

Review Article

Sustainable livelihoods and indicators for regional development in mining economies

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ABSTRACT

In recent years, there has been growing interest in identifying robust indicators which demonstrate the links between mining and development. This builds on an extensive body of work in the broad field of rural development, and aims to capture the extent to which mining is contributing to changes in economic, socio-cultural, health, political and environmental conditions. While these indicators are contested on both conceptual and methodological grounds, we argue in this paper that the sustainable livelihoods (SL) framework might offer a more robust means of understanding the interplay between mining and development. The paper traces the emergence of this framework and considers how it might be situated in the context of existing 'resource studies' literature, before proposing methodological and conceptual alternatives for understanding the links between mining and development.

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1. Introduction

Over the past two decades or so, an influx of foreign investment has facilitated unprecedented increases in mineral production throughout sub-Saharan Africa, Asia and Latin America (Hilson and Banchirigah, 2009). Primary examples include: the marked increase in copper production in Zambia; the sharp increases in gold and bauxite mine production witness in Ghana since the mid-1980s; and the rapid expansion of gold mining in Peru (Aryee, 2001; Bury, 2004; Ruffini, 2006). More recently, Rwanda's mineral industry has been producing gold ores and concentrates of columbium, tantalum, tin and tungsten for export (Yager, 2003), and Indonesia's coal output has increased rapidly (Amijaya and Littke, 2005). However, the development outcomes achieved by foreign investment in extractive industries in developing countries continue to be a matter of debate (Emel and Huber, 2008, p. 1393; Blowfield and Frynas, 2005). The negative effects that oil, gas, and mineral dependence have on long-term economic stability, social welfare and the environment has been the subject of considerable attention in the academic literature (Pegg, 2006; Atkinson and Hamilton, 2003; Gylfason, 2001; Sachs and Warner, 1995; Auty, 1993; Gelb, 1988; Nankani, 1979). But more recent empirical studies have pointed to more positive relationships between natural resource abundance, and economic growth and welfare (Sarmidi et al., 2013; Boyce and Emery, 2011; Aubynn, 2009; Brunnschweiler, 2008; Aroca, 2001).

These debates sit in parallel with two important changes in the global development landscape. The first is a significant paradigm shift beyond narrow economic definitions of development. The second and related change is an emerging recognition from within the mining industry of its need to demonstrate responsible social and environmental practice in their operational contexts. Inherent within Corporate Social Responsibility (CSR) and community development strategies is the requirement to produce evidence with regard to the various development impacts of mining at multiple spatial scales.

However, in the absence of a consistent approach to the selection of indicators based on clearly defined and conceptually robust notions of 'development', it is difficult to determine to what extent inconsistencies in conclusions about the effects of mining on developing countries are due to variations in objects and methods of 'measurement', and which represent substantive differences in development trajectories. Further, many of the 'conventional wisdoms' regarding the relationship between resource extraction and development, both positive and negative perspectives, are based on assumptions that have not always been subject to sufficient empirical testing.

There is also little recognition of the cumulative long-term implications of mining on regional development that take account of what might be referred to as 'second round' impacts – that is, the broader impacts of mining on local economies, social systems, services and infrastructure, and institutions. A major challenge, of course, is that reliable indicators of development are often limited by the availability and cost of collecting and analysing data. Thus, there is a pressing need to address the conceptual, methodological and practical constraints around understanding the impact of mining on development.

In this paper, we employ the sustainable livelihoods (SL) framework to evaluate existing evidence and identify knowledge gaps regarding the relationship between mining and the five 'capitals' posited as critical apparatuses of development within the SL approach. We begin by tracing the emergence of the SL approach as a framework for making sense of and measuring development. We then synthesise the major positive and negative impacts of mining as identified by key studies and examples in the literature, categorising them under each of the five capitals. In so doing, we

advance three central observations with regard to the existing literature. First, most of the existing analyses of mining and development in developing countries are undertaken predominantly at the national scale, particularly with respect to works focusing on the 'resource curse'. There is very little evidence regarding possible sub-national outcome differentials, or the local and regional effects of mining. Second, there is a range of contradictory narratives regarding the relationship between mining and development in relation to each of the five capital domains. The existing research evidence does not support simplistic casual assertions and assumptions about the role of mining in developing world contexts. Finally, the question of who defines 'development' opens up an important emerging space of scholarly inquiry with regard to mining in developing countries. After drawing out the implications of these observations, we conclude by proposing methodological and conceptual advances to building a more robust and comparative evidence base with regard to mining and development at local and regional scales in developing world contexts.

While the focus of this article is on the 'five capitals' in the SL framework, we acknowledge that other elements of the framework, including the vulnerability context, transforming processes and structures, livelihood strategies and outcomes are each worth further attention in the mining context in their own regard. However, as the central pivot of the framework, it is anticipated that applied research on the five capitals in any particular context would necessarily take into account how each are impacted by and impact upon these other elements of the SL approach. We also acknowledge that since the 1990s – when the SL framework first emerged and came into prominence – there has been a proliferation of alternative views of development studies and practice, one of which is post-development critique. In this context, a number of critiques of the SL framework have emerged, and donor and development agencies that initially embraced the approach no longer consider it to be their primary emphasis.

However, we argue that the critiques of the SL framework to date do not preclude a useful engagement of the framework in the resource context for several reasons, as we will elaborate further in this paper. These include (i) the SL framework may be alternatively construed as a set of principles, an analytical framework, and a development objective and is thereby flexible enough to be combined with other constructs and paradigms; (ii) the evidence-based approach of the SL framework could be put to good use in testing the array of theoretical assumptions about the positive and negative impacts of mining; (iii) the ability of the SL framework to focus in at the micro level is a strength that may further enhance analysis of the impacts of the mining sector on development which has tended to focus at the macro level; (iv) the SL framework can be used not only to organise information, but also to help its users to restructure information and knowledge from multiple perspectives – another missing thread in resource literature; and (v) the emphasis on participatory methods promoted by the SL framework may also contribute to better decisions in both public policy and private investment sectors of resource economies.

Building on our use of the SL framework to understand how impacts of mining may be perceived negatively and positively depending on their tendency to enhance or deplete one of more of the 'five capitals' at various scales, this paper also aims to demonstrate that the utility of the SL framework extends beyond its genesis as a simplistic generic framework which dominated applied development during the 1990s. Its simplicity, flexibility, potential for application at macro and micro scales, evidenced-based, people-centred, and participatory methodology makes it a 'good fit' for developing a coherent conceptual and practical framework for selecting indicators to concretely measure the interaction between mining and development at various scales.

2. Measuring development and the genesis of the sustainable livelihoods (SL) framework

Since the early 1990s, there has been a burgeoning literature on assessment frameworks and indicators for measuring 'development' (Parris and Kates, 2003). This literature emerged in large part as a result of a departure from classical modernisation theories of development. The theory was simple: economic growth leads to more income for people, which in turn reduces poverty and improves standards of living (Morse, 2013). Accordingly, up until the late 1960s, development was measured largely in terms of income per member of the population (Morse, 2013). In the 1970s and 1980s, priorities and prescriptions for development broadened considerably (Morse, 2013; Chambers and Conway, 1992), and was transformed radically by Amartya Sen's groundbreaking work on human capabilities, which inferred a much broader and more contextually defined suite of variables influencing development outcomes (Sen, 1984). In 1990, the UNDP launched the first annual Human Development Report (HDR), which promoted a comprehensive vision of a people-focused strategy as an alternative to neoliberal analysis and policy. In addition to presenting a new paradigm for sustainable economic and social development, successive reports expounded the approach in relation to key areas: inequality, public finance, participation, gender, economic growth, globalisation, technology, culture, human rights, and other domains (Morse, 2013). Despite ongoing definitional ambiguities, well over 500 efforts, initially in the form of indices created by bodies such as the United Nations Commission on Sustainable Development, have since been devoted to developing quantitative indicators to measure 'sustainability' (Parris and Kates, 2003). The trend to expand the range of indicators to measure 'development' gained further momentum in September 2000, when leaders from 189 nations agreed on a vision for a world in which developed and developing countries worked in partnership for the betterment of all. This vision took the shape of eight Millennium Development Goals (MDG), which provided a framework of time-bound targets by which progress would be measured.

Traditionally, the literature on sustainability indicators falls into two broad methodological paradigms: expert-led and top-down; and community-based and bottom-up (Bell and Morse, 2001; Reed et al., 2006; Fraser et al., 2006). Expert-led approaches predominantly use quantitative indicators drawn from a range of social and other sciences. Proponents acknowledge the need for indicators to quantify the complexities of dynamic systems, but approaches do not necessarily emphasise the complex variety of resource-user perspectives (Reed et al., 2006). The second paradigm is based on a more localised, contextual and participatory philosophy. Research in this tradition emphasises the importance of understanding local conditions, values and needs to set goals and establish priorities and that sustainability monitoring should be an on-going learning process for both communities and researchers (Reed et al., 2006; Freebairn and King, 2003).

The formalisation of 'bottom-up' community involvement in proposing and measuring indicators resulted, in part, from past failures of 'top-down' approaches (Fraser et al., 2006). The development of these approaches grew out of two closely related sets of methods often referred to as Rapid Rural Appraisal (RRA) that developed in the 1980s, and its further evolution into Participatory Rural Appraisal (PRA) which spread in the 1990s. The more developed and tested methods of PRA include participatory mapping and modelling, matrix scoring, well-being grouping and ranking, institutional diagramming, trend and change analysis, and analytical diagramming all undertaken by local people (Chambers, 1994). A more productive actor-oriented perspective, PRA was adopted in development studies. It emphasised inequalities in the

distribution of assets and power, and recognised that economic concerns are not necessarily always the primary importance (de Haan and Zoomers, 2005). This new actor-oriented perspective was mostly interested in the world of lived experience, the micro-world of family, network and community, and drew attention to related issues such as poverty, vulnerability and marginalisation (de Haan and Zoomers, 2005).

The concept of 'livelihoods' surfaced in the international development literature in the early 1990s, following Chambers and Conway's seminal report, *Sustainable Rural Livelihoods: Practical Concepts for the 21st Century* (Chambers and Conway, 1992). The authors are credited with introducing the term 'sustainable livelihoods', a phrase that, despite giving rise to a burgeoning literature, and over 20 years of empirical studies, remains highly contested (Hilson and Banchirigah, 2009). According to Brocklesby and Fisher (2003), the SL framework evolved from changing perspectives on poverty, participation and sustainable development (Sen, 1981; Swift, 1989; Chambers and Conway, 1992; Moser, 1998). They note that in 1987, the World Commission on Environment and Development used the term 'sustainable livelihoods' in discussions on resource ownership, basic needs, and rural livelihood security (WCED, 1987; Conroy and Litvinoff, 1988). The 1992 UN Conference on Environment and Development located sustainable livelihoods as a means of linking socioeconomic and environmental concerns (Brocklesby and Fisher, 2003).

Solesbury (2003) notes that in the 1990s, empirical research on sustainable development had proceeded in a number of places (Singh and Kalala, 1995; Rennie and Singh, 1996; Amalric, 1998; Leach et al., 1997a,b, 1999; Pretty, 1995; Ellis, 1998a,b). It was in this context that certain donor and development agencies decided to invest in a major programme on the SL framework, following accumulation of over a decade of evidence from both theory and practice and, importantly, from the iteration between the two. Solesbury (2003) notes that, in this sense, the SLA was a remarkable case of research influencing policy.

By the late 1990s, the idea of sustainable livelihoods had consolidated into an approach, or a number of very similar approaches, developed and/or implemented by intergovernmental organisations (e.g. The United Nations Development Programme, the Food and Agriculture Organisation, the International Fund for Agricultural Development, the World Food Programme), bilateral donors (e.g. The British Department for International Development), non-governmental organisations (e.g. CARE International, Oxfam) and research institutes (e.g. the Overseas Development Institute in London). The UK Department for International Development (DfID), however, was perhaps the best known supporter of the SL framework, but it has since moved towards more "rights based approaches". The UNDP, another champion of the SL framework, has also changed course, shifting its focus more to the Millennium Development Goals and, more recently, the Sustainable Development Goals (Small, 2007). However, the key contribution of the SL framework in repositioning human livelihood concerns as a central pivot in sustainability issues has not been abandoned in development discourse.

Scoones (2009) identifies four recurrent failings of the SL framework that has led to it not being as prominent as was in the late 1990s (pp. 181–182):

- (i) coming from a complex disciplinary parentage that emphasised the local, it has not been very good at dealing with big shifts in the state of global markets and politics;
- (ii) there has been a lack of attention paid to power and politics and a failure to link livelihoods and governance debates to development;

- (iii) the lack of rigorous attempts to deal with long term secular change in environmental conditions such as climate change; and
- (iv) livelihood studies have failed to grapple with debates about long-term shifts in rural economies and wider questions about agrarian change.

However, Scoones (2009) also notes that following its adoption by DfID, FAO, UNDP, CARE and others, there was a proliferation of SL research across all sectors, including: water (Nicol, 2000); forestry (Warner, 2000); natural resource management (Pound et al., 2003); animal genetic resources (Anderson, 2003); agriculture (Carswell, 1997); urban development (Farrington et al., 2002); river basin management (Cleaver and Franks, 2005); and fisheries (Allison and Ellis, 2001). Notwithstanding the recurrent criticism that livelihood approaches ignore politics and powers, as Scoones (2009) explains, there is also important work which attempts to clarify what is meant by ‘transforming structures and process’, ‘policies institutions and processes’, ‘mediating institutions and organisations’, ‘sustainable livelihood governance’ or ‘drivers of change’. There have also been attempts to link the SL framework with operational indicators (Hoon et al., 1997), monitoring and evaluation (Adato and Meinzen-Dick, 2002), sector strategies (Gilling et al., 2001) and poverty reduction strategy papers (Norton and Foster, 2001). In sum, while there may be some merit in criticisms regarding application of the SL framework to extend to more global and longer term trends, these do not detract from the valuable contributions it has made, and has further potential to make, at sectoral and local levels. Further, each of these contributions is capable of being extended or built upon to include wider political and environmental processes when warranted by particular research objectives.

The environment and development movement of the 1980s and 1990s spawned a variety of approaches, including village studies, agro-system analysis, rapid and participatory appraisal, and studies of socio-environmental change, political ecology, sustainability science and resilience which, in combination, offered diverse insights into the way complex, rural livelihoods intersect with political, economic and environmental processes from a wide range of disciplinary perspectives, drawing from both the natural and social sciences (Scoones, 2009). In identifying where the SL framework fits into this variegated history, Scoones (2009) notes that in the notionally trans-disciplinary subject area of development, making sense to economists is a must. The SL framework linked inputs (designated with the term ‘capitals’ or ‘assets’) and outputs (livelihood strategies), and connected these to outcomes, which combined familiar territory (of poverty lines and employment levels) with wider framings (of well-being and sustainability) (Scoones, 2009, p. 177). The input-output income elements of the livelihoods framework were of course easily recognisable by economists and were amenable to quantitative analysis. Scoones (2009) notes that unfortunately, some livelihoods analysis has never moved much beyond this, missing out on wider social and institutional dimensions. In particular, the focus on ‘capitals’ and the ‘asset pentagon’ has kept the discussion firmly in the territory of economic analysis (Scoones, 2009).

However, an important step forward was linking changes in natural capital (‘the environment’) with social and economic dimensions in discussing how assets could be combined, substituted and switched. A broader view of assets was also advocated. Bebbington (1999, p. 22), for example, saw assets as ‘vehicles for instrumental action (making a living), hermeneutic action (making living meaningful) and emancipator action (challenging the structures under which one makes a living)’ (Scoones, 2009).

It is also important to note that the range of contexts to which the SL framework has been successfully applied extends beyond the rural and agrarian livelihood contexts in which it originated. For example, in addition to the particular sector applications referred to above, the SL framework and five capitals approach has also been applied in urban contexts (see for example, Farrington et al., 2002; Meikle et al., 2001; Rakodi, 2002). The SL framework can apply to both rural and urban areas, but the composition of each of the five capitals will vary in each case.

3. Sustainable livelihoods and the five capitals

Underlying the SL framework is the belief that people draw on a range of capital assets to further their livelihood objectives (FAO, 2002; DfID, 1999). Assets refer to the resource base of people and are often represented as a pentagon consisting of (FAO, 2008, p. 17):

1. *Financial capital*: savings, gold/jewellery, access to regular income, net access to credit, insurance.
2. *Human capital*: labour power, health and nutritional status, skills and knowledge.
3. *Natural capital*: access to land, water, wildlife, flora, forest.
4. *Social capital*: refers to those stocks of social trust, norms and networks that people can draw upon to solve common problems, and which is mediated through kin networks and group membership.
5. *Physical capital*: houses, vehicles, equipment, livestock.

Various vulnerability factors (such as environmental stresses and shocks) impact assets (FAO, 2002). Assets are also filtered through policies, institutions and processes that affect the degree to which livelihood objectives are realised (FAO, 2002).

Increasingly, it is being recognised that in addition to these five categories, it is important to include analysis of political capital, as an individual’s stock of political capital will determine ability to influence policy and the processes of government (FAO, 2008). The shape of the pentagon, as set out in Fig. 1, can be used to show schematically the variation in people’s access to assets. The idea is that the centre point of the pentagon, where the lines meet, represents zero access to assets while the outer perimeter represents maximum access to assets. On this basis, different shaped pentagons can be drawn for different communities or social groups within communities.

Although some organisations have tailored their own definitions, many draw on a concept of livelihood as ‘the means of gaining a living, including livelihood capabilities, tangible assets and intangible assets’ (Chambers and Conway, 1992, p. 9). Added to this is a sustainability dimension: that ‘a livelihood is sustainable when it can cope with and recover from stresses and shocks, maintain or enhance its capabilities and assets, while not

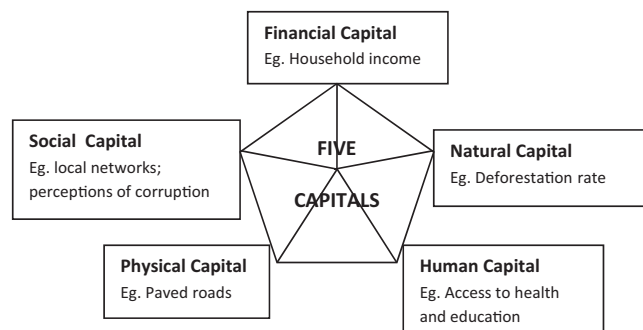


Fig. 1. The five capitals depicted as a pentagon. Modified from DfID (1999) and Bebbington (1999).

undermining the natural resource base (Scoones, 1998, p. 5). The SL Approach can be considered in several different ways (Farrington, 2001; Morse et al., 2009, p. 6):

- As a set of principles guiding development intervention (whether community-led or otherwise). The fundamental issue is the notion that an intervention has to be evidence-based rather than instigated in top-down fashion without adequate knowledge of the community.
- As an analytical framework to help understand what 'is' and what can be done. Thus the logic is to appreciate the capitals which are present, their vulnerability and the involvement of institutions.
- As an overall development objective. In this case, 'development' is the improvement of livelihood sustainability, perhaps by making capital less vulnerable or by enhancing the contributions that some capitals can make or by improving the institutional context.

Like all initiatives in development, the SL framework did not emerge from a vacuum but rather evolved from a number of older trends and ideas (Morse et al., 2009). Its focus on households, livelihoods and sustainability is not new but the bringing of all of these together within a single framework is the leap forward made by the SL framework. The imperative of this holistic underpinning has not abated with the development of new approaches.

Although the SL framework has been accused of being a good method in search of a theory (Scoones, 2009; O'Laughlin, 2004) and, arguably, more explicit attention to the theorisation of concepts is warranted, a pluralist, hybrid vision is probably more appropriate if a solid, field-based, grounded empirical stance is to remain at the core (Scoones, 2009). Being evidence-based is one of its core positive attributes, as Morse et al. (2009) points out – an attribute, we argue, that has largely been missing from the natural resource management literature which, in the case of analyses of mining, has tended to be based on untested theoretical assumptions about the industry's positive and negative impacts. Scoones (2009) also argues that the SL framework does not sufficiently address wider global processes and their impingement on livelihood concerns at the local level. However, this criticism seems to be directed at the body of empirical work that has utilised the framework thus far, rather than at its potential in this regard. As Scoones (1998) himself has previously recognised, livelihood scales may include individual, household, household cluster, extended kin grouping, village, region, nation and beyond (Scoones, 1998; Connell, 2010). There may be a valid point in posing that a central future challenge for the SL framework must be integrating livelihoods thinking and understandings of local contexts and responses with concerns for global environmental change (Scoones, 2009). However, this does not undermine the soundness of the framework itself or the range of studies that have focused on the sectoral and local level, many of which occurred beyond the 1990s into the 2000s. Again, the ability of the SL framework to focus in at the micro level is a strength it may add to analysis of the impacts of the mining sector on development which has tended to focus at the macro level.

Finally, we suggest that the SL framework can be used not only to organise information but also to help its users to restructure information and knowledge and to see the world through different lenses. In this sense, it can also be used as a framework for knowledge integration assessment (Knutsson, 2006), a further missing thread in the natural resource management literature to date. The various SL frameworks in use recognise that livelihoods are created from diverse assets and diverse activities. Analysing livelihood assets and activities at the household level can contribute to an understanding of livelihood dynamics that

transcends both disciplinary boundaries and outdated paradigms (Robinson and Fuller, 2010). The emphasis on participatory methods promoted by the SL approach may also yield better policy and investment decisions in resource economies, whether related to private sector CSR initiatives at the community level, or broader district and regional budget allocations for the public sector at various levels of government.

In order to develop an understanding of the complex relationships amongst the five capitals and corresponding assets in particular contexts, it is necessary to look beyond the assets themselves, to think about prevailing cultural practices and the types of structures and processes that 'transform' assets into livelihood outcomes (DfID, 1999). As emphasised by DfID (DfID, 1999), a single physical asset can generate multiple benefits. If someone has secure access to land (natural capital), they may also be well-endowed with financial capital, as they are able to use the land not only for direct productive activities but also as collateral for loans. Similarly, livestock may generate social capital (prestige and connectedness to the community) for owners while at the same time used as productive physical capital (e.g. animal traction) and remaining, in itself, as natural capital. This approach to understanding the complex relationship between 'capitals' or 'assets' seems to be largely missing from both the resource literature and CSR initiatives, when it comes to evaluating how communities are impacted by activities of extractive industries.

4. The five capitals in the context of mining

Much of the literature that examines sustainable development in the context of minerals and mining concerns sustainability at global and national scales (Hilson and Murck, 2000). For example, Hilson and Banchirigah (2009) note that macro economic appraisals of mining sector reform often overlook the detrimental impacts of operations on rural communities. Indeed, several studies suggest that the impacts of mining at local and regional scales are not particularly beneficial even when the macroeconomic analysis trends positively (Fessehaie, 2012; Bloch and Owusu, 2012; Bury, 2005; Hilson and Potter, 2005). In addition to the relative lack of attention paid to impacts at differing spatial and temporal scales, the resource literature has also tended to overlook divergent stakeholder views of the meaning of 'development'. There has been a marked increase in number of environmental, social and sustainability reports produced by mining companies, in line with influential standards and guidelines, including the Global Reporting Initiative (GRI), the MDGs, and various sustainability indices. However, to what extent do these broad goals and sets of indicators, developed largely by industrial countries with top-down objectives and standards, engage with the actual values and priorities of those engaged in the extractive industries and the regional development of local communities in which such activities take place? The importance of empowering stakeholders such that they can meaningfully engage and enter into purposeful communicative action has received some attention in both the literature on natural resource management and on indicator frameworks generally. A potential strength of the SL framework is that it assists with the measurement of the impact of mining and development at local and regional scales by, amongst other things, providing a methodology for collecting data at the household level relating to changes in livelihood assets.

In mining, 'sustainable livelihoods' has been used almost exclusively as a development objective, and often used interchangeably with 'alternative livelihoods' (Labonne and Gilman, 1999), the end goal being the diversification of rural communities, many of which are impoverished and over-reliant upon informal artisanal mining for sustenance (Hilson and Banchirigah, 2009). This narrow application, however, does not fully reflect local

realities: that people draw on a range of capital assets to further their livelihood objectives. [Hilson and Banchirigah \(2009\)](#) look at empirical findings gathered in three of Ghana's mining regions and find that most of the activities promoting 'alternative livelihoods' have proved highly unpopular with target groups.

Considering the aforementioned vast array of literature on development, we aim to make a case for developing more spatially-localised frameworks for measuring the relationship between mining and development, which acknowledges divergence in notions of 'development' in developing countries. As a starting point, we now explore the way in which mining and development have been conceptualised within the resource literature, according to the five capitals. Disaggregating the perceived negative and positive impacts of mining on development under each is the first step for employing the SL framework as a framework for knowledge integration and analysis, and deepening our understanding of the interaction of mining and development across varying scales and sectors. Under the headings of each of the five capitals below, we have further sorted the variegated collection of cited studies under subheadings based on the key themes that have most frequently been addressed in the resource literature. In some cases, these themes relate to particular sets of indicators – particularly with respect to those grouped under the heading of financial capital for example – while in other cases, the themes are based more generally on observed impacts such as those grouped together under 'social capital', a category which is particularly illustrative of the broad eclectic array of issues and methods of measurement pursued in the literature. This, we argue, lends further support to the view that a more consistent theoretical and methodological approach in the field of mining and development research would contribute more clarity, soundness and accessibility to its many multi-faceted findings.

The problematic process of attempting to group the cited works into a consistent and structured set of themes revealed common tendencies across this 'strand' of literature which include: focusing on only one capital in claiming positive or negative effects of mining activity, excluding consideration of associated enhancement or depletion of other capitals; limiting discussion to one spatial scale – frequently macro; scarce attention to cumulative impacts and longitudinal time scales; limited use of participatory methods in gathering data on the impacts of mining; a lack of acknowledgement of varying perspectives on the concept of 'development' being measured; impacts on people and livelihoods are generally not the focus of discussion and analysis; often, general conclusions are made without field-based evidence gathering; and finally, in instances where evidence is gathered, the underlying principles or assumptions in the resulting data analysis are often not explicitly stated or acknowledged.

While we are focusing on the limitations found in the resource literature for the purposes of making a case that engagement with the SL framework may add value to future research in this area, we are not suggesting that the various approaches of the reviewed works do not have merit in their own right. Indeed, engagement with the SL framework to its full potential would not necessarily preclude any of the methods currently found in the resource literature, some of which may likewise serve to balance the limitations of applications of the SL framework to date. For example, while the SL framework literature has tended to stay focused at the individual, household and community scales when analysing the five capitals relevant to livelihoods in particular contexts, the macro focus of much of the econometric analysis of quantitative data – which, historically at least, has frequently in literature on the 'resource curse' at the national scale – might well be usefully deployed to more fully evaluate vulnerability contexts, transforming structures and processes in SL studies. For this reason, our review below does not engage in critical evaluation of

particular approaches at the level of each individual work cited. Rather, by gathering together and presenting in one place a range of works which hitherto, due to the breadth of disciplinary perspectives, have been scattered across an almost equal breadth of journals, we seek to demonstrate the utility of engaging with an integrative approach to more fully understand the complexities of the relationship between mining and development. We discuss this further following our review set out below which is organised under headings based on the five capitals.

4.1. Financial capital

Financial capital refers to wages, savings, remittances, income, royalties, rent and other financial flows including access to employment. This is the form of capital that is most dominant in market economies and hence relates to the most comprehensive existing literature on indicators of economic growth, financial stability, and poverty reduction.

4.1.1. Economic growth

Traditionally, the focus in the resource literature has been on economic indicators at the national scale ([Morse, 2013](#); [Stevens and Dietsche, 2008](#); [Arrow et al., 2003](#); [Moore, 1997](#); [Auty, 1993](#)). The idea that mining can positively contribute to economic development and reduce poverty has been actively promoted by organisations such as the World Bank and the United Nations since the early 1980s. This aligned with the view that 'economic growth per se is a well-documented prerequisite to sustainable development and poverty reduction' ([Weber-Fahr, 2002](#), p. 13). In part, this view is based on the fact that mining has historically served as a viable route to national development in resource-rich countries such as Australia, Canada and the United States and that it can therefore play a similar role in poor countries today ([Pegg, 2006](#); [De Ferranti et al., 2002](#)).

However, since publication of [Auty's \(1993\)](#) book *Sustaining Development in Mineral Economies: The Resource Curse Thesis*, there has been a growing body of evidence which reinforces the view that 'favourable natural resource endowment may be less beneficial to countries at low- and mid-income levels of development than the conventional wisdom might suppose' and how 'This counter-intuitive outcome is the basis of the 'resource curse thesis' ([Auty, 1993](#), p. 1). As [Mikesell \(1997, p. 192\)](#) notes, the resource curse is paradoxical because production of natural resources: (i) has been the initial source of nearly all development; (ii) provides an almost immediate source of foreign exchange; (iii) attracts foreign capital and skills; and (iv) provides both raw materials for processing and a market for manufactured inputs. Research has found that the effect of the curse on growth is exacerbated in countries with weak governance and regulation structures ([van der Ploeg, 2011](#); [Bulte et al., 2005](#)). Further, when compared with diffused resources such as agricultural commodities, research has found that the concentrated nature of resources such as minerals and petroleum compounds the curse ([Murshed, 2004](#); [Bulte et al., 2005](#)). The empirical results in the resource curse literature challenged some basic assumptions of classic development theory. It also introduced a new range of assumptions, gaps and contradictions in the relationship between mining and development.

[Auty \(1993\)](#) did not apply econometrics to test his hypothesis, but researchers have since used mathematical models that have generated data which support the resource curse thesis (or RCT) ([Kuwimb, 2010](#)). The most influential work is arguably that of [Sachs and Warner \(1995\)](#), who estimated that an increase of one standard deviation in natural resource intensity (on average 16% GNP) leads to a reduction of about 1% per year in economic growth. Other researchers demonstrated that the main indicator of

resource abundance, the share of resource rents in GDP, is negatively correlated with GDP per capital growth rate (Atkinson and Hamilton, 2003). The World Bank's Operations Evaluation Department (OED) 'found that during 1990–1999 there was a negative relationship between extractive industry dependence and economic growth for all WBG borrower countries...' (Extractive Industries Review, 2003, p. 12; Pegg, 2006). Prior to this, in a World Bank Staff Working Paper, Nankani (1979) found that mineral economies underperformed economically; have lower rates of growth, and social welfare; and have more highly skewed income distributions than non-mineral developing countries. Gelb (1988) found similar outcomes for oil exporting countries (Mikesell, 1997). In terms of material deprivation, much of the earlier work on the resource curse theory, including that of Sachs and Warner (1995), documents a "statistically significant, inverse, and robust association between natural resource intensity and growth" (Pegg, 2006, p. 377; Sachs and Warner, 1995). For example, Gylfason's (2001) study of per capita economic growth from 1965 to 1998 and natural resource abundance "suggests an increase of about 10 percentage points in the natural capital share from one country to another is associated with a decrease in per capita growth by one percentage point per year on average" (pp. 848–849). Additionally, Pegg (2006, p. 377) notes, that de Soysa's (2001) results confirm that 'mineral wealth has a strong negative effect on growth' (p. 124), Leite and Weidemann's (1999) results 'suggest that natural resource abundance tends to reduce long-run growth rates' (p. 25), and Ross (2001) found that 'mineral-dependent states have significantly higher levels of inequality than other states with similar incomes: the more that states rely on mineral exports, the smaller the share of income that accrues to the poorest twenty percent of the population' (p. 12). On the other hand, countries such as Chile (Parra and Franks, 2011; Aroca, 2001), Indonesia (Usui, 1997), Botswana (Mikesell, 1997), and more recently Ghana (Aubynn, 2009), Zambia (Fessehaie, 2012) and Peru (Bury, 2005) have experienced positive economic growth through their natural resource sector. Some studies reinforce this position. For example, Sarmidi et al. (2013), who use two new variables from the World Bank database, total natural capital and subsoil wealth, found that a robust relationship between natural resource abundance and economic growth exists for more than 90 countries. Brunnschweiler (2008), in re-examining the effects of natural resource abundance on growth using new measures of resource endowment and considering the role of institutional quality, found a positive direct relationship between natural resource abundance and economic growth, particularly with respect to subsoil wealth.

Bulte et al. (2005) postulate that economic growth per se is a poor indicator of welfare. Even if natural resources are a curse for economic growth narrowly defined, they may lead to improvements in other aspects of welfare – such as the prevalence of poverty, malnutrition and infant mortality. It is an open question to what extent growth dividends, if any, percolate to other perhaps more vulnerable members of society.

4.1.2. Vulnerability to economic shocks and lack of diversity

Countries that are heavily dependent on resource exports are unusually vulnerable to economic shocks due to their lack of diversification and the cyclical nature of commodity prices (Pegg, 2006). For the past century, the international prices for commodities, including minerals, have been more volatile than the prices for manufactured goods. The 'Dutch disease', a phenomenon frequently referred to in 'resource curse' literature, was first used to describe the Dutch economic experience where the manufacturing sector declined and suffered general inflation as a result of the booming natural gas sector. With rising gas exports, Holland's exchange rate appreciated against the US dollar and pushed wages

up faster than productivity gains in the non-gas sectors of the economy. Thus, Holland's competitiveness in its other exports, especially manufacturing, was reduced while its demand for domestic non-tradeable goods rose, giving rise to inflation and declining savings in investment (Kuwimb, 2010; Davis, 1995). Analogous situations in resource abundant economies dependent on mining have been termed the 'Dutch disease' (Usui, 1997).

4.1.3. Revenue creation

Mining exports can generate large revenues for governments. In theory, this would provide funds to spend on welfare and poverty reduction (Weber-Fahr et al., 2001). However, apart from the issues of corruption and democracy in resource economies that may impede such spending, World Bank structural adjustment programmes have prevented the state from raising its revenues from the mining sector through recommendations to reduce royalties, corporate income tax rates, and customs duties on imported capital. Pegg (2006) refers to Ghana as an example, where corporate income taxes, which stood at 50–55% in 1975, were reduced to 45% in 1986 and further reduced to 35% in 1994. The initial capital allowance that investors could use to recoup their capital expenditure was increased from 20% in the first year of production in 1975 to 75% in the first year of operation in 1986 and 15% for subsequent years to the first year of production in 1975 to 50% for subsequent years to the first year of production in 1986. Royalty rates decreased from 6% in 1975 to 3.7% in 1987. Other revenue-generating duties such as mineral duty, import duty and foreign exchange tax were abolished entirely (Pegg, 2006).

4.1.4. Job creation

One of the great promises of resource development for the local region is employment (Weber-Fahr et al., 2001). However, as has been frequently noted, the capital-intensive nature of the extractive industries means the number of actual jobs created is small compared to the quantity of revenues generated. Pegg (2003) gives two examples of World Bank Group-supported gold mines in Mali. The Sadiola gold mine is estimated to have created one mining job for every US\$700,000 invested, while the Randgold mine directly created 127 jobs, or one job for every US\$1.123 million invested (Pegg, 2003, p. 20). Aubynn (1999) noted in his study on the Twarka district in the South-Western region of Ghana that the mining sector employs only 8% of the inhabitants of the district, although it accounts for over 70% of the district's GDP, and over 60% of regional GDP. One possible socio-economic implication is that the introduction of each large-scale mining activity is likely to lead to large net employment losses through its claim for agricultural land (Aubynn, 1999). Women are most likely to be the worst affected given their relatively high rate (over 70%) of employment in agricultural related activities and their low rate of employment in the formal mining sector. For example, in 1991, out of more than 300 employees of the Teberbie Goldfields mines, a former American-Ghanaian gold mining company which obtained a concession in Tarkwa in 1990, less than 3% were women, a figure that varies only slightly among the other companies surveyed at the time (Aubynn, 1999). The figure may rise by about 10% more in other contracted areas like catering. This contradicts the prevailing view that modern mining activities create more employment (Warhurst and Bridge, 1997). By contrast, current mining practices destroy subsistence agricultural activities (Aubynn, 1999).

On the other hand, Aroca (2001) found that private mining firms in Chile lowered the percentage of the poor in the Chilean II region, since – although the mining itself does not demand unskilled labour – other productive sectors such as the construction and retail sectors have hired a considerable number of unskilled workers, and thus, they are highly associated indirectly with the

mining sector. The Chilean II region, one of the 13 regions of Chile, is located in the north area of the country, in the desert of Atacama, which is rich in minerals; its economic development has been built mainly in minerals.

Hilson and Potter (2005) refer to a number of studies that show the loss of jobs in Ghana, notwithstanding growth of the mining sector. According to Hutchful (2002, p. 90), total employment in the large- and medium-scale formal sector (enterprises with 30 or more employees) fell from 464,000 in 1985 to 394,000 in 1987, and to 186,000 in 1991, 'a decline of almost 60% in five or six years'. In the agricultural sector, policy reforms, which have 'focused preponderantly on rehabilitation of the cocoa industry and reform of its marketing system' Hutchful (2002, p. 67), have resulted in the elimination of some 80,000 job positions on the Cocoa Board. Schemes allegedly put in place to improve efficiency in the public sector have also had a devastating effect on job creation and levels of employment. Between 41,000 and 45,000 civil servants were immediately 'redeployed' (29,000 were dismissed in 1988, and the remainder in 1989), over 20,000 state enterprise employees were laid off, and hundreds of private sector employees lost textile and manufacturing jobs as a result of import liberalisation (Wiessman, 1990, p. 1626). Experts generally agree that the foreign investors who have been attracted to the country's business climate have stiffened the competition for many subsistence artisans and entrepreneurs (Hilson and Potter, 2005).

More comprehensive and comparable data are required at the local and regional level to assess not just local and regional numerical net job creation data as a result of mining activity, but also the nature and impact of those gains and losses. For example, evidence from Zambia's Copperbelt region indicates that subsistence farmers displaced by mining activity become particularly economically vulnerable since their land – their only source of financial capital and income generation – is no longer accessible to them and they have no welfare safety net to draw on (Mwitwa et al., 2012; Mususa, 2012).

The literature on sustainable and alternative livelihoods includes some studies of the local impacts of mining on employment. For example, Kitula (2006) reports the findings of a study undertaken to assess the socio-economic and environmental impacts of mining in Geita District, Tanzania. The results indicated that mining activities have created a multitude of income opportunities for inhabitants of Geita District.

4.1.5. Forward and backward linkages

Through linkage creation, commodity extraction has the capacity to support local industrial production and capabilities building (Hanlin and Hanlin, 2012). There is a view that resource extraction can contribute to poverty reduction through the establishment of backward and forward linkages, which has been espoused by the World Bank and others (Pegg, 2006). However, as Pegg (2006) notes, extractive projects often do not favour local or regional suppliers.

Other works discuss the enclave nature of resource industries (see Bloch and Owusu, 2012 for a summary). An enclave economy is associated with a lack of productive, physical backward and forward linkages. In commodity production, these linkages can include fiscal linkages – state taxation of the income streams associated with the commodity, and consumption linkages – or incomes spent nationally and in the local vicinity on the outputs of domestic industries (Bloch and Owusu, 2012). Bloch and Owusu (2012) challenge the enclave thesis with respect to gold mining in Ghana. They note that gold mining tends to be *perceived* negatively in Ghana, and is seen as providing far less than it should in terms of public revenue, employment, skills development and spillovers, and localised economic development. Gold mining is thus depicted as having an enclave status, disconnected and isolated from the

rest of the economy. However, their research found that after a period of strong investment and growth, gold mining can no longer be seen as an enclave activity: it is in fact more deeply rooted in the Ghanaian economy than previously understood. They use the schema of Walker and Minnet (2006) study of the South African mining industry value chain to focus on a tiered structure of the inputs cluster for mining inputs. Based on the registration of local suppliers and data on the distribution of mining expenditures by mining companies, they found the existence of a range of 'input supplying' backward linkages for mining.

Fessehaie (2012) looks at the dynamics of upstream linkages to copper mining in Zambia drawing on qualitative and quantitative primary data collected in the Copperbelt, North Western and Lusaka Provinces, Zambia, in 2009. The research predominantly focuses on firms engaged in backward linkages to the copper mining sector. The total population of suppliers in 2009 is estimated to lie in a range of 150–200 firms. The author engages with Global Value Chain (GVC) analysis and notes that mineral-based value chains have been under-researched within the school of GVC analysis. Fessehaie (2012) found that the breadth and depth of the local mining supply chain was deeply shaped by the policies adopted in the 1990s under the Structural Adjustment Programme. During the nationalisation era, backward linkage development was a key component of Zambia's industrialisation strategy. Following privatisation, the government moved away from interventionist policies, leaving the locals to compete with international suppliers to meet the standards of the private companies. Fessehaie (2012) notes that what is needed in this era are policies to assist local and regional suppliers to be more competitive.

Hanlin and Hanlin (2012) refer to the argument that linkages are an opportunity for governments to improve employment opportunities, diversify the economic base of a country in terms of its export potential and development of dynamic capabilities within firms and industries. However, little research exists using grounded data, especially in low income environments. Building on qualitative data collected from mining company supply firms, Hanlin and Hanlin (2012) discuss factors that have impinged upon linkage development within the supply chain to gold mines in East Africa. They argue that lead firms become locked-in to particular ways of working which minimise the opportunities that local suppliers have in providing products and services.

4.2. Human capital

Human capital refers to individuals' demographic attributes, and levels of health, education, and skill development: the stock of personal attributes and competencies that can be harnessed for economic gain. There are surprisingly few studies that directly measure the relationship between health, education and mining. The few that exist are again, primarily based on national-level data and do not explore differential patterns at regional and local scales. Stijns (2006), for example, studied the link between resource abundance and human capital accumulation, and reviews the commonly-used indicators across a number of studies in both developing and developed countries. He found that subsoil wealth and resource rents per capita correlate significantly with improved indicators of human capital accumulation and emphasises that human capital accumulation is a crucial issue for economic development in all countries. However, the evidence is not uniform.

Contrary to conventional logic that would infer increased social spending with the presence of mineral wealth, other available data indicate that expenditure on education and population health actually decreases in mining economies. For example, Gylfason (2001) tested three different measures of education against resource dependence and found a negative correlation in relation

to public expenditure on education; years of schooling for girls; and secondary school enrolment rates.

Further, while mining companies may invest in local health infrastructure, mining projects are also associated with the higher risk and prevalence of a range of major communicable diseases. In Chile, for example, [Aroca \(2001\)](#) found an increase in respiratory illnesses, HIV/AIDS, prostitution rates and alcoholism in mining areas of Chile's Region II. The region also presented the highest rates of divorce and suicides in the country, which was said to reflect the deterioration of the family with the head of the household being absent several days each week due to their work schedule. Further evidence is required that compares key health and education outcomes in mining and non-mining regions of developing countries.

4.3. Social capital

Social capital refers to the social norms, rules, and institutions that regulate people's lives. Below, we discuss some of the key differentiated indicators of this form of capital.

4.3.1. Civil war and conflict

A number of studies have demonstrated a strong correlation between a developing state's reliance on natural resources and the likelihood that it will suffer from conflict (e.g. [Maconachie and Binns, 2007](#); [Collier and Hoeffler, 2000](#)). Analysing the results of empirical studies conducted across a range of countries utilising a multivariate model, [de Soysa \(2001\)](#) found that mineral wealth had a direct relationship to armed conflict within national borders. World Bank studies have similarly found that countries that have a substantial share of their income derived from the export of primary commodities are radically more at risk of conflict ([Weber-Fahr, 2002](#); [Collier and Hoeffler, 2000](#); [Pegg, 2006](#)).

[Maconachie and Binns \(2007\)](#) examined this relationship in Sierra Leone – a nation that has become synonymous with political instability, economic devastation and a brutal civil war. Fuelled by diamonds and corruption, they note the conflict focused international attention on diamond mining and trading, and demonstrated how the 'paradox of plenty' can lead to destruction and poverty. Economic and social indicators suggest that Sierra Leone was, at the time, among the poorest countries in the world. There continues to be much debate concerning the role that diamonds might play in the country's future development trajectory.

Papua New Guinea, with its heavy dependence on natural resources, limited economic development in the past two decades, poor record of governance and high-profile separatist conflicts such as the Bougainville civil war, appears to be an exemplar of the 'resource curse' theory. However, [Banks \(2008\)](#) considers that what appear to be 'resource conflicts' in Papua New Guinea are actually better conceived as conflicts around social identity and social relationships. The very different conceptualisation of natural resources in most Melanesian societies – as elements of the social world – means that resources become a conduit for local social and political agendas and tensions to be expressed ([Banks, 2008](#), p. 23). The author's argument hinges on explaining the link between resources and identity.

[Hilson and Yakovleva \(2007\)](#) examine the dynamics of an ongoing conflict in Prestea, Ghana where indigenous *galamsey* mining groups are operating illegally on a concession awarded to Bogoso Gold Limited (BGL), a Canadian multinational company. According to the authors, the conflict has come about largely because mining sector reform, which has prioritised the expansion of predominantly foreign-controlled large-scale projects, has neglected the concerns of indigenous subsistence groups, which has been the case in many other mineral-rich regions of sub-Saharan Africa.

[Hilson and Yakovleva's \(2007\)](#) analysis is one example of what [Davis and Franks \(2011\)](#) would refer to as the 'costs of company-community conflict'. Their analysis of 25 company-community conflict cases produced illuminating findings. Pollution, distribution of benefits, competition over or access to resources, poor consultation and communication, and community health and safety concerns were the leading drivers of conflict. These conflicts manifest in a variety of ways, from written submissions and publicity campaigns, to blockades, property damage, and even deaths. Considerable financial costs were borne by the companies themselves – sometimes leading to permanent operational closure. Communities also bore considerable social, cultural, spiritual and human costs. In all cases, these conflicts emerged because mining had become a perceived or real threat to one or more of local communities' other forms of capital.

4.3.2. Governance, voicelessness and powerlessness

Studies have found that oil- and mineral-dependent states tend to be less democratic and more corrupt than other states ([Pegg, 2006](#)). For example, [Ross \(2001\)](#) analysed data from 113 states between 1971 and 1997 and found that because oil and minerals generate rents and produce large export incomes for the state, they are more likely to impede engender political corruption than other primary commodities that do not share these characteristics.

[Vicente \(2010\)](#) analysed changes of perceived corruption across a wide range of public services and allocations to assess the role of natural resources in determining corruption. Noting that not much is clear about the empirical mechanisms of resource curses, the author explored the empirical effects of the announcement of an oil discovery in Sao Tome and Principe, in the period 1997–1999, on corruption. Tailored representative household surveys tested perceptions of corruption on a wide range of public services and allocations. Clear increases in perceived corruption were found with regard to vote buying, education and customs, which [Vicente \(2010\)](#) interpreted as being indicative of increased competitiveness for state resources – namely those that are accessible through political channels.

As a counter-narrative, [Haber and Menaldo \(2011\)](#) review a large body of scholarship that finds a negative relationship between natural resources and democracy, and argue that numerous sources of bias may have been driving these results. Testing a long-run relationship between resource reliance and regime type within countries over time, on a country-by-country basis and across several different panels, the study found that increased resource reliance is not associated with authoritarianism and finds results that suggest a resource blessing. Whatever the case, with this form of capital in particular, there appears to be a dearth of evidence regarding the impacts of mining on local and regional governance and empowerment.

4.3.3. Social impacts, housing and welfare

Mining impacts the economic and social fabric of the local community. A rapid influx of people can lead to price inflation ([Pegg, 2006](#); [Weber-Fahr et al., 2001](#)). The mixture of local residents and newcomers who have migrated with the hope of finding employment has led, in some cases, to increases in alcoholism, prostitution and child labour ([Pegg, 2006](#); [Weber-Fahr et al., 2001](#)).

[MacMillan \(2012\)](#) has looked at the relationship between mining, housing, and welfare in South Africa and Zambia, two countries with long histories of mining. They note the reluctance of mining companies to accept responsibility for the housing and welfare of their workers, in contrast to the situation prior to privatisation of the sector. He determines the relationship between mining, urbanisation and poverty has a great deal to do with trade cycles, the life-span of mines, and social welfare provision, or its absence. [Mususa \(2012\)](#) focuses on the character of life and social

welfare services in the mining towns of Zambia's Copperbelt, and follows the history of mining from the establishment of the industry in the 1920s. The author finds that the withdrawal of mines from welfare provision from the mid-1990s to the present has radically altered not only people's wellbeing, but also the character of urban areas, leading to the observation that towns have become more like 'villages'.

4.3.4. Spiritual/cultural transformation

Indigenous communities are often impacted by major mining operations in developing contexts. As contributions to O'Faircheallaigh and Ali (2008) demonstrate, the relationships between mining companies and Indigenous communities and their interests are contextual and complex. No singular account is representative. But as Native American activist and leader LaDuke (2005) notes, mining activities can have serious restrictive impacts on Indigenous spiritual and cultural practices and freedoms. She vividly traces how insatiable imperial consumptive appetites over-ride Indigenous rights and imperatives to access and use sacred places. Such dynamics are not rendered visible in macro-level analysis of the impacts of mining on economic development.

4.4. Natural capital

Natural capital refers to stocks of renewable and non-renewable natural resources and access to the environment. Studies have noted, in particular, how the environmental impacts of mining projects can also increase the vulnerability of the poor. For example, Pegg (2006) reports that in Zambia, copper smelters emit 300,000 to 700,000 tonnes of sulphur dioxide annually. This contributes to soil contamination and loss of vegetation. Mwitwa et al. (2012) note that one of the sectors least studied in the Copperbelt of Zambia and the Southern Democratic Republic of Congo (DRC) in terms of its influence on forests is the mining industry. They emphasise that it is critical that the impact of current and past mining activities on forests and local livelihoods be understood. Direct impacts of mining on forests include deforestation at mining sites, timber consumption and pollution. They analyse the direct social and environmental impacts of mining in two mining towns: Lubumbashi, DRC and Chingola, Zambia. The methodology integrated regional data from the Copperbelt with a case study approach to explore local stakeholder views around selected mining concessions and to 'ground truth' regional data. The data included archival research and analysis of satellite imagery. Both positive and negative impacts on local livelihoods were cited by forest-dependent communities. Casual employment, construction of a school, improved markets for forestry and agricultural products, and improved transportation were cited as benefits from the mine(s) studied. Declines in agricultural production and forest quality due to pollution and the stunting of vegetation, deteriorated water quality and human health, and the failure of revenue to reach local communities were amongst the cited costs (Mwitwa et al., 2012). Other common environmental impacts from mining operations are incurred through the activities of water discharge, dewatering, smelting, transportation and mineral extraction: heavy metals overloading, ecological impacts, sediment runoff, effluent contamination, air pollution, acidic deposition, heavy metals contamination, noise pollution, dust and sediment, gaseous emissions, oil and fuel spills, soil contamination, erosion, landform changes, alteration of water tables, vegetation and habitat destruction, and aesthetical concerns (Hilson and Murck, 2000).

4.5. Physical capital

Physical capital refers to infrastructure, plantations and other forms of built assets that can, in turn, provide for a means of

harnessing other forms of capital. There is potential for mining projects to build and upgrade existing infrastructure for the benefit of the local community. However, the actual track record of mining projects is varied in this regard. For example, as Frynas (2001) notes, more than 40 years after oil was discovered in the Niger Delta, the vast majority of people there still did not have access to basic infrastructure or pipe-borne potable water.

With reference to mining, there is often a great deal of physical capital that is developed to facilitate access to sites. Infrastructure corridors are a common phenomenon around mining projects. Some of the key indicators in this regard pertain to transportation conduits such as roads, train lines, airports and ports.

The way in which mining projects operate can greatly impact the form of physical capital generated and used. For example, 'Fly-in-Fly-out' operations lead to less physical capital generation due to the design of the project being transitory and ephemeral by design. However, in order for physical capital to be useful, it must inherently be linked to the other forms of capital, particularly human capital. Abandoned mining towns and decaying infrastructure can become a liability rather than an asset if not properly utilised (Lawrie et al., 2011).

While the resource literature reviewed above is not exhaustive, we argue that it sufficiently demonstrates how disaggregating the perceived positive and negative impacts of mining under each of the five capitals provides a useful starting point for more thorough analysis and understanding of the cross-sectoral and cumulative impacts of mining. At the very least, it serves to illuminate the futility of simplistic casual assertions and assumptions about the role of mining in developing world contexts, analysis which is frequently unsupported by empirical evidence.

The SL framework does not rely on the boundaries of an academic discipline or government-defined sector to identify relevant variables or to describe causal linkages in a relationship or system. For this reason, it can serve to facilitate cross-disciplinary, or even trans-disciplinary, approaches but is flexible enough to integrate a range of existing methodologies in deepening and broadening our understanding of multi-faceted issues. The underlying principles of the framework are robust and consistent enough to organise and underpin both quantitative and qualitative data collection and analysis, while ensuring that the perspectives of multiple sectors, including those whose livelihoods are affected, are taken into account in deciding which indicators of development are relevant or important to measure in any particular context.

5. The SL (five capitals) approach as a conceptual framework for selecting indicators to measure the impact of mining at local/regional scales

The five capitals framework derived from the SL framework helped establish the principle that successful development intervention must begin with a reflective process of deriving evidence; in this sense, and as Morse et al. (2009) note, the SL framework is an 'evidence-based' set of principles. A further attraction of the approach is that it is people-centred. As a result it builds upon the long history of the participatory movement in development, and techniques and methods honed over years of application in stakeholder participation can also be used within SL frameworks (Morse et al., 2009). Engaging a SL framework represents an acceptance that multiple sectors have to be considered; combining consideration of social, economic and natural assets necessarily mirrors the broader field of sustainable development and integrated regional development. A further attribute of this approach is the recognition that livelihoods are dynamic rather than being static.

Each of these attributes of the SL framework can be put to good use in developing a conceptual framework to underpin a selection

of indicators for measuring the impacts of mining at local and regional scales. Indicators have been variously defined in literature as ‘variable’, ‘parameter’, ‘measure’, ‘statistical measure’, a ‘proxy for measure’ and a ‘subindex’, among others (Veleva and Ellenbecker, 2001). In many studies no formal selection criteria are mentioned and when selection criteria are used they are typically applied to indicators individually. Conceptual frameworks for indicators help to focus and clarify what to measure, what to expect from measurement and what kinds of indicators to use. A diversity of core values, indicator processes and development theories have resulted in the development and application of different frameworks. The main differences among them are the ways in which they conceptualise the key dimensions of development, the inter-linkages among the dimensions, and the way they group issues to be measured, and the concepts by which they justify the selection and aggregation of indicators. The unit of analysis, variables, and indicators define what is relevant to the observer, which may be different in the SL framework compared to other approaches (Connell, 2010).

Sayer et al. (2006) note that much effort has been invested in developing indicator systems, but few such systems are widely adopted at an operational scale in real life situations. There is an abundance of project reports on participatory monitoring and evaluation, but many of these address the auditing needs of the sponsoring organisations and are difficult to access. Greater effort is needed to bring monitoring and evaluation into the public domain. The authors’ emphasis was on the use of an outcome assessment approach based on the five capitals of the SL framework.

In the resource context, a proposed methodology for selecting of indicators might include consideration of the following:

- An initial ‘top-down’ process of selecting indicators related to known mining impacts reported on in resource literature, as reorganised under each of the five capitals to be underpinned conceptually by the SL framework.
- A ‘bottom-up’ participatory process in order to take into account various stakeholder perspectives on priorities of development, including government, industry and community stakeholders involved in or affected by mining activities in particular local contexts.
- Importance/value: How are the preliminary indicators ‘valued’ by different stakeholders (i.e. to what extent is there convergence or divergence amongst groups of particular stakeholders)? Are the preliminary indicators regarded as being of equal importance and value? Do the indicators measure what they purport to measure? How adequately do they capture temporal and spatial processes? What indicators are missing?
- Collectability/measurement: While indicators might be regarded as important, are they available or can they be collected? What form might data take (for example, quantitative or qualitative data in various forms)?
- Feasibility: While data might be collectable, is it feasible to do so (in financial and other terms)?

Accordingly, what we propose is that the process of indicator selection effectively involves a series of interactions between conceptualisation, indicator development and experimentation, testing and validation, as depicted in Fig. 2.

Upon completion of an assessment framework, the next step will be to consider what procedures/strategies for engagement at the local and regional scales will enable the implementation of the framework. This will involve engaging more fully with other aspects of the SL framework beyond the five capitals, in particular governance, transforming structures and processes in specific contexts.

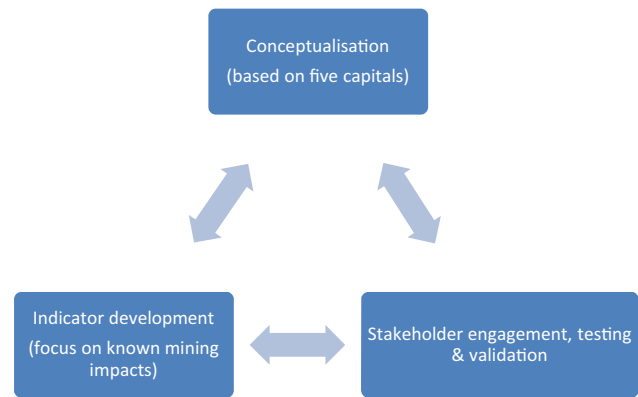


Fig. 2. Outline of process of indicator selection (conceptualisation, reflection and experimentation)

Modified from Sayer et al. (2006).

6. Conclusion

The five capitals theory, as the key element developed from the SL framework, provides a coherent methodology for both analysis and decision-making in the context of mining and development. It is capable of drawing on the full breadth of literature in development indicators and impacts of extractive industries in developing countries. It also has the potential to be further developed in applied research by more focus on its interaction with other elements of the SL framework, such as the vulnerability context, transforming processes and structures, livelihood strategies and outcomes. The SL framework, whether applied broadly or with a focus on the five capitals, can be applied at a range of different scales – from individual, to household, to household cluster, to community, region, national, or beyond with outcomes assessed at different levels. The specification of the scale of analysis is therefore critical, as is an analysis of the interactions between the capitals (and corresponding assets) in addition to other elements of the framework in terms of net development effects, both positive and negative. By organising the range of literature on the positive and negative effects of mining, under each of the five capitals, the basis for developing a methodology of indicator selection tailored to the extractive industries and regional development can be established. In applying this approach, we propose the first step in applied research, is to engage with stakeholders to facilitate a dialogue on the importance and significance of indicators of particular capitals relevant to livelihoods in the selected locality or region. This will allow for disclosure and negotiation of commonalities and differences in development objectives amongst different stakeholders – precluding the need for a top-down definitive concept of ‘development’ to be arbitrarily determined beforehand.

This paper has aimed to show that, depending on which of the five dimensions is emphasised, the capitals framework is capable of sustaining a range of conceptualisations of development, depending on the local context, purpose and the interest of particular stakeholder groups. In order to monitor impacts over time and space, measurement methodologies utilised in the ‘cumulative impacts literature’ could also supplement the five capitals approach (see, for example, Franks et al., 2013; Moran et al., 2013). Mining has often been branded “unsustainable” because of its non-renewability, which harkens back to notions of strong and weak sustainability but there are ways to overcome such determinism (Ali and O’Faircheallaigh, 2007). As this review article seeks to demonstrate, having a more specific indicator development mechanism which can be applied at the subnational

and local level can help us evaluate mining's contribution to development more constructively. Prevailing assumptions about the positive and negative impacts of mining on development, may thereby be tested more concretely within a coherent conceptual framework. The results may serve to better inform policy and investment decisions, in addition to contributing to scholarly debate on the conceptualisation of development and its relationship to extractive industries in developing countries.

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