* values or cleared completely by clicking the *Reset Data* button. The filter dialogue box applies here as described before.

Row Headers Descriptions

The *WEF Security Components*, the associated maximum baseline score from Worksheet #3, and the maximum “+” change (positive) and “-” change (negative) for all the *Sources* in the current loaded *Mining Stage* and *Process* are presented in the first four columns on the left (Figure 7). This provides a quick overview on the *WEF Security* components deemed influenced by mining for all the relevant *Sources*. Filters on these columns can be applied to filter out less relevant WEF security criteria. To activate a filter, select the cell in the column to be filtered (indicated with a small downward triangle in a box), then select the elements you want displayed from the menu (Figure 8). Selecting “X” from the list will maintain the headers. Figure 9 illustrates the effects of hiding rows based on the selection.

WEF Security

WEF Status - Mining Worksheet

Community A

Stage Operational

Aspect General Facilities

Roads, Mine footprint

User Guidance Notes

WEF SECURITY Components

Upload Data	Source			
Save Data	Use			
Reset Data	Change in Use			
	Change in Source	Baseline	+ Change	- Change

Availability (Other)

	3		
Processing/treatment/conversion	3		
Storage (short and long term)	3		
Distribution (water towers)	3		
Markets	3		

Access

Purchasing Power (livelihood income, remittances, credit)	3		
Aid (direct provision, safety nets, subsidies)	3		
Self-production (water wells, off-grid power, individual/community gardens)	3		
Barter	0		

Supporting Infrastructure

Built Infrastructure			
----------------------	--	--	--

Y	Surface Water	Y	Groundwater	N	Storage Water
	Agriculture, commercial, domestic, irrigation		Agriculture, commercial, domestic, irrigation		0
Baseline		Baseline		Baseline	

0	Drinking water is currently untreated	0	No treatment	0	0
0	There are no water storage	0	No storage	0	0
3	System of canals for diverting river water for irrigation	3	Piped water for one community with multiple access points	0	0
0	There are currently no water use charges for surface water	0	No market	0	0

0	Water currently not priced, therefore no income allocated to water	0	Water currently not priced, therefore no income allocated to water	0	0
3	Government currently pays for all surface water services and	3	Combination of government and direct foreign aid pays for all	0	0
0	Surface water from river accessed directly by local residents	0	Groundwater wells are centralized within community access points; no individual wells	0	0
0	Surface water not traded	0	Groundwater not traded	0	0

Figure 9. Worksheet #7. WEF-Influence-Mine

The screenshot shows a software interface with a filter menu open for 'MEF Security'. The menu includes options for sorting (Smallest to Largest, Largest to Smallest, by Color), clearing filters, filtering by color, and number filters. A search box is present, and a list of filters is shown with checkboxes: (Select All), 0, 2, 3, 5, Baseline, X, and (Blanks). The 'OK' and 'Cancel' buttons are at the bottom of the menu.

The data table below the menu is organized into columns for 'Surface Water' and 'Groundwater'. The rows are filtered based on the selected criteria. The visible rows are:

Category	Value	Indicator	Description
Baseline	0	●	Agriculture, commercial, domestic, irrigation
Baseline	0	●	Agriculture, comm irrigation
0	0	●	Drinking water is currently untreated
0	0	●	No treatment
3	0	●	There are no water storage
3	0	●	No storage
3	3	●	System of canals for diverting river water for irrigation
3	3	●	Piped water for or with multiple acc
0	0	●	There are currently no water use charges for surface water
0	0	●	No market
			Water currently not priced,
			Water currently no

Figure 10. Filter Menu that appears when the filter tab is activated. In this example, all rows with a 2, 3, Baseline, and "X" will appear. All others will be hidden. Note: choosing "X" will maintain the headers such as Availability and Access, as observed in Figure 9.

WEF Security					
WEF Status - Mining Worksheet					
Community A					
Stage Operational					
Aspect General Facilities					
Roads, Mine footprint					
User Guidance Notes					
WEF SECURITY Components					
Upload Data	Source				
Save Data	Use				
Reset Data	Change in Use				
	Change in Source				
		Baseline	+ Change	- Change	
		Baseline			
		Y			Surface Water
					Agriculture, commercial, domestic, irrigation
		Baseline			
		0			Drinking water is currently untreated
	Processing/treatment/conversion	2			
	Storage (short and long term)	0			There are no water storage
		3			System of canals for diverting river water for irrigation
	Distribution (water towers)	4			
		0			There are currently no water use charges for surface water
	Markets	1			

WEF Security					
WEF Status - Mining Worksheet					
Community A					
Stage Operational					
Aspect General Facilities					
Roads, Mine footprint					
User Guidance Notes					
WEF SECURITY Components					
Upload Data	Source				
Save Data	Use				
Reset Data	Change in Use				
	Change in Source				
		Baseline	+ Change	- Change	
		Baseline			
		Y			Surface Water
					Agriculture, commercial, domestic, irrigation
		Baseline			
		3			Drinking water is currently untreated
	Processing/treatment/conversion	2			
	Storage (short and long term)	0			There are no water storage
		3			System of canals for diverting river water for irrigation
	Distribution (water towers)	4			
		0			There are currently no water use charges for surface water
	Markets	1			
	Access				
	Purchasing Power (livelihood income, remittances, credit)	7			Water currently not priced, therefore no income allocated to water
	Aid (direct provision, safety nets, subsidies)	8			Government currently pays for all surface water services and
	Self-production (water wells, off-grid power, individual/community gardens)	9			Surface water from river accessed directly by local residents
	Barter				Surface water not traded

Figure 11. Effect of Filters in Viewing Data. The top image has no filters applied, whereas the bottom image has filters applied to the Baseline column to show only rows with the values 2, 3, Baseline and "X." Note that the Storage and Markets WEF Security Components have been hidden, as their Baseline values were 0 and 1 respectively.

STEP 3: EXPLORING ACTIONS AND INDICATORS

In this third step, users identify actions to address the impacts and benefits of mining to maintain and improve WEF security, and indicators to assess and track progress in the WEF system.

WORKSHEET #8A & 8B – WEF SECURITY ACTIONS AND INDICATORS

Objective. These two worksheets compile all of the potential benefits and impacts of mining in one place and enable stakeholders to work together to identify key actions to help realize potential benefits and mitigate impacts of mining. These sheets also provide menus of possible indicators (where available) that could be used to: i) track the status and trends of the WEF Security components, ii) track the potential mining benefits and impacts, and iii) track progress toward necessary actions. While Worksheet #8a focuses on the stage of mine operations, Worksheet #8b focuses on mine closure.

Process. These two worksheets display all of the saved information from Worksheet #7 for the operational and closure phases of mining, respectively (Figure 10). Directional arrows are used to summarize the potential benefits (upward arrows) and impacts (downward arrows) of mining. Text elaborating on the benefits and impacts is also provided next to the arrow.

Descriptions of the Information Displayed

Baseline (column C): the associated maximum baseline importance score for each WEF security component from Worksheet #3.

+ Change (column D): the maximum “+” change (positive) from Worksheet #7

- Change (column E): the maximum “-” change (negative) from Worksheet #7

Filters on these columns can be applied to filter out less relevant *WEF Security* components. To activate a filter, select the cell in the column to be filtered (indicated with a small downward triangle in a box), then select the elements you want displayed from the menu (Figure 8). Selecting “X” from the list will maintain the headers. Figure 13 illustrates the effects of hiding rows based on the selection.

Baseline (column G): column G is the *Baseline* value from Worksheet #3 and need not be edited.

Mining Aspects (columns H, I, J, K, L): For each Source a composite of Worksheet #7 is provided in columns H through L and include: 1. Mine Extraction, 2. Mine Waste, 3. Mine Process, 4. Economic Development, 5. General Facilities. Arrows indicate changes recorded in Worksheet #7 with the values -2 (↘) = definite decrease in source availability, -1 (↙) = slight to uncertain decrease in source availability, 0 (○) = no change in availability, 1 (↗) = slight to uncertain increase in availability, and 2 (↗) = definite increase in availability. The description column reflects the comments for each process with the number in front of the comment indicating the mining process to which the comment is associated. Note: only comments for cells having significance (first column) greater than the *Relevance Threshold* will be displayed. The *Relevance Threshold* can be set in the yellow cell under the worksheet title depending on the level of targeting required. Set the *Relevance Threshold* to “0” if all comments are to be displayed.

Actions (column N): The actions that need to be input for this worksheet describing how to achieve the potential mining benefit or mitigate the impact.

Indicators (columns P, Q, R): These three columns are for identifying *Status Indicators*, *Pressure Indicators* and *Action Indicators*. The *Action* column describes actions taken to enhance

benefits and mitigate impacts with mining activities.

Indicator List (cell B8): When one of the indicator cells is selected for a specific *Source*, the grey *Indicator List* button can be used to display a suggested list of relevant indicators and also to add your own indicator.

Managing the Screen View

Hide Inactive/Unhide Active Sources: The first step is to hide inactive and unhide *Source Categories* identified in Worksheet #6. New *Source Categories* that were identified as active in Worksheet #6 have a “Y” flag beside the *Source* name row. All other sources on this sheet (those with an “N” flag) can be hidden by selecting the columns and right-clicking the *Hide tab*. This limits the view in the sheet to include only those *Source Categories* that require input. Once hidden, column and row headers can be hidden under the *View Menu* to produce a cleaner looking page.

Hide/Displaying Actions and Indicators Columns: Associated with each *Source* are *Actions* and *Indicators* columns that can be hidden or displayed using group hide/unhide buttons at the top of the worksheet. To display columns, select the “+” above the columns and to hide columns, select the “-“. For ease, start by displaying only the *Actions* column information then expand to the *Indicators* column when ready.

Identifying Actions and Indicators

For each *Source*, conduct the following:

- 1. Describe Actions:** Unhide *Actions* column and review baseline value from Worksheet #3 for the WEF security component that are significant.
- 2. Identifying Indicators:** Using the group hide/unhide button, unhide the *Indicators* columns (Figure 13). For significant WEF security components, list the *Status Indicators*, *Pressure Indicators* and *Action Indicators* in the appropriate columns. To guide list development, the workbook contains pre-determined lists of relevant indicators. To access the list, click in the desired cell to be edited then click the *Indicator List* button on the upper left corner of the worksheet. A dialogue box containing a list of suggested Indicators will appear. Select the relevant *Indicator(s)* and/or input your own *Indicator* in the “user defined” space of the menu tab and click OK. To delete an indicator, simply click on the selected indicator again, and it will remove the highlight from the menu tab and the indicator will be deleted by clicking OK.
- 3. Repeat steps 1 and 2 for all WEF security components that are significant to the Source. Repeat for all relevant Sources.**

About the Indicator Menus

The *Indicator Menus* were generated from the example indicators reviewed and listed in the [WEF Resource Book for Mining](#). These indicators are

stored in a database embedded in the [WEFsat-Mining tool](#). This menu can be modified so that it can be improved over time with experience.

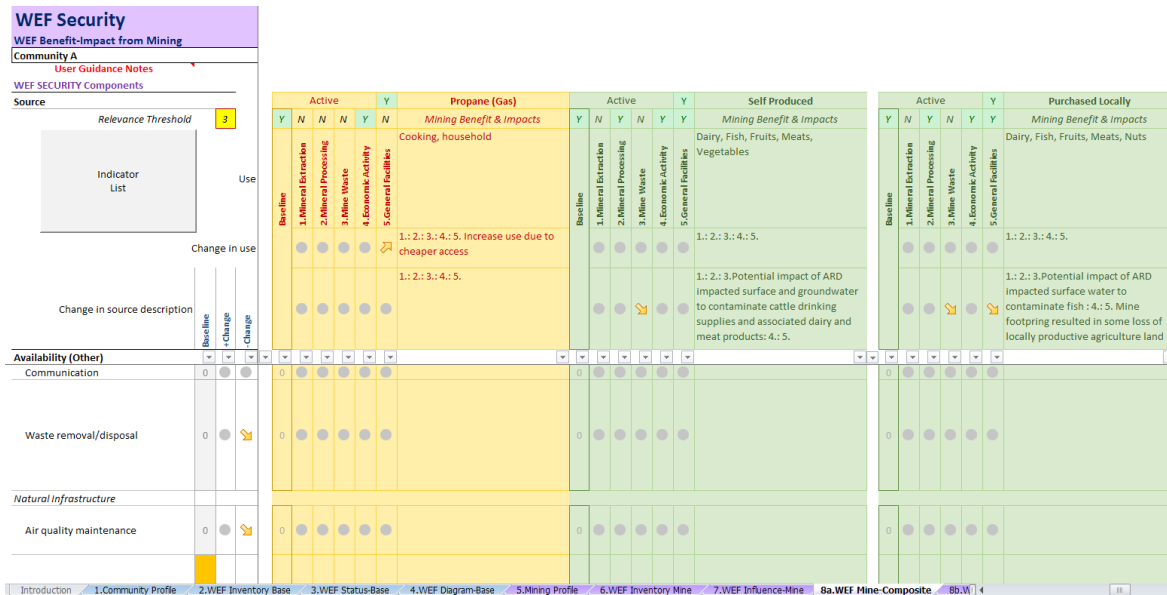


Figure 12. Worksheet #8a: WEF Mine-Composite (Operations)

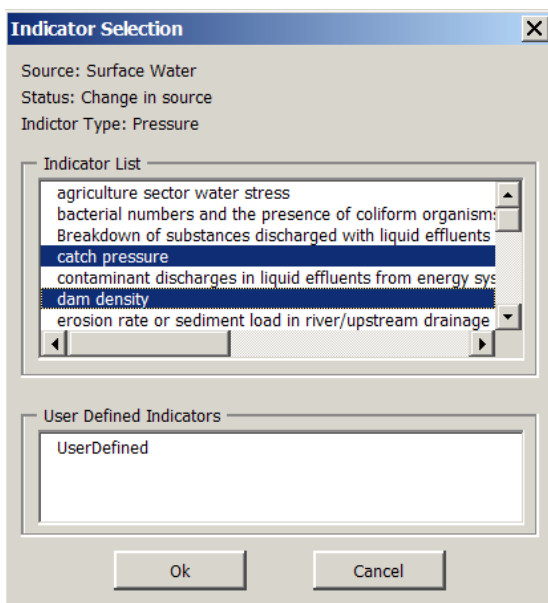


Figure 13. Indicator Selection Dialog Box

WORKSHEET #9 – MINING INFLUENCE DIAGRAM

Objective. This worksheet is the same as the WEF System Diagram Worksheet #4 and provides a canvas to incorporate and visually depict the specific influences of mining development on the original WEF security system.

Process. Begin by copying the diagram from Worksheet #4. Modify the diagram to account for any altered or new water, energy and/or food Sources potentially introduced through mining (or sources that are lost). For existing Sources and

Uses that have been changed, select the shape or connection and change the outline to dashed by selecting the shape, right clicking => Format Shape (or Format Object) => Line Style => Dash Type then select the dashed option. For new shapes or connections, use the *Palette*, copy the shapes and drag them onto the drawing space. Note: dashed lines represent altered Sources/Uses and the dotted shapes and lines in the palette represent new Sources, Uses and Connections.

Note on participatory engagement: In a participatory setting, this diagram can be used as the starting point for filling out Worksheet #6.

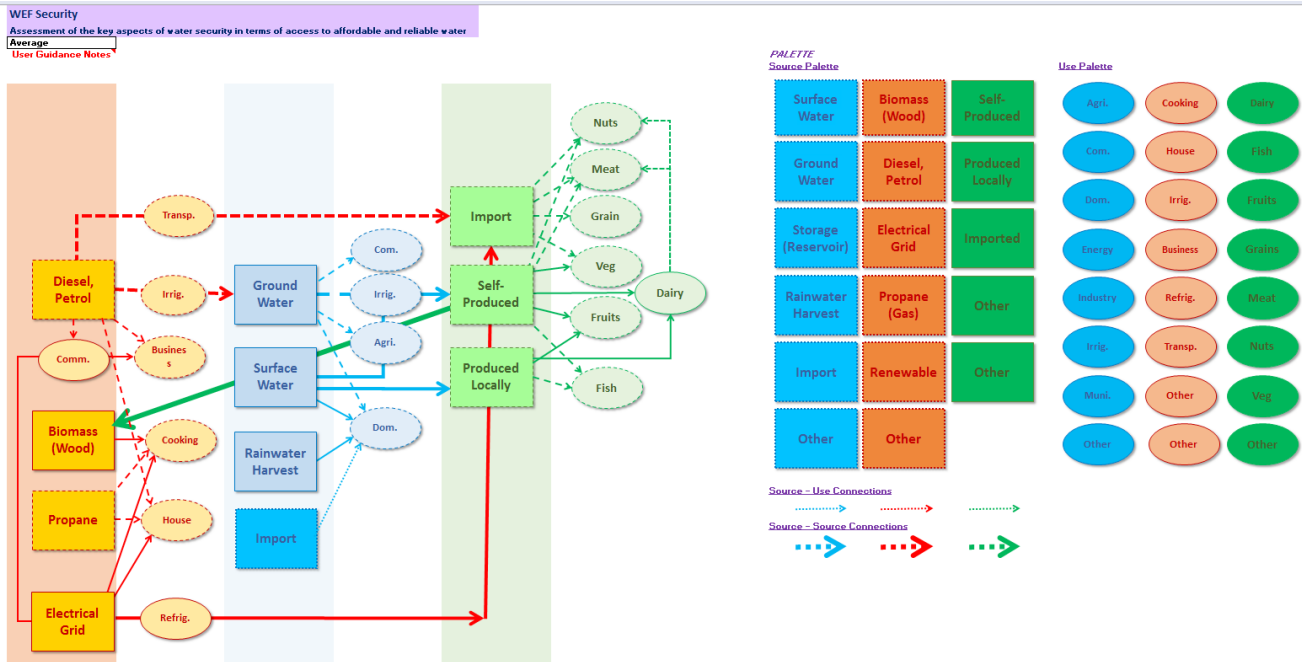


Figure 14. Worksheet #9: WEF Mine Diagram

STEP 4: SUMMARIZING FOR DECISION-MAKERS

In this fourth step, users identify and summarize the key insights uncovered throughout the use of the tool with regards to each component of WEF security.

WORKSHEET #10 – SUMMARY FOR DECISION-MAKERS

Objective. This worksheet enables users to manually compile the key information from the previous worksheets into a summary format. Show and hide buttons enable users to select which information to display. By completing this summary sheet, users distill the insights gleaned in previous worksheets, so this final tab helps users conclude with a summary of lessons learned areas to address for future improvement, in terms of: (i) the key mining benefits and impacts for each of the WEF Security components; (ii) the key actions for realizing benefits and mitigating impacts; and (iii) the set of indicators that should be tracked for each WEF security component.

Process

Sources

List the key water, energy and food sources in the *Sources* cell along with the key status indicators.

Key Connections

Include a description of key WEF connections for the *Sources* and *Purchasing Power* components and for others as needed. Draw from Worksheets #2 and #6 for connection details.

Mining Benefits and Impacts

Use Worksheets #8a and #8b to identify the key benefits and impacts on each of the WEF security components and the relevant indicators.

Key Actions

Use Worksheets #8a and #8b to identify the key actions necessary to realize key benefits and mitigate key impacts, and the relevant key performance indicators.

Indicator Summary Guidance

The total number of indicators listed should not exceed 50 for practical purposes.

The summary for decision-makers is meant to help mining companies, governments and other decision-makers involved in mine development understand the implications of mining on regional WEF security and manage them as best possible. For this reason, the summary for decision-makers should be presented factually and clearly, keeping in mind the specific needs and goals of the audience. Language used should be clear, concise and understandable to a non-technical audience.

WEF Security Executive Summary

User Guidance Notes

Security Component	Key Insights
<p>Availability</p> <p>Sources</p> <p>Water:</p> <ul style="list-style-type: none"> - Surface Water [exceedances of ph, SO4, constituents of concern] - Groundwater [exceedances of ph, SO4, constituents of concern] <p>Energy:</p> <ul style="list-style-type: none"> - Biomass - Diesel/Petrol [% change in price] - Hydropower <p>Food</p> <ul style="list-style-type: none"> - Self-produced - Purchased locally [% change in local fish catches] - Imported 	<p>Key WEF Connections [& Indicators]: Diesel and electricity grid provide power for: pumps to (i) irrigate local crops (surface water sources) and to distribute water to livestock (surface and groundwater sources) <u>as well as provide power for food preparation, refrigeration, and energy use of households.</u> Although irrigated crops are not a primary source of local food, there is some reliance on local livestock for achieving protein balance. [# and duration of power outages]</p> <p>Diesel and grid electricity is also used for food refrigeration in both households and commercial warehouses. </p> <p>Key Benefits and Impacts [& Indicators]: Mine development has brought increased connectivity to grid electricity. Some concern exists regarding degradation of grid connectivity and reliability on mine closure due to decrease in infrastructure investment capability. [annual investment in grid maintenance]</p> <p>Runoff and seepage from waste rock and tailings piles has potential to impact surface water and groundwater sources in region during both operations and closure. [ph and heavy metals concentration of runoff and effluent from mine waste facilities; ph and metal concentration of surface water and groundwater sources.]</p> <p>Key Actions [& Indicators]: Establishment of closure fund for short-term investment in electricity grid following mine closure, combined with a corresponding increase in government investment in grid system maintenance locally. [annual investment in local grid maintenance].</p> <p>Water quality monitoring system to measure effluent volume and quality both during and after closure. Construction of engineered soil covers for mine waste rock and tailings facilities. Construction of permanent seepage collect and treat system for closure. Closure fund/bond for financing annual operation and maintenance costs of covers and treatment systems. [Monitoring system in place data publicly available online; soil cover closure design complete; soil cover constructed; seepage treatment system closure design complete; seepage treatment system constructed; amount of closure bond]</p>

Figure 15. Worksheet #10: Executive Summary

GUIDANCE FOR EXPERT USERS

There are two hidden programming worksheets in WEFsat-Mining: (1) the *Properties* tab and (2) the *Indicator Reference (IndicatorRef)* tab. The *Properties* tab contains a series of references that formulas, data validation and macros use and has been established to provide an easy means of changing these options. The *IndicatorRef* tab contains the lists of indicators that are presented in the *ListBox* in the *Indicator Selection* dialogue box (Figure 13) that is activated in Worksheets

#8a and #8b. To access these hidden worksheets, right-click on any worksheet tab and select *Unhide*.

PROPERTIES TAB

This sheet contains all the references used by macros and functions in the various sheets (see Figure 14–Figure 16). Comments associated with the title reflect what each section pertains to in the workbook.

The screenshot shows the 'Properties' worksheet with several key tables and callout boxes:

- WEF Thresholds (%):** A table with categories (Water, Energy, Food) and their respective threshold values (0.05).
- Data Validation Lists:** A table with numerical values (2, 1, 0, 1, 2, 3, 2, 1, 0?) representing validation list options.
- WEF Categories:** A table with columns for Source No., No., Adj Row, and Parameters, listing various water and energy sources.
- Mining Stage:** A table with columns for Index and Load Cols, listing Operational and Closure stages.
- Landuse Types:** A list of landscape types for data validation, including Alpine, Coastal, Desert, Forest, Grassland, Industrial, Lake, Riparian, Riverine, and Urban.

Callout boxes provide detailed explanations for each of these tables:

- WEF Thresholds %:** Sets what is deemed significant in the *Use-Source* matrix in Worksheets #2, #6.
- Data Validation Lists:** Provides an editable list of the drop-down menu options in Worksheets 2,3,4,6, 7 and 8. Editing this will show as new options in the dropdown menu. However, editing these will likely lead to a disruption in conditional formatting associated with those same cells.
- WEF Category:** Table serves two purposes:
 - Lists for Data Validation Lists in Worksheets #2, #6
 - Lookup table for row adjustment and number of parameter
- Mining Stage:** Row and column adjustments used by macros in Worksheet #7. These will need to be adjusted if columns are added/deleted to Worksheet #7.
- Landuse Types:** The list of landscape types for data validation list in Worksheets #6. Editing this will show as new options in the drop-down menu.

Figure 16. Functionality of Properties Worksheet, Part 1

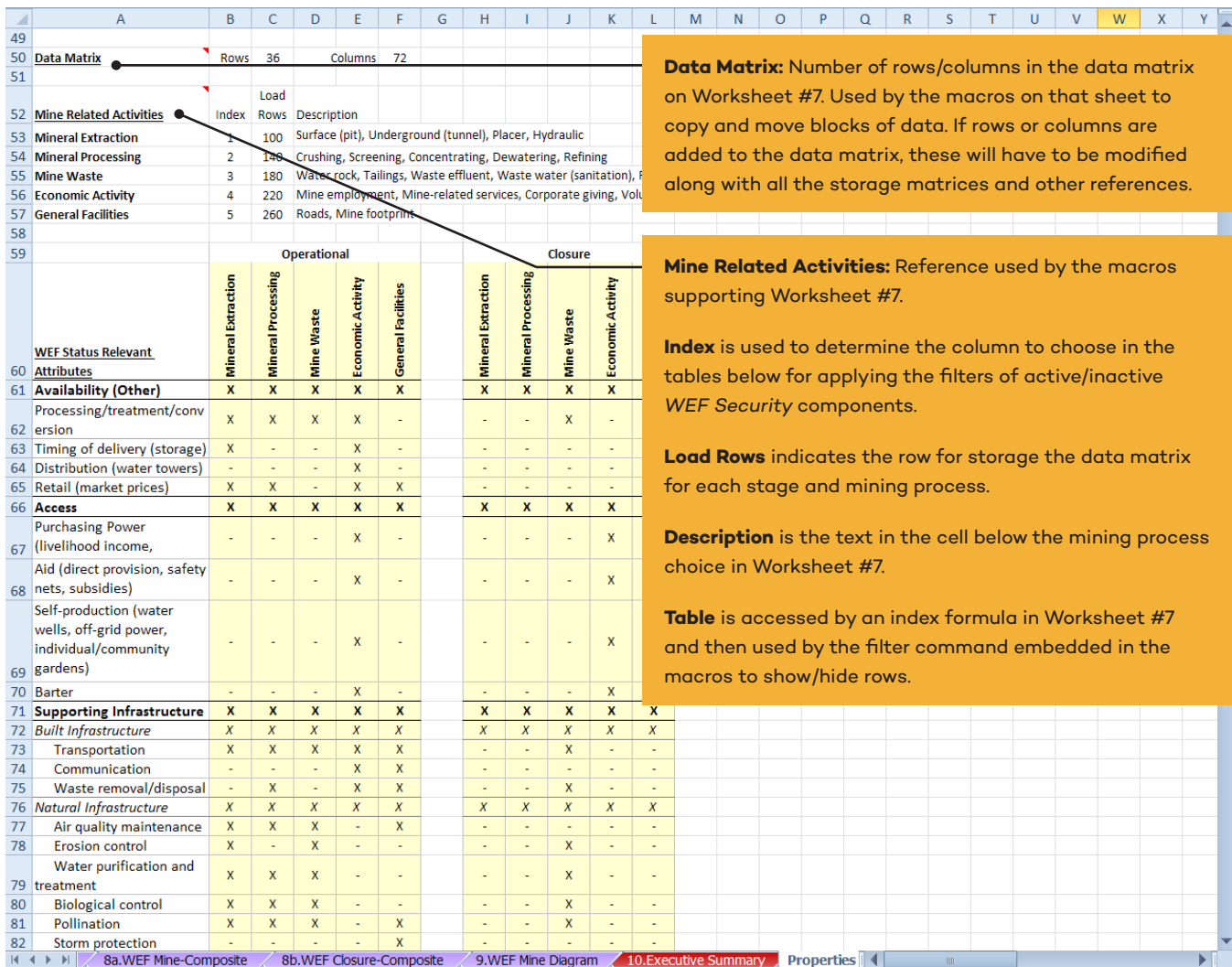


Figure 17. Functionality of Properties Worksheet, Part 2

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y
79	Water purification and treatment	X	X	X	-	-		-	-	X	-	-													
80	Biological control	X	X	X	-	-		-	-	X	-	-													
81	Pollination	X	X	X	-	X		-	-	X	-	-													
82	Storm protection	-	-	-	-	X		-	-	-	-	-													
83	Supporting Institutions and Policies	X	X	X	X	X		X	X	X	X	X													
84	<i>Institutions</i>	X	X	X	X	X		X	X	X	X	X													
85	Utility boards	-	X	-	X	-		-	-	-	-	-													
86	Resource Coops	-	-	-	X	-		-	-	-	-	-													
87	Safety oversight agencies	X	X	X	X	-		-	-	X	-	-													
88	Education and training	X	X	X	X	-		-	-	X	-	-													
89	Law enforcement and security	-	X	X	X	X		-	-	X	-	-													
90	<i>Policies and Plans</i>	X	X	X	X	X		X	X	X	X	X													
91	Resource use	X	X	X	-	X		-	-	-	-	-													
92	Climate change adaptation	-	-	X	-	-		-	-	X	-	-													
93	Disaster recovery and risk management	X	X	X	-	X		-	-	X	-	-													
94	R&D and Innovation	-	X	X	X	X		-	-	X	X	-													
95																									
96																									
97																									
98																									
99	Indicator Guide Matrix																								
100	Active Indicator Cells Inventory	Surface Stat.	Surface Pres.	Surface Act.	Ground Stat.	Ground Pres.	Ground Act.	Stor Stat.	Stor Pres.	Stor Act.	RWH Stat.	RWH Pres.	RWH Act.												
101	Indicator Type	15	16	17	28	29	30	41	42	43	54														
102	Column in composite sheet																								
103	Col. Load from IndicatorRef	1	4	7	1	4	7	1	4	7	1														
104	Change in Use	68	68	68	68	68	68	68	68	68	68														
105	Change in source	5	5	5	5	5	5	5	5	5	5														
106	Availability (Other)																								
107	Process/treatment	131	131	131	131	131	131	131	131	131	131														
108	Timing of delivery (storage)	164	164	164	164	164	164	164	164	164	164														
109	Distribution (water towers)	197	197	197	197	197	197	197	197	197	197	197	197	197	197	197	197	197	197	197	197	197	197	197	197
110	Markets	230	230	230	230	230	230	230	230	230	230	230	230	230	230	230	230	230	230	230	230	230	230	230	230
111	Access																								
112	Purchasing Power	263	263	263	263	263	263	263	263	263	263	263	263	263	263	263	263	263	263	263	263	263	263	263	263
113	Aid	296	296	296	296	296	296	296	296	296	296	296	296	296	296	296	296	296	296	296	296	296	296	296	296
114	Self-production	329	329	329	329	329	329	329	329	329	329	329	329	329	329	329	329	329	329	329	329	329	329	329	329
115	Barter	362	362	362	362	362	362	362	362	362	362	362	362	362	362	362	362	362	362	362	362	362	362	362	362
116	Supporting Infrastructure																								
117	Built Infrastructure																								
118	Transportation	395	395	395	395	395	395	395	395	395	395	395	395	395	395	395	395	395	395	395	395	395	395	395	395

Indicator Guide Matrix: Sets the reference column and row for the indicator lists for the Indicator Dialogue Box on Worksheets 8a, 8b. Row 102 is the column in Worksheets 8a, 8b, and the starting row of the indicator list is associated with each WEF Security component. This will need to be edited if rows/columns are inserted/deleted on either Worksheets 8a or 8b or the IndicatorRef worksheet.

Figure 18. Functionality of Properties Worksheet, Part 3

INDICATOR REFERENCE TAB

The *IndicatorRef* tab is the database of indicators that supports the *Indicator Selection* dialogue box activated when the *Indicator List* button is clicked on Worksheets #8a and #8b. The top of the column of indicators lists either the title of the *WEF Security* component (in italics) that the indicator set pertains to (also includes rows for *Change in Source*, *Change in Use*). For example, row 5 (Figure 17) is the header for the indicator set associated with the *Change in Source* row (row 10) in Worksheets #8a and #8b and the *Change in Use* row (row 9 of Worksheets #8a and #8b) starts in row 68 of this worksheet. State, pressure and action indicator sets are available for water (blue header), energy (yellow header) and food (green header) systems. The list is used to populate the listbox in the *Indicator Selection* dialogue box. The indicators are compiled from the tables in the [Water-Energy-Food Resource Book for Mining](#), where specific citations are listed in the reference section.

Changing the Indicator Database

Indicators can be added, edited or deleted directly in the cells, but a maximum of 499 characters will be shown in the listbox for each indicator.

The number of indicators appearing in the listbox is denoted by the number in the upper right-hand column associated with the *WEF Security* component. For example, if 10 indicators are listed in this sheet but the number is only 8, only the first 8 indicators will be shown in the listbox.

Selected Indicators: The active column indicates which indicators have been selected (“Y”) or unselected (“N”). The cell to the right of the indicator is associated with its status.

User-defined indicators are listed as a text string in the cell below the *Indicator List* title and above the indicator list. Edits here will appear in the *User-Defined Indicators* text box in the *Indicator Selection* dialogue box.

Warning: It is not advisable to insert/delete rows or columns in this sheet. If columns or rows are added or deleted then the macro supporting the *Indicator Selection* dialogue box will not reference the correct cells. To rectify, then, the *Indicator Guide Matrix* in the *Properties* sheet will need to be modified to reflect the change in rows/columns.

Action		Indicator Directory Energy						Indicator Directory Food							
State		Pressure			Action			State							
Change in Source	2	Change in Source	25	Change in Source	1	Change in Source	0	Change in Source						42	
Indicator List	Active	Indicator List	Active	Indicator List	Active	Indicator List	Active	Indicator List						Active	
UserDefined		UserDefined		UserDefined		UserDefined		UserDefined							
Describe any measu	Y	% land used for new bioenergy producti	N	land use and land use chan	N		N		# of food emergencies vs. food-water vulnerability						N
Describe any measu	N	% of increased access to modern energy	N		N		N		% agricultural land classified as having moderate to						N
	N	% renewable energy/ total energy	N		N		N		% area equipped for irrigation actually irrigated						N
	N	average reserve to production ratio for	N		N		N		% of farmers renting out land; % of farmers renting						N
	N	bioethanol and biodiesel production	N		N		N		% of the cultivated area equipped for irrigation						N
	N	change in forest area over the last 10 ye	N		N		N		aquaculture						N
	N	energy imports	N		N		N		Area certified						N
	N	enewable energy share in national ener	N		N		N		area equipped for irrigation by type of irrigation (su						N
	N	primary production of renewable energ	N		N		N		area that is potentially irrigable						N
	N	proven recoverable reserves	N		N		N		average dietary energy supply adequacy						Y
	N	pump price for gasoline and diesel	N		N		N		average value of food production						N
	N	ratio of hydropower to total energy sup	N		N		N		cereal import dependency ratio						N
	N	self-sufficiency	N		N		N		cereal yields						N
	N	share of renewable in total primary ene	N		N		N		change in cropland use						N
	N	stocks of critical fuel (e.g., oil, gas, etc.)	N		N		N		change in freshwater fish production (aquaculture)						Y
	N	total dam capacity (national)	N		N		N		crop yield gap (actual yield as % of attain						N
	N	total energy production	N		N		N		cropland per gross production value of agriculture						N
	N	total estimated resources	N		N		N		depth of food deficit						N
	N	total jobs in bioenergy sector	N		N		N		economic value of food products/ reduction of use c						N
	N	total primary energy supply	N		N		N		food imports						N
	N	total primary energy supply per capita	N		N		N		import quantity index of agricultural products						N
	N	transport energy intensities	N		N		N		livestock diseases / death						N
	N	utilization of total hydropower capacity	N		N		N		livestock production index						N
	N	woodfuel production by volume and val	N		N		N		livestock total per hectare of agricultural area (live						N
	N	years of energy reserves left	N		N		N		meteorological data						N
	N		N		N		N		normalized difference vegetation index (NDVI)						N
	N		N		N		N		number and % of population which is undernourishe						N
	N		N		N		N		number of farmers with certificates						N

Figure 19. Indicator Reference Tab. Note: Food indicators are listed to the right

ADDITIONAL INFORMATION

CONTACT INFORMATION

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REFERENCES

Bizikova, L. et al. (2013). *The water–energy–food security nexus: Towards a practical planning and decision-support framework for landscape investment and risk management*. International Institute for Sustainable Development. Retrieved from http://www.iisd.org/pdf/2013/wef_nexus_2013.pdf

IISD. (2015). *Water-energy-food resource book for mining: Assessing and tracking the benefits and impacts of mining on water-energy-food security*. International Institute for Sustainable Development. Retrieved from <http://www.iisd.org/publications/water-energy-food-resource-book-mining>

World Economic Forum. (2011). *Global risks 2011, Sixth Edition: Executive Summary*. World Economic Forum. Retrieved from http://www3.weforum.org/docs/WEF_GlobalRisks_ExecutiveSummary_2011_EN.pdf.

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