## SUSTAINABLE LIVELIHOOD STRATEGY IN MINING

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Sustainable Measures are providing to consulting services or communities and organizations who are working on sustainability, but we unable to give you a quick solution. Economist also cannot do all the work for societies. Sustainability cannot be developed and imposed on a community by someone outside that community. It needs to be developed and implemented by the community itself otherwise it will not work. The concept of sustainable development is an important focal point for decision makers in the industry. As per Brundtland report the sustainable development as development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs (WECD,1987). There are number of sustainability methodologies exist in practice for evaluating the performance of companies (Ramchandra , 200.0). The World Business Council for Sustainable ( WBCSD,1997), the Global Reporting Initiative ( GRI, 2002 a, b) and development of standards ( OECD ) Indicators are the key driver for a adoption of sustainability management in the industries . According to KEI (2005), Indicators and composite indicators are increasingly recognized as a useful tool for policy making and public communication in conveying information on countries performances in fields such as environment, economy, society, or technological development. The indicators are adopted to summarize and demonstrate the complexities of a dynamic environment to a meaningful information.(Godfrey and TODD (2001). By conceptualizing a dynamic scenario and by identifying hotspots, indicators simplify , quantify , analyze and communicate complicated information ( Warhurst,2002). Now question is how can we provide sustainability livelihood strategies in mining area?

We know that Mining is an industry of operations are temporary economic activity extending over a finite period of time . Poorly closed mines and derelict landform leave behind a legacy that brings forward several sustainability issues. Abandoned mine sites , degraded environment around the mine site and loss of livelihood of local people shatters the local economy . The local people remaining in ghost mining townships lose their food and social security. This is the post mining general scenario seen in a closed mine sites in India. Such legacy of unsustainable mining violates the basic tenets of sustainability, that is, inter and intra generational equity. To ensure long term environmental, economic and social sustainability of mining activities and the benefits from any ongoing mining activities may be invested in social, human and natural capitals of the peripheral areas of any mining area The ultimate aim is to enhance livelihood of local people, improvement in natural capital in the area and build up of social capital in the region, which are likely to stimulate long term economic growth in the region. This growth will be sustained even after mine closure. Any policy designed to implement these programs is necessary comprehensive research and framing some comprehensive indicators. The sustainability indicators should be developed with the in consultation stakeholders, i.e all economic agent directly or in directly relate to mining activities and allocate financial resources to implement these programs and review of the existing policies on affected people and policy suggestions are central to the research work. This necessitate implementation of sustainable mine closure plan at the mining regions, starting from mine inception. If mine closure plans are implemented at the closing stage, under limited cash flow situation, there will be shortage of funds. To obviate this problem mine closure plans will have to be implemented progressively starting from mine inception. In many countries a comprehensive mine closure systems have been developed. In India relevant policies are being framed and implemented, however, how far these policies are not so effective in attaining both intergenerational and intra generational equity so it necessitates comprehensive policy research to developed sustainable indicators in mining area. It is the not problem for mining area but the problem of world is that explosive rise in population, spread of the consumerism and pace of industrial, agricultural and other activities to serve the huge market demand, have now put a tremendous pressure on the scarce natural resources. This is similar to the analysis by Ehrlich who provided the famous IPAT expression,$I = P \times A \times T$, Where I = impact o pressure on natural resources,

P = population, A = affluence or level of consumption and T = technology. With rise in either of P, A or T, impact or stress on natural resources rises. It has given rise to the great question of sustainability of human race itself over a longer time horizon. Since the last quarter of the 20th century, these factors have started to render a negative twist to the otherwise positive sensational results of development. The adverse impacts of these factors are evinced in the damages to the environment and ecology that have been caused over these years in the pursuit of fruits of unmindful and over ambitious industrial and agricultural activities. Acid rain, desertification, global warming, air/water pollution, biodiversity extinction, natural resource deterioration etc. are some of the serious consequences that have begun to threaten the very existence of mankind if not controlled properly in time. Until the last quarter of the 20th century, most of the attention were put on implementing the feature of economic development – economist were till then concerned about the of the phenomena of poverty, inequality and unemployment. But these environmental and ecological concerns were soon integrated together with the concept of economic development – giving rise to the notion of sustainable development. Sustainability in a general sense implies maintenance of a certain state in its present form or improved form. Now to speak in simple terms sustainable development implies the maintenance of present level of human well-being in undiminished or possibly in enhanced form over future generations. Human well-being in a broad sense is intimately connected with the consumption of goods that are turned out in the production sphere. Consumption and production from the backbone of all economic activities which are linked together by the market institution. But there is also an intimate interrelation between economic activities and flow of environmental services that sustain the former. First the environment provides all kinds of minerals and natural resources which are transformed by the production sector into consumable goods. Second the environment provides a very vital service by acting as a receptacle or sinks for the hazardous air/water pollutants, industrial and agricultural wastes as well as domestic garbage. Third it provides direct benefits to human beings by providing life support services like oxygen that we require for breathing, water that we require for drinking. It also caters to the aesthetic, spiritual of recreational hankering of human beings, for example by making provision of enjoyment of swimming or boating in a water course, or enjoyment in a sanctuary or the natural beauty and serenity enjoyable in a mountainous region etc.

Majority of the available literature , on indicator development focus on conceptual frameworks for sustainability indicators are developed by various research agencies. of different countries . Few examples are EPA , USA, MMSD , ICUMN OECD .

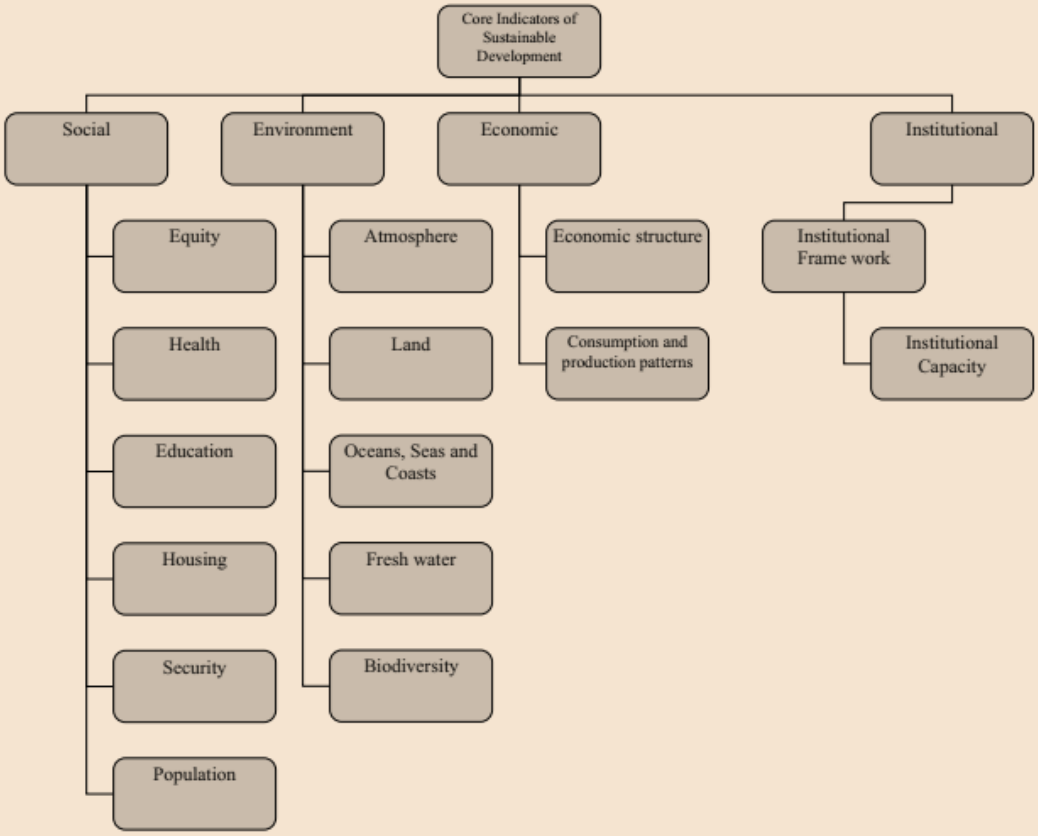


**Fig. 5.** The United Nations Commission for Sustainable Development (UNCSD) theme indicator framework.
*Source*: Labuschagnea et al. (2005).

***INDICATORS***

(An indicator is a way to measure a specific issue or condition that is relevant to the overall health of a community. It acts as a gauge to determine whether that condition is improving or deteriorating, thus highlighting problems in a community before they become too severe. Citizens and policy makers can use indicator information to create effective solutions in a timely manner. Indicators can also show a positive trend, enabling a community to recognize that they are moving towards a higher level of sustainability.

Indicators are three general categories: economics, environmental, and social. These categories are sometimes referred to as the three-legged stool of sustainability, with each category representing a leg of the stool. Just as all three legs of the stool are necessary for the stool to stand up, a healthy economy, environment, and society are necessary for a healthy community. Issues and problems in these categories rarely occur independently of each other and require analysis and

solutions that address their interconnected nature. Indicators analyze different aspects of a community, shedding light on the quality of life in that area.

indicators of sustainable community: ways to measure how well a community is meeting the needs and expectations of its present and future members. One of the primary goals of our site is to explain what indicators are, how indicators relate to sustainability, how to identify good indicators of sustainability, and how indicators can be used to measure progress toward building a sustainable community. Starting up an indicators for sustainable development can be a bewildering task. From our experience in working with communities, we have found that everyone has the same set of basic questions. To help you develop and use indicators of sustainability, we have prepared clear, indicators .

So, we cannot provide you with a complete set of ready-made indicators for your community, but we can provide some basic information that is useful in developing indicators. Here is some basic information to help you get started:

- **Explanations of indicators and <u>sustainability</u>,**

Sustainable Measures is committed to the development and growth of sustainable communities. We want to provide a focal point for dissemination, evaluation and discussion of indicators of sustainable communities. Unlike sites whose subject is "sustainability" in general, this site focuses on how communities can use indicators of sustainability in a practical way to determine their direction and measure their progress. Our goal is to educate and inspire community members from diverse backgrounds, and provide them with a forum for discussion. This site is not meant to be a forum for "experts" to talk among themselves, though experts who wish to contribute are certainly welcome. Instead, this site is dedicated to volunteers: the members of a community who give their time and effort to serve on committees, support community government, and organize at a grassroots level. By providing community members with information in a clear, easy-to-use format, i hope to make this information available to a much broader spectrum of people than would otherwise be possible.

**SOME LITATURAL ABOUT SUSTAINABLE INDICATORS**

**Literature review on sustainability indicators**

**EPI (2010)**

Two broad environmental protection objectives: (1) reducing environmental stresses on human health, and (2) promoting ecosystem vitality and sound natural resource management. These are gauged using 25 indicators tracked in 10 policy categories:

- Environmental Health
- Air Pollution (effects on humans)
- Water (effects on humans)
- Air Pollution (effects on ecosystems)
- Water (effects on ecosystems)
- Biodiversity and Habitat
- Forestry
- Fisheries
- Agriculture

European Regional Science Association (2002)

Sustainable development is viewed as comprising the environmental, socio-cultural and economic dimension. About thirty-five key indicators have been defined to measure the three dimensions of sustainability, such as air pollution, consumption of natural resources, quality of open space, population exposure to air pollution and noise, equity and opportunities and economic benefits from transport and land use.

Zhu et.al. (2009)

Soil environmental quality is the capacity of a soil to function, within ecosystem and land use boundaries, to sustain biological productivity, maintain environmental quality, and promote plant, animal and human health. In the long-term, vegetative rehabilitation of mining wastes aims at, as far as possible, the proper ecological integration of the reclaimed area into the surrounding landscape, which is sustainable and requires minimal maintenance. Two indicator-based system of soil environmental quality that evaluates sustainable rehabilitation of mine waste through a set of two sub indicators, chemical fertility and stocks of organic matter, and further combines them into a single general Indicator of Soil Quality .

**DiSano (1987)**

Indicators can provide crucial guidance for decision-making in a variety of ways. They can translate physical and social science knowledge into manageable units of information that can facilitate the decision-making process. They can help to measure and calibrate progress towards sustainable development goals. They can provide an early warning, sounding the alarm in time to prevent economic, social and environmental damage. They are also important tools to communicate ideas, thoughts and values because as one authority said, The 1992 Earth Summit recognized the important role that indicators can play in helping countries to make informed decisions concerning sustainable development. This recognition is articulated in Chapter 40 of Agenda 21 which calls on countries at the national level, as well as international, Indicators can provide means of measurement to calibrate and monitor sustainable development . In earth summit (1992) recognized the role sustainability indicators in decision making in matters related to sustainability development across the countries/

**Mori Koichiro and Christodoulou Aris (2011)**

They has discussed conceptual requirements for a City Sustainability Index (CSI) and to review existing major sustainability indices/indicators in terms of the requirements. The following indices are reviewed: Ecological Footprint (EF), Environmental Sustainability Index (ESI), Dashboard of Sustainability (DS), Welfare Index, Genuine Progress Indicator (GPI), Index of Sustainable Economic Welfare, City Development Index, Human Development Index (HDI), Environmental Vulnerability Index (EVI), Environmental Policy Index (EPI), Living Planet Index (LPI), Environmentally-adjusted Domestic Product (EDP), Genuine Saving (GS), and some applications of composite indices or/and multivariate indicators to local or regional context as
case studies.

**László Pintér et.al. (2005)**

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international, governmental and non-governmental organizations to develop and identify indicators of sustainable development that can provide a solid basis for decision- making at all levels.

**Yale Center (2010)**

The Environmental Sustainability Index (ESI) benchmarks the ability of nations to protectthe environment over the next several decades.It does so byintegrating 76 data sets – trackingnatural resource endowments, past and present pollution levels, environmental managementefforts, and the capacity of a societyto improve its environmental performance –into 21 indicators of environmental sustainability.These indicators permit comparison across a range of issues that fall into the following
five broad categories:

- Environmental Systems
- Reducing Environmental Stresses
- Reducing Human Vulnerability to Environmental Stresses
- Societal and Institutional Capacity to Respond to Environmental Challenges
- Global Stewardship

**Chamaret et.al. (2007)**

Minerals extraction is related to complex sustainable development issues that are subject to international and local controversies. Debates must be based on objective and comparative elements. Defining strong indicators for assessing impacts and performances of mining sites thus appears necessary to inform and support the decision-making process for stakeholders. Recently, many indicator sets have been developed on an international level based on top-down approaches, but they commonly lack le-intimacy for stakeholders and adequacy to specific site issues. They thus need to be complemented by the consultation of local actors concerned by such mining activity, in order to de-fine indicators that are closer to the needs and contexts of the specific sites.

Hammond (1995)

Indicators can be used for many purposes at many levels—community, sectoral, national, or international.

**WRI report(1995)**

In 1990, WRI published the first estimates of greenhouse gas emissions for all major countries. The estimates were presented as an aggregated greenhouse index.It allowed users to compare national emissions.

**(Graymore et al: 2008).** Grouped Indicators into dimensions based on the regional sustainability model. For each dimension, the indicators chosen assess equity, population and major pressures human activities have on carrying capacity. Each indicator was required to: 1) have data available; 2) be relevant to sustainability and the dimension it was to be used; 3) reliably measure pressure against sustainability thresholds; and 4) have a known sustainability threshold, target or similar to enable the development of a sustainability scale for standardization of data. The indicators chosen measured the largest impacts on carrying capacity, so the indicator should be small and manageable.set could be small and manageable, as other studies have shown that more indicators do not necessarily give a better assessment.

**(Gustavson et al., 1999; Richards et al: 2007).**Standardizing indicator data to a common unit enables comparisons and aggregations of indicator data. For SHCC, for the standardization of indicator data, a sustainability ranking scale was developed ,similar to that used in the Wellbeing Assessment. The scale was based on literature and expert opinion on sustainability

thresholds/targets thought to be applicable worldwide. However, when SHCC is used, the first step should include a review of the scales to ensure new information hasn't changed the understanding of what is sustainable for the indicator and that they are applicable to the region. The use of known or assumed sustainability thresholds or targets for the sustainability ranking allows for an assessment based on the best science available. A four-point scale was used so that indicator data can be ranked without the need for calculations. Individual indicator ranks
can be aggregated to produce ranks for each dimension, as well as an overall rank. This aggregation provides information about regional audiences, from regional managers and professionals to the wider community.

**(Shawn Morford-aug:07** During the late 1990s, researchers published a framework for social indicators based on the "human ecosystem" or resiliency framework (Machlis et al. 1997; Force andMachlis 1997). Based on the theory that humans exist within social systems, not unlike how plants exist in ecosystems, this framework assumes that human systems require three critical resources: natural resources, socio-economic resources, and cultural resources. These are accompanied by three subsystems: social institutions, social cycles, and social order.
**Marchack (1983),** and later, Lee and Eckert (2002) represent some of the foundational work on the social conditions and impacts of single industry towns. They observed issues such as alcoholism, gender discrimination, and human capital that were associated with instability in resource-base towns. The work of these authors was instrumental in broadening an understanding of social and economic impacts in land-based programs.
**(Shawn Morford-aug:07)** The use of social indicators has a long history in many fields beginning in themiddle of the last century. The use of social theory to guide the development of
indicators has gradually matured since the 1970s. The Journal of Social Indicators Research has chronicled social indicator research since its inception in 1974 and includes an increasing number of articles that report on theories of indicators for various constructs. However, much of the work on social indicators relates to government social intervention programs (such as welfare reduction programs)rather than land use.
**(Depaizza, Andrea:2007)** *This paper proposes first attempt for the development of a statistical tool where basic measures and/or tests (i.e.individual indicators) are organised and grouped in composite indices addressing different dimensions within RIA.*
*The latter can be variously combined, resulting organized and synthesized indicators, preserving the components' constituent elements. Due to current limitations of data and in information availability, weights for aggregation are left undetermined in practice; the same reason impacts on selection of elementary indicators and the shape of composites, indicators are impossible to determined at operational stage.* Extensive usage of RIA in support of evidence-based (or at least informed)policymaking is still limited to a few, mostly English speaking/common law based countries. However, this situation is likely to change in the near future, in view of the diffusion of the culture of governance and better regulation. This, favored by the Oecd and the World Bank, in the last decade resulted in the adoption of RIA principles by a swiftly growing number of advanced economies and by some LDCs as well.
. **.(Depaizza, Andrea:2007)a.** A reasonable first step in designing an indicator (even more so a system of indicators)a.is to know what we want to track, and ask ourselves whether what we have at hand – duly arranged and put in shape – can do the job, and which additional pieces of information we might need. b.In the case of the overall quality of RIA systems the concept is too wide to catch it easily (though still partially) by a single measure, maybe complex to compute, like
GDP does for wealth. Hence, as the quality of RIA encompasses different dimensions, c.At the end, conceptual framework for analysing RIA systems based on common (chrono) logical macro-phases, identifying the three moments of *input*, *outputs* and *outcomes* or, borrowing from an other area of

research, distinguish amongst RIA *readiness*, *usage* and *impact*,3 a quasi equivalent taxonomy, which allows adding to the former also an intermediate step of *process*. It is worth noting that this is only one way *political stability and absence of violence, government effectiveness, regulatory quality, rule of law, andcontrol of corruption*.

.( **.M. Saisana and A. Saltelli)**
Composite indicators aggregate multi-dimensional processes into simplified concepts often aiming at underpinning the development of data-drivennarratives for policy consumption, thus Composite indicators enter into public debate once signals of society's performance in complex fields, such as economy, environment or technological achievement are sought.
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**(Nardo *et al.*, 2005)**In the OECD-JRC Handbook on Composite Indicators offers a review and guidelines on constructing such aggregate measures of countries performance. A recent compilation of existing composite indicators lists over 130 such measures from the fields of economy, society, environment, globalization, and technology (Bandura, 2005) and an informationserver on the topic is available at a European Commission site (EC-JRC, 2007).

**.(Munda, 2004)**In mathematical terms, a composite indicator score (or rank) is a function of indicators and weights. Weights may represent the relative importance of each indicator or be implied by the data. The function may involve linear or geometric averaging or use of outscoring matrix in a multi-criteria setting.

**( Andrew Sharpe) (2004**) summarizes: "The aggregators believe there are two major reasons that there is value in combining indicators in some manner to produce a bottom line. They believe that such a summary statistic can indeed capture reality and is meaningful, and that stressing the bottom line is extremely useful in garnering media interest and hence the attention of policy makers.

**Rosen (1991)** noted that while a causality entailment structure defines the natural system, and a formal causality system entails the formal system, no rule was ever agreed on how to move from perceived reality to a model. In fact, a model will describe some features of the real system but also scientists' choices on how to observe the reality. When building a model or a composite indicator to describe a real-world phenomenon, formal coherence is a necessary but not sufficient property. The choices during the development phase of the composite indicator (e.g. choice of indicators, normalization method, set of weights, aggregation method) will stem from a certain perspective on the issue to be modeled. Reflexivity is thus inherent in a model since the observer and the observation are not separated and the way the human mind approaches the problem is
part of the problem itself.

**Funtowicz and Ravetz,1990).**The development of a composite indicator is not straightforward, but it involves theoretical and methodological assumptions that need to be assessed carefully toavoid producing results of dubious analytic rigour (Saisana *et al.*, 2005).Furthermore, the fact that a composite indicator is likely to be received by a polarizedaudience calls for stringent standards of rigour and robustness (Saltelli, 2006). Tomaximize their utility and minimize their misuse, composite indicators need to bedeveloped using the best available evidence, documented transparently, and validatedusing appropriate uncertainty and sensitivity analyses.

**(Gilpin, 1996)** Indicators have been defined in a number of different ways: the Dictionary ofEnvironment andSustainable Development defines an indicator as:*"a substance or organism usedas a measure of air or water quality, orbiological or ecological well-being."*

**(.The ISO 14000 -ISO, 1999)** series defines an environmental indicator as:*"a specific expression that provides information about an organisation'senvironmental performance, efforts to influence that performance, or thecondition of the environment."*

**.(The OECD :1993)** provides another useful definition of an indicator as:*"a parameter or a value derived from parameters, which providesinformation about a phenomenon. The indicator has significance thatextends beyond the properties directly associated with the parametervalues. Indicators possess a synthetic meaning and are developed for aspecific purpose."*

**(Nadine Ancrien, Marc pirawx etall)** Their study based on the north-eastern semi-arid area of Brazil, because of climatic and economic risks, production systems use limited amounts of inputs and instead exploit accumulated fertility. The substitution of the woody native vegetation by pastures has led to its almost total deforestation. The environmental and socio-economic viability of these systems is thus questionable. Consequently, a team made up of researchers from Semi-Arid Embrapa and Cirad centres tested a methodology to design sustainability indicators. In this paper, They first present some methods used to design indicators of the sustainability of production systems; secondly we describe the approach used which consisted in defining a conceptual framework based on the characterization of the biomass flows within a farm, that enabled us to simultaneously analyze the production systems as a whole; and assess the state of resources:
For **the design of sustainability indicators they consider following thing**
* the definition of a conceptual framework based on a flow-oriented approach that enable to design sustainability indicators.

* the characterization of the biomass flows that exist within the farms of the target
of the diagnosis in order to specify this framework and extract relevant indicators

* the validation of the indicators selected comparing them with those used by the
farmers.(indi)
**.(Camacho-Sandoval and Duque,2001; Nambiar et al., 2001).** IdentfiedFour main selection criteria
for indicators are mentioned: facility of analysis; ease of use for decision making ability to reflect the transformations of the environment and the effect of the practices; and validity at several scales of analysis These indicators arise mainly from the three `pillars' of sustainability: ecology, society, economy. In other words, the performances of the farms are evaluated according to a broader concept of economic effectiveness, minimal ecological costs and participation in local dynamics. Based on these three
pillars, different authors have proposed different frameworks to analyse the performance of production systems.

**.( Landais :1998**) identified four main components of systems performances: viability, which depends on the technical and economic performances of the system and on the security of the market and prices; viability, which reflects the farmer's quality of life; transmissibility, which is related to the possibility of succession; and finally, reproducibility, like Design of sustainability indicators in Brazilian semi-arid area

**.(Aurelie chamaret,etall)** Mineral extraction is related to complex sustainable-development issues that are subject to international and local controversies. Debates and decisions need to be based on objective and comparative elements. Defining strong indicators for assessing impacts and performances of mining sites thus appears necessary to inform and support the decision-making process of stakeholders. In recent years, many indicator sets have been developed on an international level based on top-down approaches, but they commonly lack legitimacy for stakeholders and adequacy to specific site issues. They need to be complemented by the consultation of local actors concerned by such mining activity, in order to define indicators that are closear to the needs and contexts of the specific sites. This is the goal of the work reported in this paper, undertaken at the Arlit uranium mines in Niger.

**. (Helen Rey-Valette,Francis Laloe etall-2007)**they viewed that Initially, indicators are especially designed per sustainable development pillar(environmental, economic, social, and then institutional pillars), based on a relatively exhaustive approach. Nowadays, interactions occurring between pillars are favored by considering key issues, thus enabling the values and priorities of relevant populations to be taken into account. At the same time, it should be noted that lists are to be reduced. The question of providing an optimal list of indicators is widely discussed and appears as a kind of scientific mirage. There is a need for short lists(comprising `seven plus or minus two' indicators, see P-M. Boulanger this issue) so that they are appropriate and usable as well as stable over time. LaloeÈ (in this issue)suggests that there is no need for a list necessarily including all the relevant
indicators; this list may be considered as a basis useful for calculating these indicators 'on request'. The dimension of this database is determined by the dimension of the representation of the system for which durability is to be determined. This type of distinction between indicators and `databases of indicator' is also observed during the implementation of the MONET indicator system (de Montmollin and Scheller, in
this issue); these authors define three separate objectives: `Establishing the frame of reference, developing the systemic structure and selecting the sustainable development indicators'. This distinction can also be noted in Le Fur's paper (in this issue) when he defines `a common information platform used as an effective basis for a multiparty exchange.

**( Zittoun(2006),** Provided a tool which is useful for contributing `to resource reallocation as well as to
the reassignment of power and governing practices'. According to this author, `not only indicators have the faculty to measure a problem but they also build it as much as they are built by the problem itself'. This refers to observed constraints from the 'division of labour' mentioned by DesrosieÁres (2004): `some objectives are negotiated(by politicians), and expressed by means of words denoting indicators. Then, the
latter are transcribed using negotiated procedures (by statisticians) in aim of harmoniously quantifying these indicator. These procedures are as similar as possible in the various countries'. This distinction between political and technical issues requires `the creation and implementation of hybrid forums where these evaluation methods may themselves be assessed' (DesrosieÁ res, 2004), such hybrid forums are
also considered by Callon et al. (2001). In fact, the author (DesrosieÁ res, 2003) further mentions the difficulties associated with the assumed lack of need for connecting information production issues and issues generating information demand: `these two stories, concerning economic policies and statistics, respectively, are rarely presented, and above all, investigated simultaneously'. Implementing this connection may be one of the needs explaining the importance given to the

indicator issue . . .Introduction to the key issue of using sustainable development indicators 7These reflections about the social role played by indicators lead to considering indicators as a tool for government policies, which is necessarily related to the development of these policies. Initially, indicator supply is `taken over' by the government and the great supranational institutions: indicators are a government attribute and a way for expressing its power, as well as being a management tool for its policies.

**.(Laszlo pinter,Peter Hardi-Dec2005)** Their paper was prepared for the United Nations Division for Sustainable Development
(UNDSD) expert meeting (New York, 13-15 December 2005) on sustainable development indicators (SDIs). The paper provides a review of key achievements and emerging trends in the field of SDIs, reflects on the role of the indicator system developed by the United Nations Commission for Sustainable Development (UNCSD)and offers a set of options and suggestions for the way forward. As strategic policy tools, SDIs have the potential to turn the general concept of sustainability into action. Today, however, we are far from achieving this potential.
Among *emerging trends,* the paper highlights:
• Continuing interest in the development of aggregate indices;
• Interest in core sets of 'headline indicators';
• Emergence of goal-oriented indicators;
• Measurement of sustainability by capital ('green') accounting systems; and
• Emphasis on making better use of indicators in performance measurement.
Given the need for global level cooperative action on many sustainable development
(SD) issues, agreement on a framework, goals and indicators would be helpful.

**(*UN 2002).***The mandate was further confirmed by the Johannesburg Plan of Implementation (JPOI).
Specifically, the JPOI called for:
*"…further work on indicators of sustainable development by countries at the national level, including integration of gender aspects, on a voluntary basis, in line with national conditions and priorities"*

**(. CSD on 11-12 April 2005 )**Most recently, the report of the 13th session of the also pointed to the need for continuing work on SDIs on the national level. The report called on:
*"Member States to continue to work on the development and application of indicators for sustainable development at the national level, including integration of gender aspects, on a voluntary basis, in line with their national conditions and priorities, and in this regard invites the international community to support the efforts of developing countries"(UN 2005a).*

**(Laszlo pinterandPeter Hardi-Dec 2005)**In the view of the authors, other international legal mechanisms, such as the Aarhus
Convention may play a catalytic role, because of their influence on the enabling conditions required for the development and effective use of indicators (UNECE 1998). The Aarhus Convention itself is open to accession by countries outside of the Economic Commission for Europe (ECE), subject to approval of the Meeting of the Parties, so its applicability goes beyond ECE members and the regional level. Its combined emphasis on strengthening access to information and facilitating public participation is directly applicable to the systematic development and use of SDIs as key information tools.

Parallel to, though not necessarily derived from international commitments, there are other examples of national and sub-national legislation requiring the establishment and reporting of SDIs.

The SDI agenda was accompanied and directly or indirectly influenced by several other global trends that we have seen unfold in the last decade. Among these trends, the following were particularly relevant—for different reasons—for SDIs:

• undisputable evidence of the growing cost, but also some benefits of globalization on environmental and social conditions, at national and international levels;
• improved understanding of the interactions between ecosystems and human wellbeing, particularly poverty;
• increasing number of state of the environment (SOE) and integrated assessments, reports, multilateral environmental agreements (MEAs) and use of economic and other instruments for environmental policy, all of which require a quantitative evidence base;
• rapid development of information and communication technologies (ICTs), including the Internet and geographic information systems (GIS), with many countries still left, though, on the wrong side of the digital divide; and
• increasing emphasis on strategic initiatives, including national strategies for sustainable development (NSDS) and the Millennium Development Goals (MDGs) that involve time-bound targets and require systematic monitoring of progress.

**.(Pintér 1998; Parris and Kates 2005).** SD could be interpreted to mean the maintenance of aggregate stocks, inventories or qualities of economic, social, ecological or institutional assets overtime. However, operationally, this works only if we have information on these stocks, inventories and qualities, their substitutability and safe limits to their depletion. Indicators can provide this information, and thus they were often used to collectively define key aspects of sustainability in specific contexts (During the last 10 years we have seen a remarkable expansion of interest in SDI systems, both in industrialized and, albeit to a lesser extent, in developing countries. SDIs are seen as useful in a wide range of settings, by a wide range of actors: international and intergovernmental bodies; national governments and government departments; economic sectors; administrators of geographic or ecological regions; communities; nongovernmental organizations; and the private sector. SDI processes are underpinned and driven by the increasing need for improved quality and regularly produced information with better spatial and temporal resolution.

. **Indicator Zoo –** assumes the continuation of currently dominant SDI practices into the future:

o weak global coordination;
o diverse set of institutional arrangements;
o diverse, even if sometimes comparable frameworks;
o diverse, but contextually appropriate indicator sets
o SDIs and underlying statistical and information systems develop on parallel tracks, with incidental cross-referencing and limited coordination;
o distributed and weakly coordinated data collection system; and
o no systematic linkage to global or national scale country-specific policy targets.

- **Global Coordination** – assumes stronger coordination mechanisms without a major overhaul of the existing approaches:

o stronger role for global organizations in promoting the harmonization of

common frameworks, methods and ultimately indicators;
o promoting the integration of national SDI frameworks with underlying statistical and information systems;
o direct coordination with some global reporting systems, like EPI, MDG indicators, GEO, etc.;
o distributed, but coordinated data collection and reporting;
o no common data platform; and
o linkage to some existing global and national targets.

arrangements between key actors involved in SDIs:
o strong global coordination and capacity building;
o strong national champions and commitment, including resources;
o distributed, but well-coordinated statistical data collection systems,
o common global data sharing platform; and
o effort to identify and link SDIs to targets wherever possible throughout the entire spectrum of SDIs.
- **Synergy World** – assuming that key actors of SD are willing to compromise, and there is political appetite for connecting SDIs with other policy mechanisms:
o accept globally relevant components of the MDGIs, but complement them with SDIs from the existing CSD set or new indicators that capture dimensions where the MDGIs are weakest, particularly in the area of Earth support system and ecosystem services;
o better quantification of poverty-environment links;
o add a long-term sustainability perspective to existing non-environmental MDG indicators;
o develop a direct interface with statistical monitoring and data sharing platforms; and
o embrace an evolutionary learning approach and promote integration with NSDS.

**Steinemann (2000, p.640)** defines a holistic approach as one which facilitates "moving away from analyses of isolated risks and toward a broader understanding". Most of the efforts made towards developing such approaches have come from the application of Health Impact Assessment or Social Impact Assessment, precisely because the reductionist approach requires existing knowledge and understanding amongst affected communities which is often lacking (see, for example **,Arquette et al., 2002; Kemm, 2000; Mindell et al., 2001).** Both **Bell andMorse (2008) and Lawrence (1997)** call for a more systems-based approach in order to implement holistic assessment, and this requires process where communities are systematically involved in defining visions ofsustainability and also the means to achieve the vision.There are different degrees of reductionism whereby complex systems are reduced to ever fewer measures, with the extreme being a single value (e.g., **Barrera-Roldán and Saldívar-Valdés, 2002**; **O'Reganet al., 2009)**. Advice in both England (**Office of the Deputy PrimeMinister, 2005**) and Western Australia (**Government of Western Australia, 2003**) suggests that a number of disaggregated indicators should be used; whilst not reductionism to the extreme of using single indices, this is still a form of reductionism. In England, an Institute of Environmental Management and Assessment forum on SEA met in2 A.J. Bond, A. Morrison-Saunders / Environmental Impact Assessment Review 31 (2011) 1–7,2006 to review progress with the Government advice and concluded that too many objectives (each associated with a number of indicators) were being set

**UN working list of indicator**

A framework of indicators

| Sustainability Dimension | Indicator | Remarks |
|---|---|---|
| Social | a) Percentage of population living below poverty<br>b) Gini's index for income inequlity<br>c) Unemployment Rate<br>d) Ratio of Average Female Wage to Male Wage<br>e) Poverty gap index<br>f) Net migration rate due to mine opening<br>g) Number of persons trained by total population between 20 – 30 years<br>h) Total budget for building social capital / Total budget allocated for mine rehabilitation | A separate study may be conducted along with SIA from consumption pattern of the respondents<br>Separate data for the study are is not available<br>Not available |
| Health | a) Mortality rate below 5 years<br>b) Life expectancy at birth<br>c) Percentage of population with free access to primary health care center<br>d) Number of doctors per ten thousand population | Not available with respect to the study area |
| Education | a) Primary school enrollment rate<br>b) Secondary school enrollment rate<br>c) Adult literacy rate<br>d) School drop out rate<br>e) Percentage of tax collected from the mining companies spent on primary , secondary education with breakup<br>f) Distance of college from villages<br>g) Total budget for building human capital / Total budget allocated for mine rehabilitation | |
| Infrastructure | a) Infrastructure expense per capita<br>b) Percentage of tax collected from the mining companies spent on infrastructure development<br>c) Percentage of population with access with adequate sewage facility<br>d) Percentage of population with access to safe drinking water<br>e) Floor area per capita | |
| Ground Water | a) Annual Withdrawal of Ground and Surface Water as a Percent of Total Available Water<br>b) Concentration of Faecal Coliform in Freshwater<br>c) Domestic consumption of potable water per capita<br>d) Domestic consumption of water for daily per | |

| | | |
|---|---|---|
| | capita<br>e) Biochemical oxygen demand in water bodies<br>f) Number of months water bodies (pond, well and tube well ) run dry<br>g) Size of recharge lagoon created for recharge of aquifer<br>h) Extent of ground water aquifer recharged by rainwater harvesting ( based on scientific study )[1]<br>i) Annual water drawn in dry seasons from rain water harvesting facilities created near a mine site<br>j) Quantity of surface runoff stored/ Total surface runoff from mined watershed | |
| Agriculture | a) Total agriculture land / Total land available<br>b) Total agriculture land covered by irrigation / Total agricultural land<br>c) Total agricultural land supporting multiple crops / Total land supporting single crop<br>d) Total agricultural land with chemical fertilizer application/ total agricultural land<br>e) Total agricultural land with natural fertilizer / total agricultural land<br>f) Agriculture yield / hectare | |
| Environment | a) Ecological footprint / active mining zone<br>b) Dump area rehabilitated naturally/ Dump area rehabilitated by scientific technical and biological reclamation techniques<br>c) Excavation area / area backfilled<br>d) Excavation area / area backfilled and agriculture established<br>e) Backfilled area brought to some land use in consultation with stakeholders / Total backfilled area<br>f) Area used for water storage / Excavation area<br>g) Ratio of number of native species used for afforestation / Number of exotic species used for plantation<br>h) Overall survival rate of planted trees<br>i) Total budget for building natural capital / Total budget allocated for mine rehabilitation<br>j) 95 th percentile value of environmental parameters / Standard values either stipulated by government or expert knowledge<br>k) Mean value of environmental parameters | |

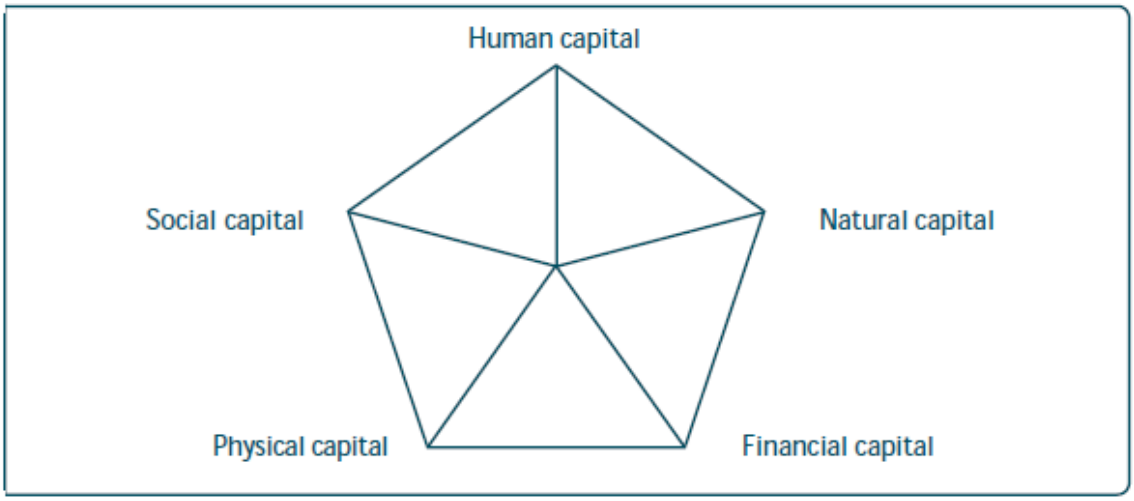
| | | |
|---|---|---|
| | / Standard values either stipulated by government or expert knowledge<br>l) Ratio of water flow in the surface nallahs / (mine water pumped + surface flow due to rainfall )<br>m) Ratio of air quality at the working zone and outside the green belt area. | |
| Community development | a) Total villagers trained/ Number of adults in the village<br>b) Number of SHG functioning in the area<br>c) Number of loans provided by bank for SHG and entrepreneurship development | |

A comprehensive set of indicators are provided in Table. These indicators cover a wide range of indicators on livelihood assets. The indicators developed, so farm, mostly focuses on macro level performances of different countries to ensure sustainability. Conceptual frameworks for sustainability indicators are developed by various research agencies. of different countries as EPA , USA, MMSD , ICUMN OECD but they prepare the indicators in the macro economic concept . So it is very difficult to set up sustainable in dictators for specific region by perception of local people and other stake holder analysis as villagers needs priority surroundings the mine areas are very difficult to determined as they can not identify their need priority clearly due to their lack of education ,They also not identify social effects from mines. So it is difficult to prescribe the certain indicators which help them long term sustainability. so we consider

***Integration of sustainable livelihood strategy in sustainable indicator development framework***

In the discussions made so far no definite trend has emerged about perception of socio economic and environmental vulnerabilities of mine closure. Therefore, at this stage it is difficult to make any policy suggestions

A holistic approach integrating the need of the stakeholders with sustainable livelihood strategy analysis can be a possible approach to resolve the problems of mining sustainable issues on a long term basis. The core to livelihood analysis is integrating the strength of the villagers alongwith their need perception under vulnerable situation arising out of mine closure. Policies and development initiatives shall aim at transferring some profit earned by the mining companies to livelihood assets. . The villagers shall be made aware of these assets , which are their strengths Livelihood assets are human capital , natural capital , social capital , financial and physical capital. Investments on these livelihood assets are based on the need perception of the villagers that are available through village level surveys . The local intuitional capacity may be examined and policies to build their capacities may be implemented so that at local level they are able to build theses assets. In vulnerable condition like mine closure the people will then be able to use livelihood assets to make shifts in their means of livelihood . Thus they will more resilient to face the challenges of mine closure.




Asset pentagon, shown above, is a dynamic concept. At the time of survey the asset pentagon was narrow . This means that livelihood assets to the mining community is low . The analysis made so points out that the social capital is very low. . that is , edge of the pentagon pointing to social capital is narrow. The villagers being in an improvised state could not foresee the vulnerability context of mine closure. As livelihood assets are developed the pentagon assets enlarges and people are empowered . They can be also brought under a community development programme ( Annexure )

Perquisite to development of a strategic framework is Social impact assessment of the area ( Annexure). The following steps are adopted to assess the livelihood assests of a community.

**Identification of stakeholders**

A). Primary stakeholder

a) Aboriginal people ( local villagers)
b) Local contractors
c) People employed in service sectors e.g. shops , restaurant etc
d) Panchyat representatives from a village
e) Mine owners / Mine officials
f) Resettled villagers
g) Land losers

B). . Secondary stakeholder

a) Local and national government
b) NGO
c) Policy makers
d) A mine during it's life cycle brings forth several sustainability issues. Since inception of a mine there is a shift in traditional means of earning to mining jobs . As the mine closes down vulnerable section of the mining community loses their livelihood and do not have enough resilience to face the shocks of mine closure. This thesis adopts a case study approach to elucidate the major issues of environmental, social sustainability. In consultation suitable indicators are developed

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