Is it possible to have sustainable mining in a significant biome?

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Abstract

This article summarizes a logical proposal for sustainable mining in a given region, taking into account variables that go from the set of natural resources to the social grade of acceptance of a political agenda; there are indicators applied to certain minerals and to a given region (the Amazon). It uses technical language, but all it takes to understand it is a minimal compression about set theory.

The mere distinction between renewable and nonrenewable resources does not quite fit anymore, as such, within the current sustainable development framework, for the sake of resource exploration and development analysis.

Sustainable and nonsustainable resources distinction is more suitable, proper and makes sense when dealing with natural resources exploration/development analysis, since they are subject to societal agreements, as part of their acceptances and uses.

Logical formalizations are thus needed and will be herein presented defining a sustainable mining in a given environment.

Sustainable development

Let

$$R \equiv \bigcup_{0}^{n} R_i$$

where:

$R \equiv$ is the set of all resources as, for instance:

$R1 \equiv$ natural resources

$R2 \equiv$ environmental resources

$R3 \equiv$ energy resources

$R4 \equiv$ capital resources

$R5 \equiv$ human resources

: :

: :

$Rn \equiv$ any resource and

$Ro \equiv \varphi$, i.e., no resources at all

Let W be a transform such as:

$$W : R \rightarrow D$$

where:

$W \equiv$ is the transform work

$D \equiv$ is the set of development stages and W a surjective function, i.e. it links at least one argument to every possible image.

Let:

$$S_i \equiv \bigcup_{1}^{n} \left\{ S_{i_1}, \cdots, S_{i_n} \right\}$$

be the set of development hypothesis where n is the number of subsidiary hypothesis which characterizes Si respectively to D.

Now consider:

$$S_d \equiv D \bigcup \left\{ S_{d_1} \cap S_{d_2} \cap S_{d_3} \cap S_{d_4} \cap S_{d_5} \right\}$$

where:

$S_{d1} \equiv$ set of minimal use of natural resources

$S_{d2} \equiv$ set of optimal (or maximal) use of physical flow resources

$S_{d3} \equiv$ set of minimal use of energy resources

$S_{d4} \equiv$ set of minimal use of environmental resources

$S_{d5} \equiv$ set of maximal social satisfaction states

such as:

$$s \in \bigcap S_d \leftrightarrow (\forall\, S_{d_i} \in S_d,\, s \in S_{d_i})$$

and S_d is a no empty set.

$$S_d \neq \phi$$

Thus:

S_d = set of sustainable development scenarios belonging to D and having as constraints

Then:

$$\bigcap_1^5 S_{d_i}$$

represents the goals and targets of a political agreement, a political agenda, setting for the agreed states of sustainable development.

Sustainable development indicators

Having defined, formally, sustainable development, in order to measure it one needs and indicator or indicators.

Let define effort (T) as a function, or transform , that attributes a positive number to every productive operation (P) or process.

Thus:

$$T : P \rightarrow \mathbb{R}^+$$

where $T(p) = \Gamma$

for every $p \in P$ and $r \in +$ and $+$ is the set of real numbers.

Let define enhancement (E) as the benefit obtained by the person, or firm, x from y -also person, or firm- who performs or allows to perform operation P.

Let:

$$E : X \cap Y \cap P \rightarrow \mathbb{R}^+$$

such as:

$$E\,(x,\, y,\, p) - E\,(y,\, x,\, p) - T\,(p)$$

Is the measure of agreement, **(A)** indicator of agreement when the enhancement **E (x, y, p)** obtained by x from y through p, the disturbance **T(p)** which the operation p causes to x, and **E (y, x p)** the enhancement obtained by y as retribution to x to performs or allows to perform operation p.

Thus:

if A (x, y, p) = 0

it implies a mutual enhancements or benefits for x and y

if A (x, y, p) < 0

$x \in X$, looses

if $A(x, y, p) > 0$

$y \in Y$, looses.

for a community or nation or any social group, **G**

where $X \subset G$ and $Y \subset G$

$$A(x, y, p) = \sum_{x \in G} E(x, y, p) - \sum_{y \in G} E(y, x, p) - \sum_{1}^{n} T(p)$$

where **n** is the number of productive operations considered involving *x* and *y*.

If **A (x, y, p)** is a sustainable indicator , As

then:

$$As = Sd \bigcup \{A_1, \cdots, A_n\}$$

where

A_i = is the set of agreements obtained under prevailing **Sd** conditions

Sustainable ore body

Let:

$$R_{S_i} = R \bigcup_{1}^{5} \{Sd_1, Sd_2, Sd_3, Sd_4, Sd_5\}$$

be the set of sustainable resources

a sustainable ore body (Os) is such that

$$O_{S_i} = R_{S_i} \bigcup A_{S_i}$$
$$m \in \bigcap O_{S_i} \leftrightarrow (\forall A_{S_i} \in O_{S_i}, m \in A_{S_i})$$

where *m* is ore mineral reserve.

Significant bioma

Be it the Amazon or the Boreal biome:

- it has been already considered in:

$$\bigcap_{1}^{5} S_{d_i}$$

- and:

$$As = Sd \bigcup \{A_1, \cdots, A_n\}$$

- and:

$$R_{S_i} = R \bigcup_{1}^{5} \{Sd_1, Sd_2, Sd_3, Sd_4, Sd_5\}$$

Conclusion

Much has been said and written on sustainability and mining sustainability; however, this is the first ever exercise on giving a formal, logical, treatment to the issue.

We started, very simply, by utilizing second-grade set theory and working further on the concepts. From the set of RESOURCES we establish the set of SUSTAINABLE DEVELOPMENT SCENARIOS. Then, we define a set of SUSTAINABLE DEVELOPMENT AGREEMENTS, where the societal voice is, once more, heard; then , the set of SUSTAINABLE ORE BODY and for a PARTICULAR BIOMA.

Such a presented view of the issue is believed to center on the real important points of the overall discussion and really promotes sustainable enterprises.