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UNIVERSITY OF THE WITWATERSRAND



FACULTY OF SCIENCE

SCHOOL OF ANIMAL PLANT AND ENVIRONMEMENTAL SCIENCES (APES)

MSC ENVIRONMENTAL SCIENCE RESEARCH REPORT

INCLUSIVE WEALTH AS A METRIC OF SUSTAINABLE MINING: A CASE STUDY IN THE PLATINUM SECTOR

A Research Report submitted to the Faculty of Science University of Witwatersrand Johannesburg in partial fulfilment of the requirements for the degree of Master of Science in Environmental Science

(Coursework and Research Report)

By

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REPORT SUMBITTED 2016

DECLARATION

I declare that this Research Report is my original work, and that it has never been written and submitted for any degree or examination anywhere else. I do hereby submit this Research Report at the Faculty of Science, School of Animal Plant and Environmental Sciences at the University of Witwatersrand in fulfilment of a Master of Science Degree in Environmental Sciences.

Signature ……

Date …….

ABSTRACT

Challenges in the mining and extractive sector include their ability to show that they contribute towards the welfare and well-being of the present generation without compromising the potential benefits of the future generation to enjoy a better quality and standard of living from their environment. This research aimed at establishing whether Inclusive Wealth, an approach to assessing of sustainable development originally for use at the national scale, is applicable and useful when applied at the scale of an individual mine, i.e. locally. A case study of Mogalakwena platinum mine was carried out. The concept of Inclusive Wealth allows that sustainability objectives can be achieved in an extractive industry provided that natural capital (in the form of mineral resources, in this case) is converted into other forms of capital, such as social and manufactured capital, efficiently and thus does not result in a net loss of total ('inclusive') wealth, where wealth is consistently defined as the potential to deliver future benefits.

The Inclusive Wealth framework has been criticised for its theoretical assumptions and gaps in data availability. This research project shows that Inclusive Wealth has the capacity to act as satisfactory sustainability indicator at a local level, despite being better explored and thus more comprehensive at a national level.

The objective of the research was to calculate inclusive wealth impacts of Mogalakwena Platinum mine in order understand the balance between social, environmental and financial objectives. It also looked at the changes in Natural Capital over time, throughout the life cycle of the mine, through quantifying the time course of flows of key ecosystem services. The research also looked at the background of sustainable development, debates around sustainability and ecosystem services and their valuation. Desktop research was conducted with use of company reports, Environmental Management Programme Reports, Sustainability Reports, financial or stock market reports. These indicators derived from these sources were projected for the lifetime of the mine.

DEDICATION

This thesis is dedicated to my husband Mr Passion. T. Pabwe and our two sons, Jayden and Jeremy for their steadfast support and patient encouragement of this project. It is also dedicated to my mother, a fervent prayerful woman and my late father who taught me that even the enormous task can be accomplished if it is done one step at a time. Above all I dedicate this project to God, my eternal rock and support.

ACKNOWLEDGEMENTS

My gratitude goes to my supervisor Prof R. J. Scholes who gave his time to guide me during the course of this research, his patience, motivation and immense knowledge. I also appreciate all the people who assisted me in compiling this research especially my interviewees, Ms Mary-Jane Morifi, Department of Agriculture Mokopane, Mr Stephen Bullock and all those who gave their time and energy to communicate and share information with me. Their efforts contributed a lot to the success of this research. Above all I thank GOD for giving me the energy and knowledge to complete this MSc project. There were days when I didn't have the time, but I made the time. I didn't have the knowledge, I did what I knew. There were times I felt that I didn't have the support but I learned to support myself. At times I lost my confidence but the confidence came with results. I lost my father and only brother in law during the course of my studies, I had a lot going against me but I also had enough going for me. I had plenty of excuses but I chose not to use any of them. If it wasn't for God I wouldn't have made it this far.

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ABBREVIATIONS

AAP	Anglo American Platinum
ABET	Adult Basic Education and Training
AIDS	Acquired Immune Deficiency Syndrome
ARIMA	Auto Regression Integrated Moving Average
ARV'S	Anti-Retro Viral
AIP	Alien Invasive Plants
CSR	Corporate Social Responsibility
EIA	Environmental Impact Assessment
EMPR	Environmental Management Planning Report
EMS	Environmental Management Systems
ESV	Estimated Service Value
GDP	Gross Domestic Product
GIS	Geographical Information Systems
HC	Human Capital
HDI	Human Development Index
HIV	Human Immunodeficiency Virus
IAP	Invasive Alien Plants
IDP	Individual Development Plan
IWI	Inclusive Wealth Index

IWI	Inclusive Wealth Index
LED	Local Economic Development
MA	Millennium Assessment
MC	Manufactured Capital
MEA	Millennium Ecosystem Assessment
MS	Management Systems
NC	Natural Capital
NGO	Non-Governmental Organisation
RDP	Reconstruction and Development Programme
SA	South Africa
SD	Sustainable Development
SDG	Sustainable Development Goals
SLP	Social Labour Plan
UK	United Kingdom
UN	United Nations
UNEP	United Nations Environment Programme
UNU-IHDP	United Nations University-International Human Dimensions Programme
US	United States

CHAPTER 1: INTRODUCTION

Introduction

Background to study

Inclusive Wealth (IW) is a designed sustainability metric which is the sum of (i.e., 'Includes') Natural Capital, Manufactured Capital and Social Capital (NC, MC, and SC respectively). The purpose of this research is to establish whether the I W concept is a useful and practical metric that can be applied at a scale of an individual mining project, since this is where many development decisions are made. It helps in trying to understand how the exploitation of NC contributes to societal well-being by determining the total value of the current and future flow of benefits from an ecosystem. Mogalakwena Platinum mine in Mokopane, Limpopo Province has been used as a case study. There is a very high need for a robust way to evaluate and promote mining sustainability in the area. The platinum sector faces a complex macro-economic and societal landscape; that is why this mine has been selected as a case study. There has been much in the news in recent years in terms of environmental, financial and social sustainability issues in the platinum sector. Mining is fast growing in the study area, as evidenced by the recent opening of the Platreef, another mine owned by Ivanhoe mines.

"Sustainable development is a pattern of societal development along which (intergenerational) well-being does not decline,"(Dasgupta & Duraiappah, 2012). It is widely agreed that human well-being is a multi-dimensional concept, (MA Conceptual framework, 2003). One approach to quantification is via a set of 'capitals', including, but not limited to, the well-known financial capital.

A 'capital' is considered an asset which delivers future benefits, and the value of the capital is based on the value and timing of those future benefit flows. Some versions of the 'capital' concept illustrate five or more capitals (financial, natural, manufactured, human and social: Porritt 2005).The IW concept simplifies this to three (social, manufactured and natural) on the notion that this core set is commensurate (i.e., expressed consistently in the same units, therefore can be added and compared), but not easily fungible (i.e. interconverted) between the three elements, whereas

categories such as manufactured, financial and the distinction between human and social capital are hard to operationalize and are fungible, therefore do not need to be separated (Pemberton & Ulph, 2001). The three capitals also map neatly onto the widely-used notion that sustainability covers "people, planet and profit".

Sustainability is a growing concern worldwide, especially in the mining industry. Mining companies need to engage in business transformations whose core attributes are based on sustainable development. In some framings of sustainability, this is impossible for an industry predicated on the use of a non-renewable resource.

The concept of Inclusive Wealth (IW) is a good way of thinking about sustainability and development as it allows for a paradigm shift in the way sustainability is viewed. In particular, it does not require that everything remains the same forever. IW, in simple terms, is the sum of three capitals namely; human capital, manufactured capital and natural capital (Barbier, 2012). IW allows that natural capital (which includes non-renewable resources such as mineral ores) can be changed into other forms of wealth and wellbeing provided that the conversion is efficient, i.e. does not result in a net loss of wealth. For sustainable development, the increase in the other forms of capital must thus outweigh the loss of natural capital incurred (Scholes, 2009).

The challenge in the mining sector today is the ability of an operation to show that its activities contribute to the welfare and well-being of the current generation without compromising the potential of future generations: this is the widely accepted principle behind sustainable development, (Brundtland, 1987). The problem in operationalizing this ideal has been disagreement of how to measure it. The IW proposal, which has been officially accepted for application at national level within international comparison contexts, (UN Rio+20,Constanza et al. 2013), is that development is sustainable if 'Inclusive Wealth' does not decrease as a result of development, even if one or two of the capitals does, either temporarily or permanently (Scholes, 2009).

A systems approach that takes into account economic, environmental and social concerns needs to be fostered in the sustainability domain (Azapagic, 2004). For a mine to contribute to sustainable development, it must reduce its environmental impacts (including social impacts) throughout its life cycle by implementing necessary environmental management systems and social programmes.

In practice, this will often mean that a mine must perform beyond its regulatory requirements, because performing within required legislation does not automatically mean sound environmental or social practice (Hilson & Murck, 2000). According to Ross (2004), mineral wealth should offer governments the opportunity to grow the economy and reduce poverty by minimizing equality. Economic stagnation and civil conflicts may increase in mining communities if economic, social and political challenges are not managed well. Therefore sustainable development needs to be fostered.

In relation to the 2015 Sustainable Development Goals, The Inclusive Wealth Index per capita is being used as an indicator of inter-temporal human wellbeing to a country's economic growth in the context of sustainable development (UNU- IHDP & UNEP,2014). In this sense , IW can also be defined as the social worth of an economy's productive base (Dasgupta, 2007). Manufactured Capital is also known as 'investment' by income accountants, meaning accumulation of reproducible wealth (Dasgupta and Duraiappah, 2012). It is expressed as a present asset value, where in principle the value of the asset is the net present value of future income which can be derived from it. Natural Capital, by analogy, is the net present value of future flows of ecosystem services. Human Capital comprises of things which help to assure future livelihood benefit flows, such as education and health and skills (Dasgupta, 2007) . The slightly broader concept of social capital also includes other issues which are of value, such as social cohesion, networks and good governance. However, these are harder to quantify, and especially to assign monetary value to.

The Gross Domestic Product (GDP) has been almost exclusively used to define economic success at national scale, yet it does not explain whether capital stocks (inclusive wealth) are enough to generate consumption flows for future generations. Many nations have focussed on consumption, production and employment as main issues that promote the wellbeing of their nationals. IW, by contrast provides a thorough overview of capital stocks of the three key assets of any nation. Therefore, IW more appropriately measures human wealth, development and progress, than single-focus metrics such as GDP, (UNU-IHDP& UNEP, 2014). The components of IW also have individual utility: for instance Natural Capital can be used to quantify ecosystem degradation and restoration, (Scholes, 2009).

Rationale and aim of the study

The aim of this research is to evaluate the contribution of a single large mining project to sustainable development in local area in South Africa, by applying the concept of inclusive wealth. The project being assessed is the Mogalakwena Platinum Mine; IW is the metric to be used in evaluating whether the mine makes a positive and sustainable contribution to the local community and to South Africa as a whole, over its lifetime and beyond.

CHAPTER 2: LITERATURE REVIEW

Introduction

This chapter comprises a Literature review of IW, the three capitals, sustainable development and ecosystem services.

Sustainability is a growing concern worldwide, especially in the mining industry. Mining companies need to engage in business transformations whose core attributes are based on sustainable development. In some framings of sustainability, this is impossible for an industry predicated on the use of a non-renewable resource.

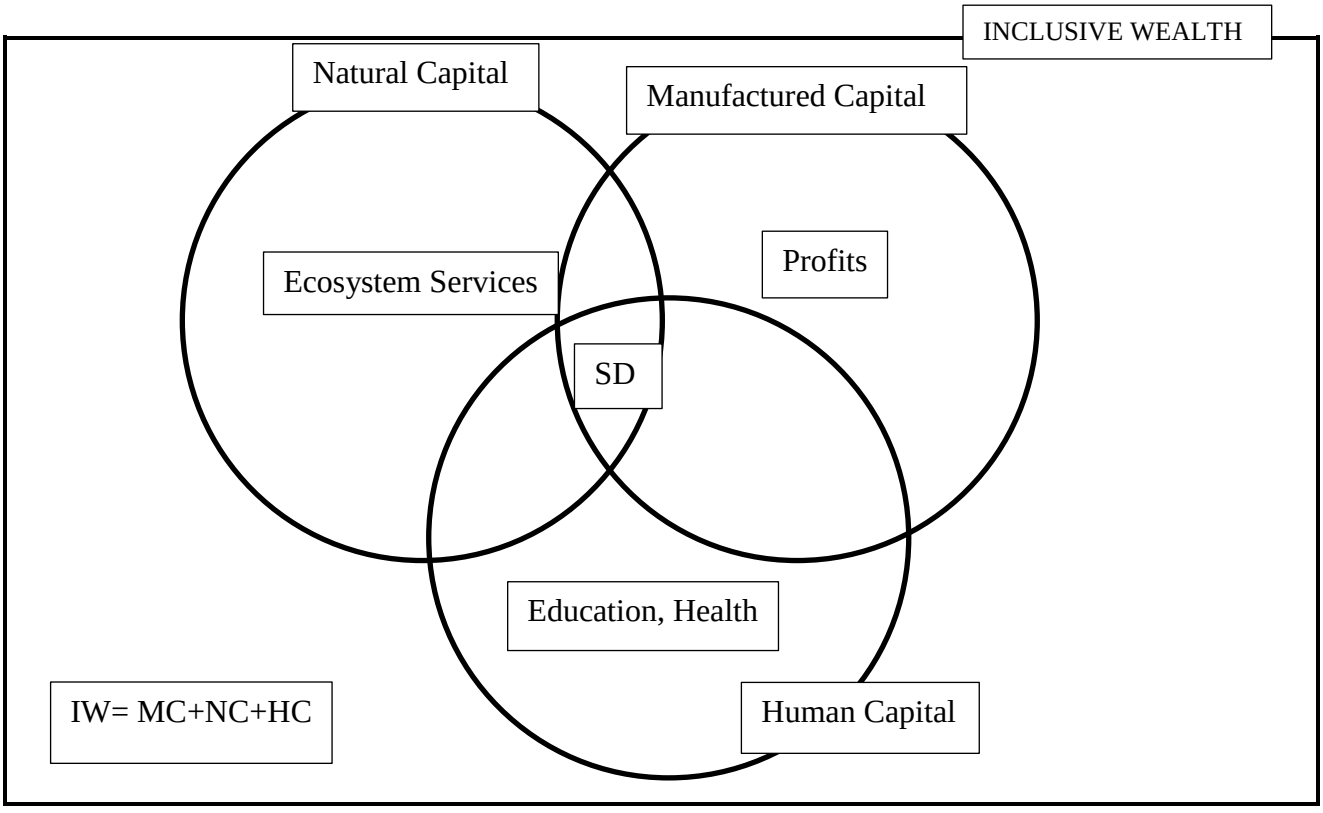


Figure 1: Relationship between Inclusive Wealth, Sustainable Development and ecosystem services.

Sustainable development needs to be fostered in local communities where extraction occurs, as well as at higher levels of social organisation, such as the nation. Mineral wealth should offer governments the possibility to reduce poverty by minimising inequalities and grow the economy.

If the social, economic and political challenges are not managed well there is likely to be economic stagnation and civil conflicts in those respective communities (Ross 2016).

Debates on Sustainable development

Many people consider the concept of 'Sustainable Development' to be an oxymoron, in other words, a contradiction in terms. How can a development, by definition a change to the status quo, ever be sustainable (where 'sustainable' is implicitly considered to be 'keeping things as they are')? Other viewpoints are more accommodating. According to Gray and Milne (2002) sustainability is the efficient use and allocation of resources over a period while the distribution of resources is fair and spreading the opportunities between the present and future generation equally. Aronson et al. (2012) also mention that sustainable development has two perspectives through which it may be defined: Human well-being is stressed by some proponents while other proponents emphasise the maintenance of natural processes. Some framings of sustainability state that things should be returned to some former 'better' state, or at worst kept constant at their current state. The IW concept requires that for development to be considered sustainable, economic well-being, other aspects of human well-being and the quality of the environment *considered collectively* should not decline, (Dasgupta, 2007).

The idea of sustainable development is not new but the way it is implemented, promoted and reflected upon keeps changing. Blewitt (2014) explains that sustainable development is seen as an idea stating that the future should be better and healthier compared to the present and the past. According to Arrow et al. (2012), sustainable development implies that human beings behave in ways that keep and improve their economic well-being, the quality of the natural environment and social justice. Sustainable development should be understood in broad terms (Blewitt, 2014).

According to the Global Compact Report of 2013, CEOs feel that the business world is not adequately focussing on the global sustainability challenges. The positive is that most CEOs are now taking a systems approach to sustainability and they are now concentrating on the impacts of business. The global Compact has helped CEOs to come together and understand critical sustainability issues. They have set common goals which they will all commit to and work on challenges as they forge ahead.

Can mining be sustainable?

Natural resource extraction results in a lot of changes to both the environment and the social fabric, resulting in challenges. Mining is an extractive industry, depleting a non-renewable resource, and as such is considered inherently unsustainable by many commentators, (Dashwood 2012: as cited in Bird, 2014). Once the resources have been depleted they cannot be replaced. This is a flaw in the simplistic use of GDP as metric of development: classical GDP counts the positive benefit flows from mining, but it ignores or misallocates the negatives (see below). It completely ignores the fact that once a non-renewable resource is extracted and sold on, that asset must be subtracted from the net wealth of a nation- you no longer own it. Recent protocols for calculating Systems of National Accounts ('Adjusted GDP') try to fix these flaws. To embrace the concept of sustainability within this worldview, mining firms have largely engaged in Corporate Social Responsibility programmes in order to demonstrate their social responsibility and environmental friendliness. The critique is that these pay lip-service to sustainable development, but are essentially image management exercises rather than going to the core of their operations and addressing the impacts which they have.

Mining could be considered sustainable if the value inherent in the exploited resource is turned into a viable, renewable resource of human wellbeing or sustained improvements of ecosystem productivity based on some other, renewable, resources. This can be achieved through good investment, the creation of social capital and the reduction in destruction of natural capital, or its restoration, (Eggert, 2001).

In both industrialised and developing countries, mining firms have come up with policies to mitigate the adverse environmental impacts of their activities and to work within their stipulated environmental policies. Most companies now strive to comply with all environmental regulations in their host jurisdictions. According to Bird (2014), it is paramount that sustainable development be viewed in light of addressing issues such as pollution, health, safety and local community engagement; but it is also important to consider the ways in which mining contribute towards the economic development of host countries, for better or worse(Bird, 2014).

Numerous studies have been conducted to try and find out how biodiversity can be successfully conserved. Margules and Pressey, (2000) came up with six steps that can be used in conservation Planning and these can be employed at Mogalakwena mine.

1. Compilation of information concerning the biodiversity of the site to be rehabilitated.

2. Conservation goals should be identified for the planning site.

3. A review of the already existing conservation areas, i.e. Groenfontein farm.

4. Alternative conservation areas should be selected of where rehabilitation can take place.

5. Conservation actions should be implemented.

6. Maintaining standard values of the conservation sites.

Mining in Australia has a noticeable, environmental impact but does not have the largest physical footprint... A lot of mines in the world are expected to close in the near future. It has been discovered that a number of mining countries do not have appropriate legislation and policies for mine closure in place. Successful mine closure should be in accordance with the public's interest. Performance standards should be set in order to assess the success of mining rehabilitation. Monitoring progress against set standards is also important(Cristescu et al. 2012).

Indices of development

The most widely used yardstick of development is the Gross Domestic Product (GDP). In South Africa the average GDP per capita is high relative to many African countries while still being well below the level in developed countries. The use of averages alone is problematic, since it ignores distributional effects i.e. inequity (the huge gap between the rich and poor). GDP per capita correlates poorly with people's subjective perceptions or well-being above a certain minimal level; and it does not take into account resource depletion and environmental damage; for instance it counts the economic activity in the health and pollution clean-up sectors as positive contributions to the well-being of the country and its people.

The Human Development Index (HDI) is now preferred in many countries as a measure of well-being (Bohensky et al. 2004). HDI is the combination of GDP per capita with mean educational

level and longevity, in an unweighted fashion (Agarwala, 2012). While this is a better measure than GDP alone (Aoki-Suzuki, 2015), it does not consider the issue of whether the three factors can simply be averaged. They are not in the same units, and are therefore first 'normalised' in a rather arbitrary way. The lack of weighting implicitly says that the three factors are equally important: but are they? HDI takes no account of environmental or natural issues at all.

Inclusive Wealth presents itself ahead of HDI as it strives to overcome short sighted estimates of the HDI by looking at the changes in produced human and natural capital over time so as to provide a long term perspective on a society well-being and sustainability, (Powell, 2012).

Inclusive Wealth

At the Rio+20 UN conference, a consensus was reached that "the shift towards sustainability as a core development pillar demands an index which will quantify measure and track sustainability" (UNITED NATIONS 2012, UNU-IHDP& UNEP2012). Inclusive Wealth and an IW indicator were the response to these deliberations. It has a strong and operational conceptual basis: by defining each of the capitals in a consistent way as the net present value of future expected benefit flows, if those benefit flows can be assigned a monetary value, the capitals all have the same units, and be summed without arbitrary normalisation or weightings. The units (monetary value) are in readily understandable terms for decision-makers. IWI per capita, in relation to the 2015 Sustainable Development Goals (SDG's), is being used as a metric of inter-temporal human well-being to a country's economic growth in the context of sustainable development (UNU-IHDP & UNEP, 2014).

The history of human development in the world, including in South Africa, most often starts with the depletion of natural resources, such as forests, soils minerals or wild populations (Scholes, 2009). Everyone has an impact on the earth because we all consume products and services of nature (Wackernagel et al. 1999). Industrialization has grown at rapid (and to some, alarming) rates. This has affected the global environment to such an extent that some of the effects might be irreversible (Hart & Milstein, 2003). This 'borrowing against natural capital' can result in net human well-being benefits in the present and future generations provided that the natural capital is converted into other forms of wealth, well-being and opportunity efficiently, or is later restored, (Scholes, 2009). The increase in other forms of capital must be bigger than the loss of natural

capital incurred. Examples of inefficient conversion can easily be found: where the benefits accrued to society are much smaller than the losses they sustain; or where the benefits are concentrated among a few ('elite capture'), but the losses are carried by many; where the benefits are taken in the short term but the costs are borne by future generations; where the benefits are exported but the costs are local; or where the financial benefits are not invested in productive ways, but are consumed in spending which yields no long term benefit (Scholes, 2009).

In the IW conceptualisation, mining contributes to sustainable development if mineral wealth from extraction can be invested properly, economic benefits from mining are sustained, social and natural costs are avoided, minimised, compensated for or restored, (Eggert, 2001). A program or project that advocates sustainable development must ensure that the economy and human well-being flourishes (Lautensach & Lautensach, 2013). A robust way of measuring development should take into account a variety of forms of wealth that also include a wide range social, natural and human assets (Bird, 2014). This means that the wealth of a natural system should be kept and managed properly to meet future needs. Social and natural capital cannot generally be replaced over short time scales (years to decades). Thus in many cases, sustaining them must take priority over manufactured capital which is often quite short-term and replaceable, (Ochola et al., 2010).

IW as a metric and an indicator has its own limitations. Its theoretical assumptions have been questioned, together with the gaps in data availability. Racelis (2013) describe IWI as a measure of the social value of the capital assets of any nation beyond manufactured capital. However, it still undoubtedly standout as a promising endeavour, (Thiry & Roman, 2014).

Manufactured Capital

Savings and individual investments derived from income are financial and commercial assets. The size of the 'capital' is calculated, implicitly or explicitly, in terms of its future earnings potential. For a financial asset such as money in the bank, or ownership of a share portfolio, this is readily done because it is directly reflected by their market values. For other forms of MC, such as buildings, infrastructure or machinery, it is implicit in their depreciated present value.

According to United Nations University International Human Dimensions Programme (UNU-IHDP) and United Nations Environment Programme (UNEP) (2014), a lot of countries are doing

well in improving the wellbeing of their citizens when measured in purely financial terms. Finance ministers are mostly interested in the foreign exchange balance and the tax receipts while they base their budget decisions on indicators such as Gross Domestic Product (GDP) (Pagiola et al. 2004). For example, if GDP is the measurement tool for well-being, economic gains will be seen to have been attained and the trends to be positive, even though some countries are better off than others. However, GDP per capita has been criticized as a measure of human welfare (UNU-IHDP, 2015). It is often used to measure certain ecosystem benefits but is not comprehensive since it undervalues (or ignores) the benefits of natural ecosystems and does not take into account depreciation of natural and other capital assets (Pagiola et al. 2004).

Natural Capital and its basis in ecosystem services

For any type of development to be sustainable the conversion of natural capital should result in the creation of equivalent social and or economic capital, (Limpitlaw, 2015). In a way exactly analogous to Manufactured Capital, Natural capital is the net present value of future flows of ecosystem services. Natural assets include, among other things lands, forests and water sources. The natural asset value is dependent upon the quality and extent of resources. Changes in global prices for resources that are sold internationally can have a negative or positive impact on the value of natural assets (Bird 2014) as evidenced by the current global economic conditions.

The changes in biodiversity have generated worldwide concern due to a number of reasons which include ecotourism, "mining" for medicines, ethical and aesthetic reasons according to Barbier et al. in (Hooper et al. 2005). Ecologists have also raised concern on the effects of changing biodiversity on ecosystem properties such as hydrology, productivity, nutrient cycling and carbon storage. They have also delved into the effects of anthropogenic activities on the changes in biodiversity and how they affect the goods and services that ecosystems provide to humans and their well-being. It is usually of concern if changes in biodiversity really affect ecosystem properties. The main concern is whether the changes in properties will result in adverse influence on human well-being? Natural systems like wetlands, forests, grasslands and woodlands to mention a few, are used directly to generate income (Emerton, 1999). Another worldwide concern is the extinction of species. Indigenous species extinctions are regarded to be as important as global extinctions; significant changes in abundances are as important as other factors in affecting

ecosystem properties. The tremendous effects of alien species and Indigenous extinctions are very common in the South African context. Invasive Alien plants (IAP) are proving to be hard to reverse, as seen by the numerous efforts and attempts being made to reintroduce species or to get rid of I A P's (Hooper et al., 2005).

Human Capital

Human capital encompasses those things which help to assure future livelihood benefit flows, such as education and health. Other 'capitals' approaches also talk of social capital, which includes things like a sense of belonging, networks and social cohesion; and 'governance capital' which includes rule of law and good governance, (Saegert et al., 2002).

Human assets include skills and health and these increase in value if there is development in terms of school systems, health services and so forth. The presence of these infrastructures means that the value of human assets in relation to economic productivity is greater.

Is Inclusive Wealth meaningful at local level?

The concept of IW and the methods to calculate it have to date mostly been defined and carried out at national level(UNU-IHDP, 2015). In principle, the idea can be applied at other scales as well; for example upward at global level, or downward at local government level. The question being answered in this project is: can it be usefully applied at the level of a single project, such as a mine? Mines unavoidably result in the reduction of some forms of natural capital in the long term (the depletion of an ore reserve), and others in the short-to-medium term (the loss of habitat and ecosystem services due to the physical infrastructure, mining operations and waste dumps). Depending on how carefully mining is conducted, and how effective post-mining restoration is, the negative natural capital impacts in the short, medium and long-term can be reduced. By paying wages, constructing physical structures (roads, water supplies) and investing in 'social infrastructure' (e.g. training facilities, clinics, housing, sanitation) that are necessary for running of the mine, mining contributes positively to inclusive wealth of the local area and far beyond (Bird, 2014).thus the IW impacts of a local mining project are felt at local level, regional (district) level, national level and international level. Can these impacts be teased apart in a way which does

not result in double counting? Can doing so help to balance the tendency for the benefits of mining to accrue at national and international level, but the costs to accrue at local level?

Mines can work hand in hand with governments, businesses and civil organisations to develop infrastructures that are useful to their own activities (water systems, health systems and electricity grids), but also providing benefits to adjacent communities. Bird (2014) states that apart from paying taxes, mines also contribute to the wealth of the nation by finding ways to add to human, productive, social, financial and commercial assets of the country. Mines will eventually close and the communities in which they operate in together with the government, use up much of the wealth derived from mining during its lifetime. It also important for mines to find ways to foster inclusive wealth development in the communities they operate in so that they address sustainability challenges at mine closure (Bird 2014).

Ecosystem Services

According to Fisher et al., 2009, "Ecosystem services represent the goods and services derived from the functions and utilised by humanity". Ecosystem services are a source of livelihood to communities. They are categorised as provisioning, regulating services, supporting services and cultural services as seen in the case study of the Gariep Basin, (Bohensky et al. 2004). Natural ecosystems provide commodities such as edible fruits, materials for clothing and construction, edible animals and medicinal products. Other communities value the cultural and aesthetic value of natural ecosystems. In some instances, ecosystem services provide biological and chemical processes that are of use to human livelihood and these include water purification, soil formation and pest control among many others (Pagiola et al. 2004). Destruction and degradation of natural ecosystems and loss of biodiversity has become an issue of global concern as it affects the well-being of people.

The Utilitarian framing formed the basis of ecosystem services in the 1970's as it depicted ecosystem functions as a service that increased the public's interest in biodiversity conservation. Daily (1997), started the concept of ecosystem services when he tried to explain society's dependence on ecological life support systems. Gomez-Baggethun et al. (2010) highlighted that ecosystem services were developed as a serious part of the research agenda after the Beijer Institute's Biodiversity Programme in the early 1990's. The research priorities that were pointed

out in this programme were later addressed in a number of publications including Daily 1997 and Constanza et al. 1997.

The Millennium Ecosystem Assessment (MEA) was introduced to take stock of the ecosystem conditions and to map out the trends in ecosystem services. The assessment was also a drive to explore future scenarios and identify what drives ecosystem changes. It gave way to understanding the necessity of ecosystem services and to create awareness of the results that arise when ecosystem services change and how they affect human well-being. Over and above, the assessment would also provide action for maintaining continual provision of ecosystem services, (MEA 2005).

The livelihood of communities is supported by the provision of ecosystem services. The MA classification of 2005, define ecosystem services as: cultural services (which provide non material benefits), supporting services (nutrient cycling, soil formation), provisioning (water, food and fuel…) and regulating services (these control climatic processes, diseases, and land degradation). Rural communities in Mokopane depend on the ecosystem services and products for them to thrive. Natural systems provide edible animals, commodities such as edible fruits or plants, medicinal products and materials for clothing and construction. Others value the cultural and aesthetic value of natural ecosystems. Ecosystem services also provide biological and chemical processes that are used by human beings for their livelihood and these include water purification, soil formation and pest control (Pagiola et al. 2004).

A number of ecosystem functions have been characterised as services, valued in monetary terms and they have been incorporated into markets and payment mechanisms. Environmental and resource economics developed methods to value and include economic impacts on the environment into decision making. According to Constanza et al. 1997 as cited in Gomez et al. 2010, undervaluation of the ecological dimension will translate to the fact that services provided by natural capital are not adequately quantified in comparable terms with economic services and manufactured capital.

The link between IW and SD

Sustainable development encourages a vibrant environment which directly contributes to improving human well-being, (Wood & DeClerck 2017). The global economy is based on the

neoclassical economic theory which state that consumption growth is strongly inter linked with individuals' well-being, (Marks et al., n.d.). In a thriving mining town, people are able to purchase goods and services that enhance their quality of life.

The relationship between well-being and ecosystem services is complicated and changes over time, (McMichael et al., 2005). The growing demand in world economies and the rapid population growth has resulted in a lot of pressure being put on natural ecosystems. There has been an increase in the conversion of natural ecosystems to mining, agriculture, industrial and residential use. The conversion is also a result of prosperity of humans all over the world leading to the escalated demand for ecosystem inputs. Pagiola et al. (2004), points out that loss of biodiversity, destruction and degradation of natural ecosystems is alarming and has become a cause of concern across the globe because degradation of ecosystem services will eventually affect human wellbeing. The tremendous pressures that ecosystems face today have been caused by intentional and unintentional human activities. Forests have been converted to other uses, wetlands have been drained and agricultural land has been degraded which is enough evidence that ecosystem services are being overlooked.

CHAPTER 3: METHODS

Introduction

Study area



Figure 2: The location of the Mogalakwena Platinum Mine in the Limpopo Province of South Africa.

Mogalakwena platinum mine, a large open pit mine located in the north-western part of South Africa in a town called Mokopane. It is one of the largest platinum mines in South Africa. The local municipality's major economic activities include tourism, mining, conservation and agriculture. Mining is the key activity and there are no other significant large employment sources.

According to the Mogalakwena Housing and spatial development framework draft status quo document, the area is rich in a wide spectrum of natural vegetation and physical environments that enable it to provide habitat to small and large mammals which include birds, reptiles, amphibians and insects. A lot of farms including cattle farms have been have been converted to game farms.

Hippos and crocodiles are still found in their natural habitat in the majority of the perennial rivers. Leopards and cheetahs are still found to roam over large areas of the Mogalakwena Area.

Calculating IW and the Capitals

The Inclusive Wealth Index is calculated as follows:

$IWI = P_{MC} \times MC + P_{HC} \times HC + P_{NC} \times NC$ (Thiry & Roman, 2014).

MC – Manufactured Capital

HC – Human Capital

NC – Natural Capital

P_{MC}, P_{HC} , P_{NC} – Respective Shadow Prices of the 3 capitals

Manufactured Capital

Conventionally, this involves the measuring of stock estimates by:

- Accumulation of investment and depreciation in a permanent way.
- Accumulating them in addition to the known capital stock in the reference year (Yamaguchi et al., 2014).

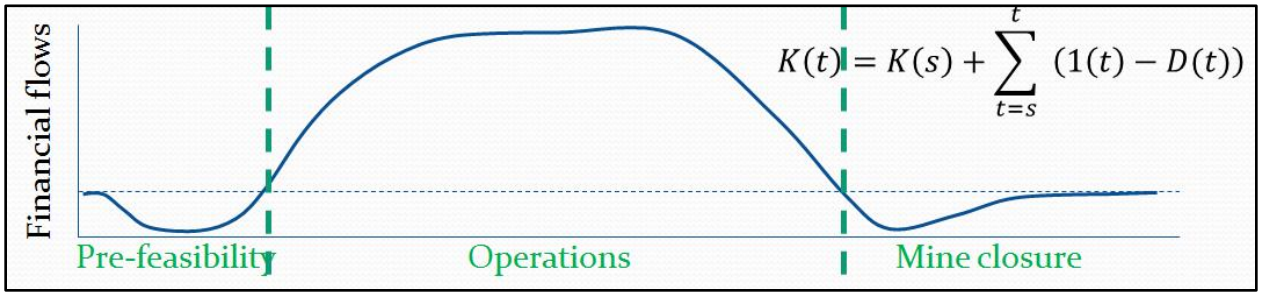


Figure 3: Manufactured Capital

I (t) – investment

D (t) – Depreciation

T - Time

Manufactured capital is divided into corporate stock, housing stock (plants, public stock and machinery) the stock categories are combined in K (t) which is MC in the IWI equation.

s - Base year

In this study we used a different approach, treating the value of MC in exactly the same way as the value of NC and HC- in other words, as the net present value of future income streams. The income streams were estimated from an ore mining rate, the platinum content of the ore, a price of platinum and an estimate of the costs per tonne of the mining operation. Since much of the mine lies in the future (just as it would if this assessment was done at start of the mine, as it normally would be), reasonable estimates have to be made of all quantities. The key ones are the difference between future platinum prices and the cost of extraction- currently negative (i.e. uneconomical), but positive in the longer term or else mining would never be undertaken.

$$\text{Value addition} = (\text{price of platinum/Oz} \times \text{platinum produced Oz/yr}) - (\text{cost of platinum Oz/yr} \times \text{platinum produced Oz/yr})$$

The price of platinum used was determined using the international platinum prices found on the internet, (https://www. Goldbrokers.com/charts/platinum-price/zar)

- For purposes of this study, the following platinum prices were used:

  1993 – 1999 $500

  2010 - $1500

  2014-2017 - $1300

  A price of $1100 was assumed for the rest of the life of mine based on current international prices putting into consideration the high costs of platinum production at the moment.

- The rand exchange rate of R13/$ in 2017 was used for this research. Dollar/Rand fluctuating exchange rates from 1994-2015were also taken into consideration, (http://businesstech.co.za/news/general/82273/sa-rand-value-1994-2015).
- Rates and taxes paid to Mogalakwena municipality = R2, 2 million, (Mogalakwena Value added poster, 2013). 2013 was used as the base year.
- The Ore reserves for Mogalakwena platinum mine are 3696200000 tonne according to the mine's EMPR of 1993.

Ore mined was 360 000 tonnes/year, according to the Amplats Annual Report, 2014.

Ore grade at Mogalakwena mine is 8g/tonne (0.285714286 ounces/ tonne where 1ounce= 28.3g)

Cost of producing an ounce of platinum of $1272/oz. was used in 2014 and this was according to platinum production costs by world region 2013-2014, (https://www.statista.com). The drop in price of platinum in 2016 and 2017 has been predicted to be short term. Capital economists forecast that by 2020 will improve to about $975. However, for purposes of this study, the platinum price has been assumed to be $900 from 2018 onwards in order to calculate I.W of Mogalakwena Platinum Mine.

- Split between international and national dividends was assumed to be 50/50.

In order to carry out the specific objective of this research, i.e. can IW be applied usefully at local scale, manufactured capital was sub-divided into local, national and international scales using the various mechanisms (dividends, taxes etc.) by which the wealth is distributed at those scales.

Manufactured capital (local)

Local scale MC consists of rates and taxes paid locally. In principle it also includes a fraction of the 14% VAT paid on local expenditure (e.g. in part of worker salaries), but it was unclear what size this fraction should be, since VAT accrues nationally and is then redistributed in some untransparent way. The workers' salaries themselves are a cost item to the mine, not a value addition; they are a major element of 'human capital' (HC).

Manufactured capital (national)

- Tax rate for corporates in South Africa is 28% (www.sars.gov.za). For this research, a tax rate of 30% was assumed and this was used to calculate national MC to government. Tax is deducted from the value added provided the mine has made a profit that is greater than zero.
- Dividends paid to S.A institutions and individuals were assumed at 50% of the after tax profit. Tax paid to government plus national dividends added together and brought to net present value make up the national MC.

Manufactured capital (international)

Dividends paid to foreign shareholders were assumed at 50% of the after tax profits and this figure brought to net present value makes up international MC. Analysis of annual reports from Mogalakwena mine from the start of the mine to the forecasted closure were carried out in order to estimate the financial benefit flows that were needed to calculate manufactured capital. The financial flows were projected for the lifetime of the mine (including the rehabilitation and closure phase, where they could be negative, since there are costs incurred but no mineral income). The projection was based on the mine prospectus and estimates of the reserves, and a projection of future international commodity prices. These are highly uncertain, but this uncertainty is important to capture as a risk element in development decision-making.

Human Capital

Educational attainment is used in inferring Human Capital stock (Yamaguchi et al., 2014).

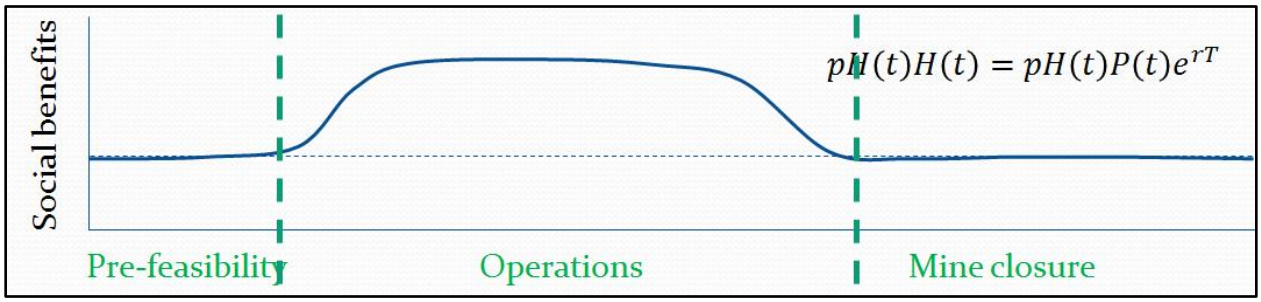


Figure 4: Human Capital

P (t) – population of persons aged 18^{+} years

r – Rate of return on education

T _ Education attainment

H _ shadow price of Human Capital

For purposes of this research, salaries paid and bursaries awarded by the mine where used to calculate the social capital of Mogalakwena platinum mine.

Human Capital calculations

- To calculate HC, number of employment positions created by mine was multiplied with the actual earnings per person for a specific employment category; all three categories summed up and brought to net present values.
- Actual salary rates per person per year were used :

Unskilled labour R100 000

Semi-skilled labour R200 000

Professionals R600 000

- According to the EMPR for 2013, approximately 2000 workers were employed by the mine.
- From the Amplats social labour plan of 2015, bursaries of about R 50 000 each were to be awarded and the following projections were made:

2016 – 11 awarded

2017 – 22 awarded

2018 - 29 awarded

2019 – 35 awarded

2020 – 30 awarded

An assumption was made to calculate human capital with 35 bursaries and keep it constant for the following years only to reduce it to 15 in the last ten years before the mine is foreseen to close in 2052. The number is not expected to grow as the mine can only employ up to a certain number of employees and as time progresses it will only offer bursaries as a way to plough back in to the community and not to employ the respective graduates.

Human capital was estimated from the lifetime earning potential of people affected by the mining operation (i.e. employees and their beneficiaries, incidental beneficiaries and those who might be negatively affected for instance by pollution or loss of livelihoods). These trends were estimated

for the duration of the planned lifetime of the mine, in other words, for present and about one future generation.

Natural Capital

Natural Capital takes into account the Present Value of all current and future benefits of an ecosystem that it generates (Pagiola et al. 2004). For purposes of this research, Ore reserves, Grazing, game farming (tourism) will be used as the land cover types. Ecosystem service flow values for land cover types in Mokopane will be determined by multiplying areas of each cover type, in acres, by estimated annualized dollar value per acre for that cover type (Costanza et al. 2006).

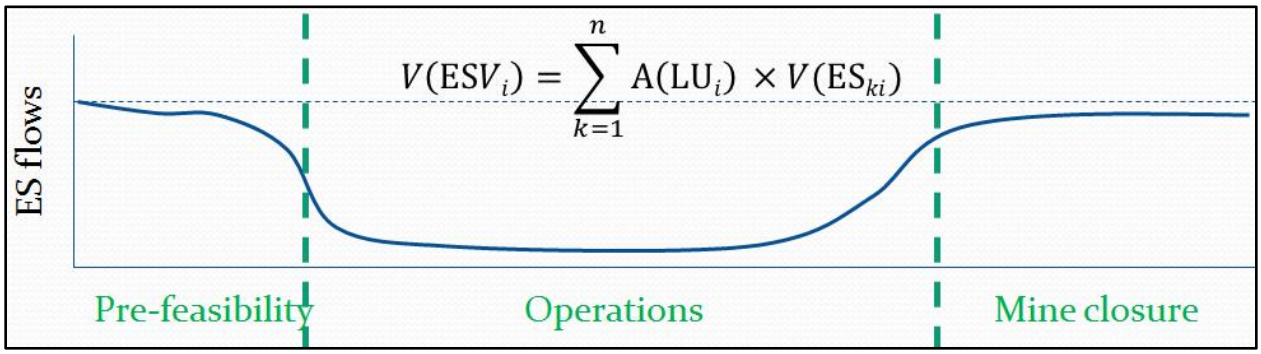


Figure 5: Natural Capital

The total Estimated Service Value (ESV) of a given land use or land cover type will be determined by adding individual ecosystem service values associated with each land use/ cover type (Costanza et al. 2006).

A (LU_i) - Area of land cover (i)

V (ES_{ki}) – annual value of ecosystem service (k) for each land use (i)

Natural capital calculations

Natural capital was to be estimated from the net present value (in all the above cases, a social discount rate of 3% pa was assumed for calculating net present value) of estimated future flows of ecosystem services deriving from water resources (both those impacted by the physical mine footprint, and those used from remote sources but not recycled or purified before release), the loss of agricultural, grazing and wood-production potential due to the physical footprint of the mine

and supporting infrastructure; and the loss of tourism revenue due to the presence of mining. These services had been selected because markets existed for them in the area, and thus monetary values could be assigned. The future trajectory of the flows was estimated from the EMPR.

This was desktop research, based on existing data; Annual integrated company reports and other public domain documents such as the legally required mine Environmental Management Programme Report (EMPR) were used (table 1).

For purposes of this research NC= grazing + tourism + water.

Grazing

Grazing area affected was about 1161 hectares according to EMPR for 1993.

1. Grazing (off take/yr) = hectares affected ×
   carrying capacity of Mogalakwena area (0.125/ha) ×
   LSU production (off take rate) of 18%
2. Grazing = hectares affected (1161 ha) × margin/ha (R131.60)

Water

1. Water values = ore mined (tonne/yr) × water use (1 cubic/tonne) +
   mined and infrastructure area × *lost waterper unit land area* (yield/yr) −
   return flow

Water use: 60 000 cubic meters of purified water and 112 000 cubic meters from the borehole, EMPR, 1996. The value of water in the agricultural sector is) R0.50/$m^{3.}$ A mean annual rainfall of 600 mm is received in the area. Water value after production is (R0.50 – R0.20 = R0.30/m^3), where the 20c/m^3 is the cost of purification back to fitness for agricultural use (Water Research Commission). After mine rehabilitation the water becomes less and less toxic over a period of 30 years, until it is the same as naturally generated water. Water yield of 300 cubic meters per hectare per year was used under natural conditions. Water use is assumed at 1 cubic meter per ton mined. It has been assume that water has two components, i.e. water pumped out of the system by the

mine and water stopped from getting into the river. The return flow of water is 79% in Waterberg (this refers to the water that re-enter the water system after human use).

Tourism

1. Value addition = visitor nights × value add (margin) /tourist/night.

Tourist occupancy per hectare in Waterberg is estimated at 20 guests per 500hectares with a75% occupancy for 365 days per year. This translates to 11 tourists per hectare. It has been assumed that a room is R1000 a night and costs to the establishment is R800 which translates to a margin of R200 per tourist per night. The room rate was averaged after comparing 3 game lodges (Mabula Game lodge, Itaga Game Lodge and Legend Golf Safaris) www.bushbreaks.co.za

It was assumed that there were zero tourism nights from start of mine until rehabilitation and in the 5th year of rehabilitation we had full recovery.

Table 1: Data Collected

TYPE OF CAPITAL	DATA COLLECTED	SOURCE OF INFORMATION
NATURAL CAPITAL	Mineral reserves Water	Mogalakwena EMPR 1993 www.treasury.gov.za/other/epir/waterpdf (21/2/2017)
HUMAN CAPITAL	No. of employment created/yr. No. of bursaries awarded/yr. Earnings/person/yr. Bursary funding/yr.	Amplats EMPR 2013 Amplats SLP Report 2015 Stats SA Census Amplats SLP Report 2015

MANUFACTURED CAPITAL	Contribution of dividends	Amplats annual reports
	Price of platinum/oz./yr.	(https://www. Goldbrokers.com/charts/platinum-price/zar)
	Platinum mined/oz./yr.	Amplats annual report, 2014
	Cost of platinum/oz./yr.	https://www.statista.com
	Dollar/Rand exchange rate	(http://businesstech.co.za/news/general/82273/sa-rand-value-1994-2015). Stock Market
	Tax rate(SARS)	www.sars.gov.za
	Local rates and taxes	Mogalakwena value added poster,2013
	Inflation rates	www.statssa.gov.za

CHAPTER 4: RESULTS AND DISCUSSION

Inclusive Wealth

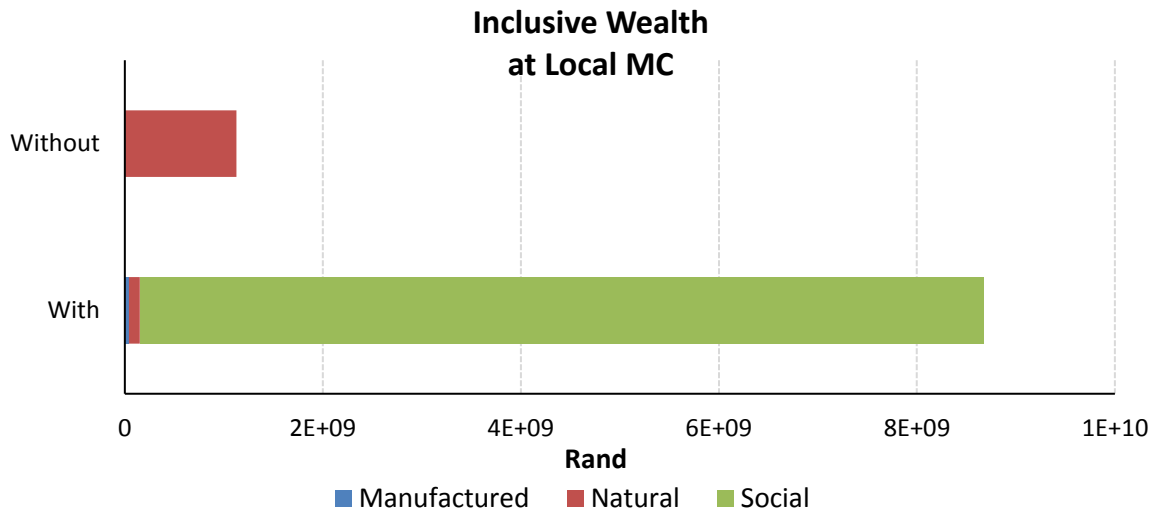


Figure 6: IW of Mogalakwena Platinum mine at local level, with and without the mining project, in rand values of the year in which mining started (1996).

Basing from the information depicted in the above graph, it was concluded that IW at local level with the mine was positive and greater than IW without the mine, despite the decrease in natural capital. This is because manufactured and especially human capital increased much more at this scale than the natural capital decreased. It shows that even at the community scale, agreeing to the mine would be 'sustainable', since the IW with mining is higher than without; wealth can be expected to increase over time.

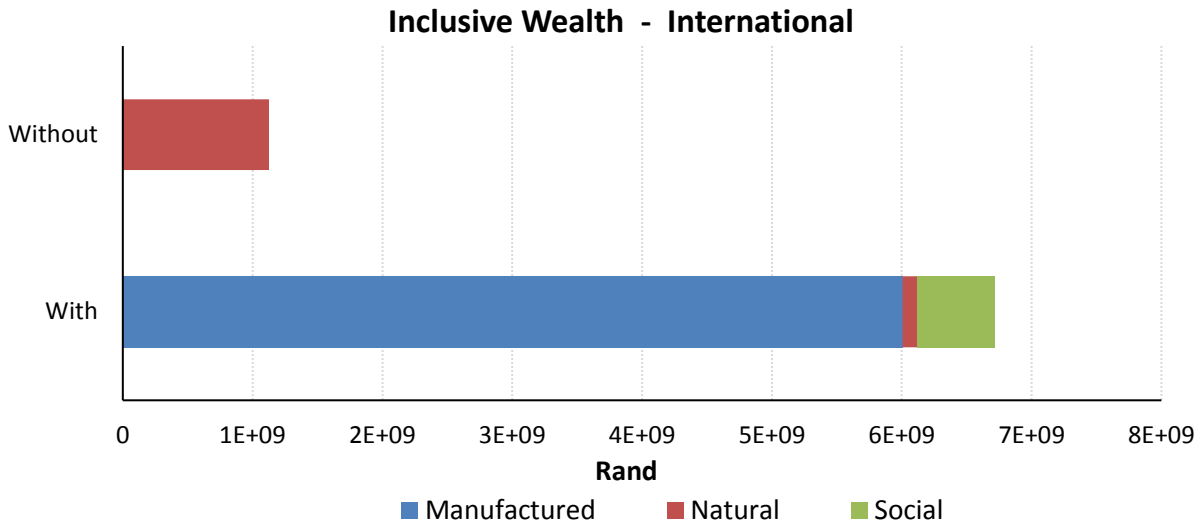


Figure 7: IW of Mogalakwena platinum mine at international scale with and without the mine.

IW is still positive and greater with mine as compared to IW without the mine both at national and international level. However at international scale, unsurprisingly, most of the human capital is expressed as manufactured capital, in the form of return on shareholder investment. Due to the increases in manufactured and human capital, standards of living of SA nationals improve leading to a positive inclusive wealth at national level. The national treasury ploughs back into Mogalakwena community in the form of child and social grants and so their literacy levels increase and life expectancy also increases boosting the national human capital.

Natural Capital

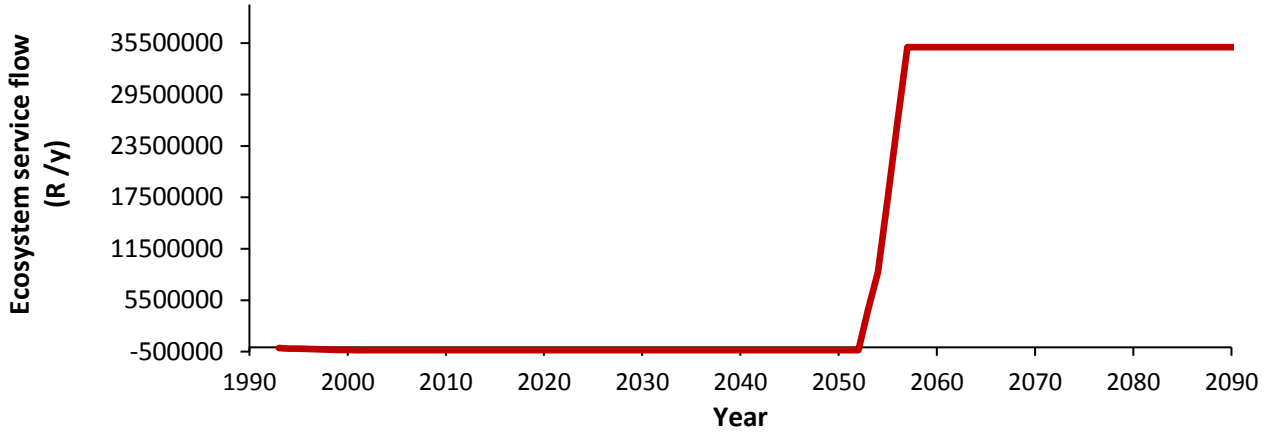


Figure 8: Ecosystem service flow for Mogalakwena mine (Natural capital) in 1996 rand terms.

From the graph above, natural capital was depleted wen the mine started and during its operation due to extraction and exploitation of mineral resources, water, and the prevention of grazing and tourism income. As mine pits increased and production increased water available for use by the community and environment decreased. Useful run off from annual rainfall also decreased as the mine used up a lot of water. All these factors negatively impacted natural capital resulting in negative values and these only improved and started to pick up at rehabilitation and mine closure. However, costs of cleaning up water to a level where it was fit for agriculture is a positive to the community and had positive impacts on natural capital.

The mine seemed to be a following a weak sustainability path as it depleted natural resources but invested in other forms of capital as was seen by the increase in human and manufactured capitals. Approximately 360 000 ounces were projected to be mined every year, (Amplats Annual Report 2014).

As the mine expanded and its pits increased, water available for the community members decreased over time and thus we have negative water values for the period where the mine was in operation. Run off also decreased and all these water values only started increasing at rehabilitation and closure. The ecosystem value of water was set to Agriculture value; the cost of cleaning up a cubic of water to a level where it was fit for agricultural use was a positive to the society as it saved society by cleaning it up.

Manufactured Capital

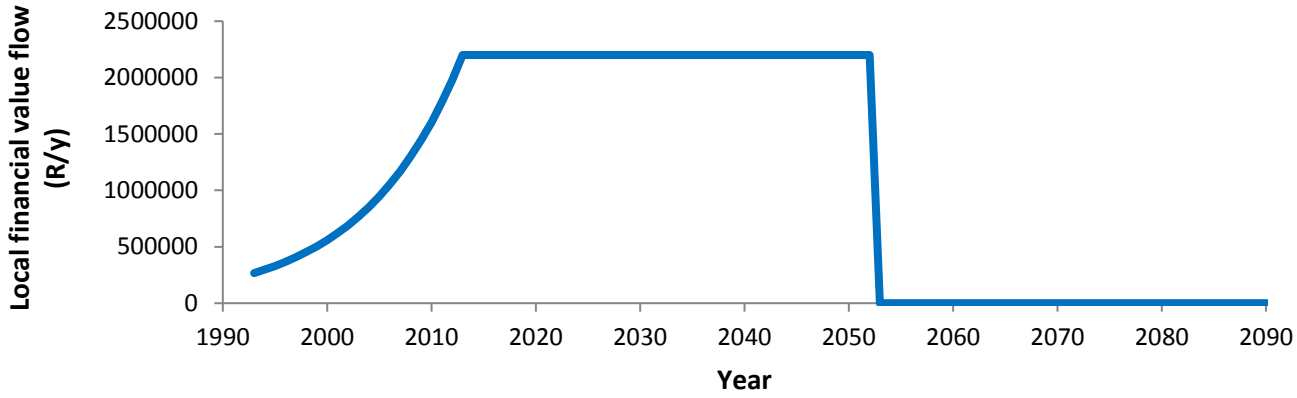


Figure 9: Local financial value flow for Mogalakwena mine (Manufactured Capital).

South Africa produced 77% of the annual global output in 2007, Johnson Matthey, 2008 with Anglo platinum producing 50% of South Africa's annual platinum production. Mogalakwena platinum mine was the strongest contributor in terms of cash generation for Amplats. Genc, 2008 stated that platinum prices were affected by supply and demand, price of crude oil and gold and the ratio of the US dollar, Euro and SA rand among other variables.

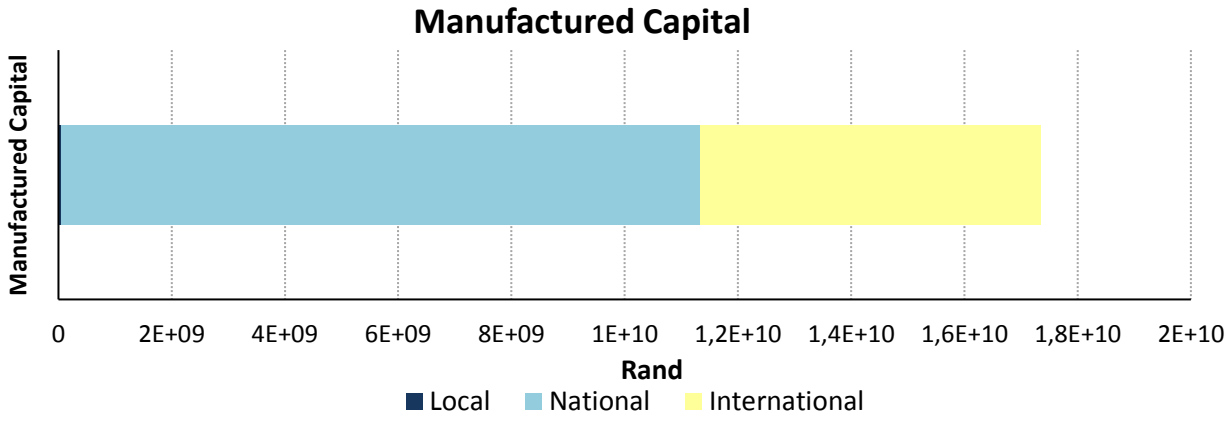


Figure 10: Total Manufactured capital for Mogalakwena platinum mine, classified into that which is delivered locally, nationally and internationally.

Manufactured capital was the greatest contributor to the IW of the mine. Figure 9 shows the gross margin of Mogalakwena mine. The mine was contributing a lot into the economy of S.A through tax payments to the government and dividends paid locally. The bursaries offered to local students

also contribute to national MC as some of the graduates move out of Mokopane to be intercepted into the national labour market and contribute through taxes also. Dividends paid internationally were also high. The operating profit was negatively affected due to the exchange rate fluctuations. There was an increase in input costs due to high energy costs, renegotiated labour wages and due to the low commodity prices. The strengthening of the US dollar caused increased pressure on commodity prices. According to the Integrated Report, 2015, ore reserves decreased in 2015 because of the decrease in Platinum Group Metal prices due to reallocation of ore resources.

Discussion

Community protests that took place in September 2015 led to a loss of 8600 ounces of platinum at Mogalakwena and this caused huge disruptions as there was a lot of property damage. The protests were a result of concerns of community members on lack of opportunities, poor service delivery and lack of employment. The root causes of these strikes were poverty, unemployment and inequality in communities. It was also been noted that community members had very high expectations on job opportunities, local procurement and investment. Political factions were now taking advantage of the unrests and some were fuelling these unrests, tensions were also rife among traditional leaders.

Platinum prices

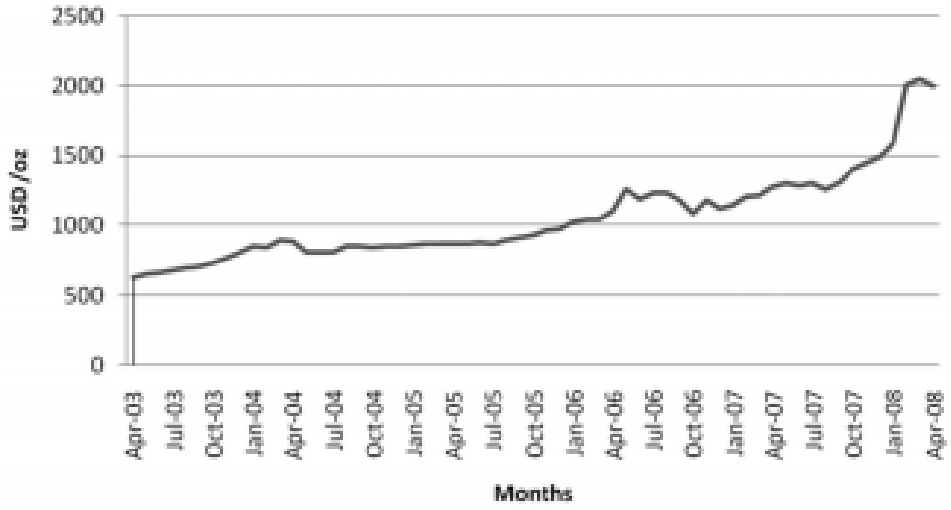


Figure 11: Platinum prices 2003-2008 (www.apmex.com/spotprices/platinum-price).

The price of platinum was obtained from the business tech information obtained from the internet, (www.apmex.com/spotprices/platinum-price). The rand/dollar exchange rates have been

fluctuating for the past years. The prices rose unsteadily up to 2016. These prices were converted to a 1996 equivalent value and these figures were brought to net present values. For the future, the last known price (around $1000/ounces in the last quarter of 2016) was projected, as a constant, but in equivalent 1996 values since that is the reference year. The auto regression integrated moving average (ARIMA) was used and a price of $1032 was forecasted for the last quarter of 2017 with $723 as the price of platinum for 2020, (www.tradingeconomics.com). However $1100 was used till mine closure because platinum demand is forecasted to rise in future due to demand for platinum for other uses especially in the automotive and jewellery industry.

Platinum demand is forecasted to remain flat for the next 5 years based on past trends, (www.platinuminvestmsnt.com). For purposes of the research platinum price for 2017-2021was $1032 which was rounded off to $1100 including royalties, Anglo American platinum executive head marketing, Andrew Hinkly in the mining weekly said that there is foreseen positive long term outlook for platinum. SFA Oxford head, Stephen Forrest reiterated that 2018 demand growth was expected to return and auto catalyst demand growth to dominate demand 3 years on.so to break even in the platinum industry, a price of $960/oz. was needed (www.miningweekly.com).

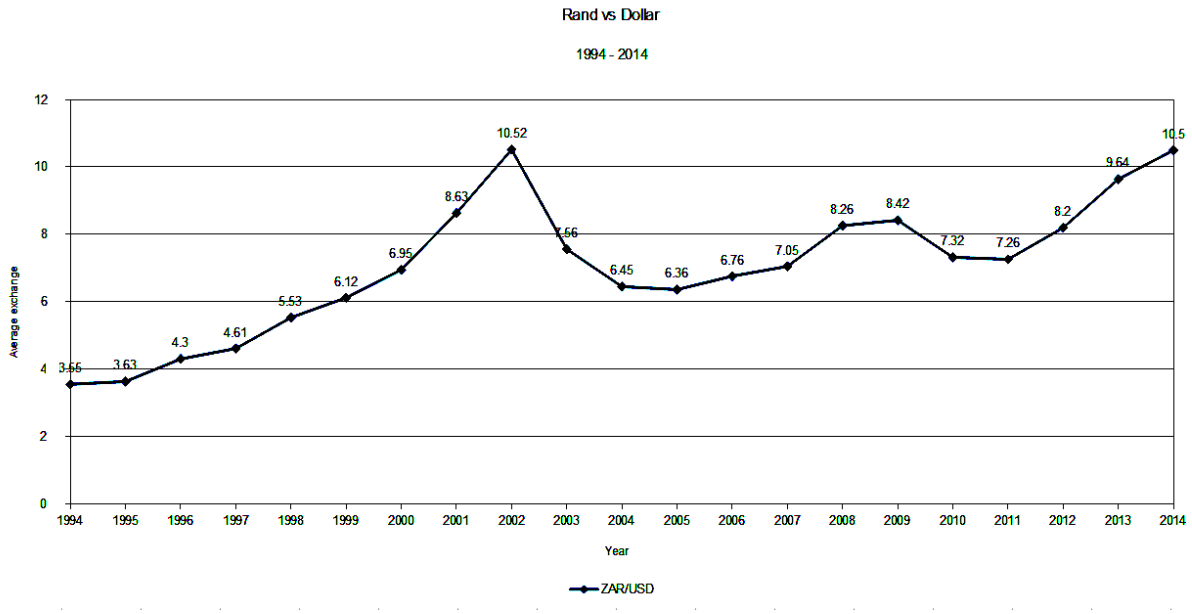


Figure12: Rand versus dollar exchange rates from 1994 - 2015
(http://businesstech.co.za/news/general/82273/sa-rand-value-1994-2015)

Market prices of minerals have been significantly volatile due to the global economic conditions which are beyond the control of South Africa. Platinum prices are denominated in US dollars and this has resulted in accounting volatility. The mine's revenue from its operating and capital expenditure are being affected by the rand/US dollar exchange rate. The rand is expected to be at R14.57 in the last quarter of 2017 while it's expected to tumble down to R16.66 in 2020, (www.tradingeconomics.com).

Costs of producing an ounce of platinum have been on the rise since about the year 2000 and this has a negative effect on the manufactured capital and literally means that platinum mines have been making a loss from the layman's point of view. Cost price is fixed at 2014, as $1272 but was reduced to about $800. It is common knowledge that currently platinum shares have dropped, but mines are still operating because they have probably managed to cut costs otherwise it would not be logical for a mine to continue operation at a loss and investors will also not stick around.

Human Capital

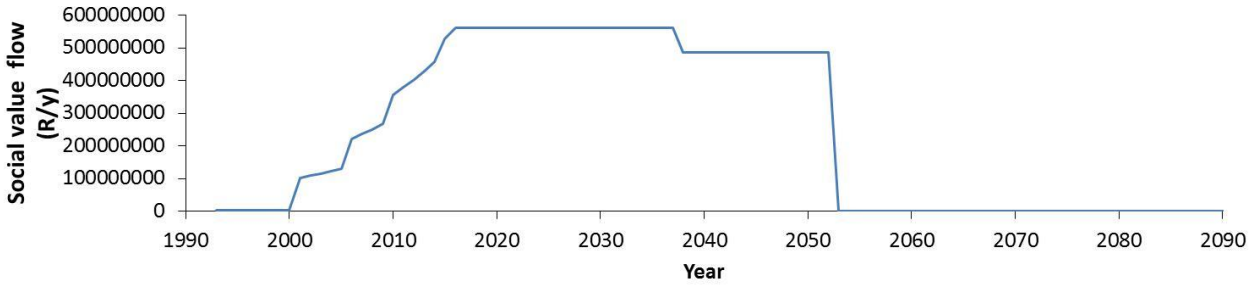


Figure 13: Social value flow of Mogalakwena mine (Human capital)

Employment increased since the mine started as it opened up a lot of opportunities for the local person that is why the graph was rising, and employment increased with increase in population, increase in production and as the mine expanded. The graph has a steady and almost stagnant growth at the peak of mine operation, improved mining methods and increased efficiency will reduce rate of employment in the local area. However, population continued to increase but the

mine could only employ up to a certain level. Use of machinery increased production but reduced employment.

Income based approximations and community development funds were used and future earnings generated by human capital investment. However, human capital is multi-faceted. The health aspect was not included in calculating human capital for this project because it was a challenge to get data in relation to health. Investment in Education in Mokopane is seen to be generating higher returns for inclusive wealth growth.

Employment creation by the mine to community members together with provision of bursaries caused the steep increase in the social capital. By providing employment the community members had an improved disease free year extension by about 5-10 years.

The mine played a very important role in improving the standard and quality of education in the areas around the mine. According to the EMP for 2013 the mine made the following investments:

- More than 2000 people are employed by the mine.
- 865 employees were set to achieve ABET level 4
- Funds were also made available for local people to train in early childhood development.
- Bursaries
- Learnership programmes
- School sponsorships
- Operator academies
- Portable skills programmes
- Winter schools
- Weekend schools
- Health and welfare programmes
- Community training and development which includes Adult basic education training (ABET) and cadetships as part of Mogalakwena sustainable development plan of "helping people to help themselves".
- Employee training and education assistance in relevant fields.

Local Employment challenges

Mogalakwena mine is the key economic activity and the largest employment source in the area. The mine has put in place a policy to look for employees locally first at least employing 30% of its workforce from the community and then further field. However this has been hindered by the current economic situation resulting in it employing about 20% workforce locally. The other

limitation is that the level of education is still very low with matric rate at just 10 %, (Hamman et al. 2009), and so professional and semi-skilled labour is not readily available in the area. According to the Municipal fact sheet published by statistics S.A for the 2011 Census, the area had about 307 682 people with an annual growth rate of 0, 31%. There has been a lot of negative social impacts due to the mine's existence. There has been an influx of people seeking employment in the area causing a large strain on housing needs, water and sanitation facilities.

A net outward migration of graduates that are not affected by mining was observed. Migrant labour was also noted as a problem in the area as this was high though a local advantage was being provided. Labour from outside Mokopane and villages that are not within the50km radius is often resented and this caused a negative impact on the local economy. Mining and engineering skills have been in short supply and thus the mine launched bursary programmes targeted at local children,

It has also been noted that prostitution is very high in Mokopane leading to high levels of HIV/ Aids infections translating to high medical costs for the municipal budget. According to a research carried by Quantec in 2006, it was found that Mogalakwena's HIV/AIDS prevalence rates seemed to increase each year and that the greater component of HIV/AIDS prevalence in Limpopo was from Mogalakwena figures as depicted in the diagram below.

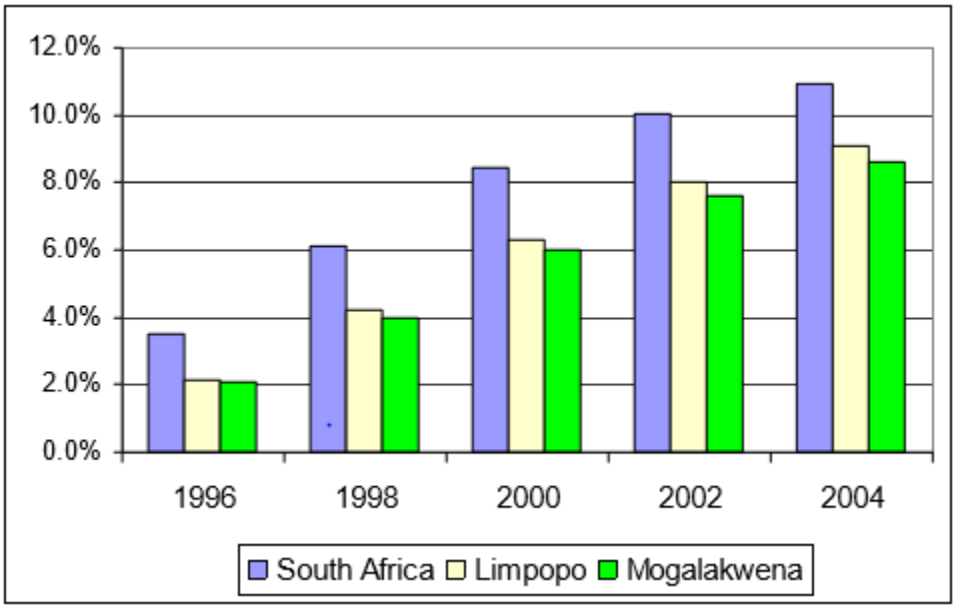


Figure 14: HIV/AIDS Prevalence Rate 1996-2004, Quantec Research 2006.

CHAPTER 5: CONCLUSION

Introduction

There have been a number of studies conducted to try and show that there is an unsustainable decrease in ecosystem services across the globe. There is need to manage well and protect the areas or communities that are important so that ecosystem services can still be provided in the future. South Africa has been included in the Southern African Millennium Ecosystems assessment (MEA 2005), interest in conservation planning and biodiversity research together with agricultural and hydrological research has been generated. Most South Africans who live in the rural areas survive on subsistence farming and depend largely on ecosystem services (Egoh et al. 2008).

The purpose of this research was to analyse the long term trends in local Inclusive Wealth and see how the Mogalakwena mine is performing in efforts to sustainably improve the well-being of their local communities. From the case study, it can be concluded that I W can be applied at a local level. The research managed to assess changes in natural capital over time. It is seen from the graphs below that Natural capital starts off high and eventually becomes very low by the time the mine is closed. The I W impacts of the mine could also be calculated. The reduction in natural capital has been offset by the increase in human and manufactured capital as shown in the findings on Figure 6.

Local human well-being has been improved by the operation of the Mogalakwena Platinum mine. It has built schools and clinics in the communities. Education levels have been improved in the community with the availability of bursaries and introduction of ABET. Community members have been empowered as they have been provided with funds to start cooperatives and have been assisted in registering businesses. All these efforts by the mine to better the lives of Mogalakwena people have contributed to the high Human Capital evidencing that the mine is sustainable.

Manufactured capital is the primary contributor and main source of wealth in Mokopane. There are relatively significant increases in human capital and huge losses in natural capital but it can be concluded that Mogalakwena Platinum mine is contributing towards the welfare and well-being of the present generation without compromising potential benefits of future generations.

This research was also aimed at evaluating the contribution of Mogalakwena Platinum Mine to sustainable development in its local areas applying the concept of inclusive wealth. The results of the research show that the presence of the mine in the Mogalakwena area has brought about a large contribution in inclusive wealth at local scale, and in particular to social capital. The creation of jobs by the mine and other related industries is the main reason for the high social capital. The area was historically known as a rural community with less educated community members made some income on subsistence mining. The area was dominated by poor households with very high dependency ratios and unemployment rates. Over the years the unemployment rate has been seen to decrease from 47.6% in 2009 (according to the IDP Fact Book of 2009) to 40.2% in 2011(Stats SA Census 2011).The social capital has been increased because of the improvement in education levels in the communities. The mine has invested a lot by offering bursaries to its employees and community members.

IW was used to evaluate whether the mine was making a positive and sustainable contribution to the local community and to South Africa as a whole, over its lifetime and beyond. It was found that at local level the manufactured capital was a small contribution but coupled with the social capital it still remained sustainable though not very profitable as manufactured capital was a small fraction. At national level it was observed that both manufactured and social capital had a huge contribution to South Africa as a whole over the lifetime of the mine. However in the long run, the manufactured capital contributions at national level must be ploughed back to local communities to keep sustaining the social capital as the local community is already getting a huge injection from the mine in form of local employment, bursaries and community development projects.

As income grows so does diet. It changes from grain to meat, as mentioned by (Alexandratos and Bruinsman 2012, Tilman et al 2011, cited in IW Wealth Report 2014). It therefore means that land uses need to change. Investment in agriculture and food security becomes paramount in order to accommodate population growth.

Review of research question

Evidence considered above highlight that IW at local level could be measured. It was concluded that IW can be used at local level too and that it is methodologically sound at local level though a lot of assumptions had to be made. These results show that the community is currently living well, only depleting natural capital while investing and saving in social and manufactured capital.

Manufactured and social capital are offsetting any decline in the natural resources and natural quality as evidenced by the high IW while the mine is in operation as compared to without the mine.

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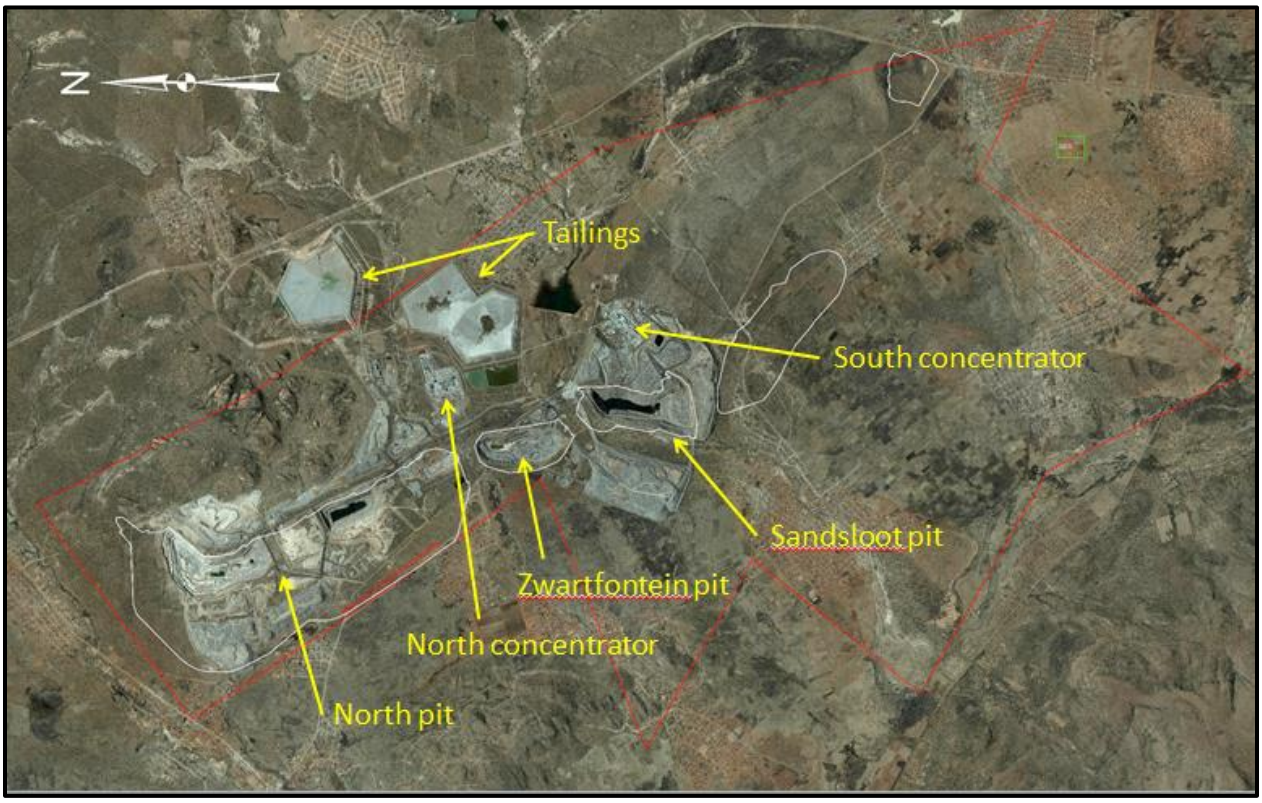
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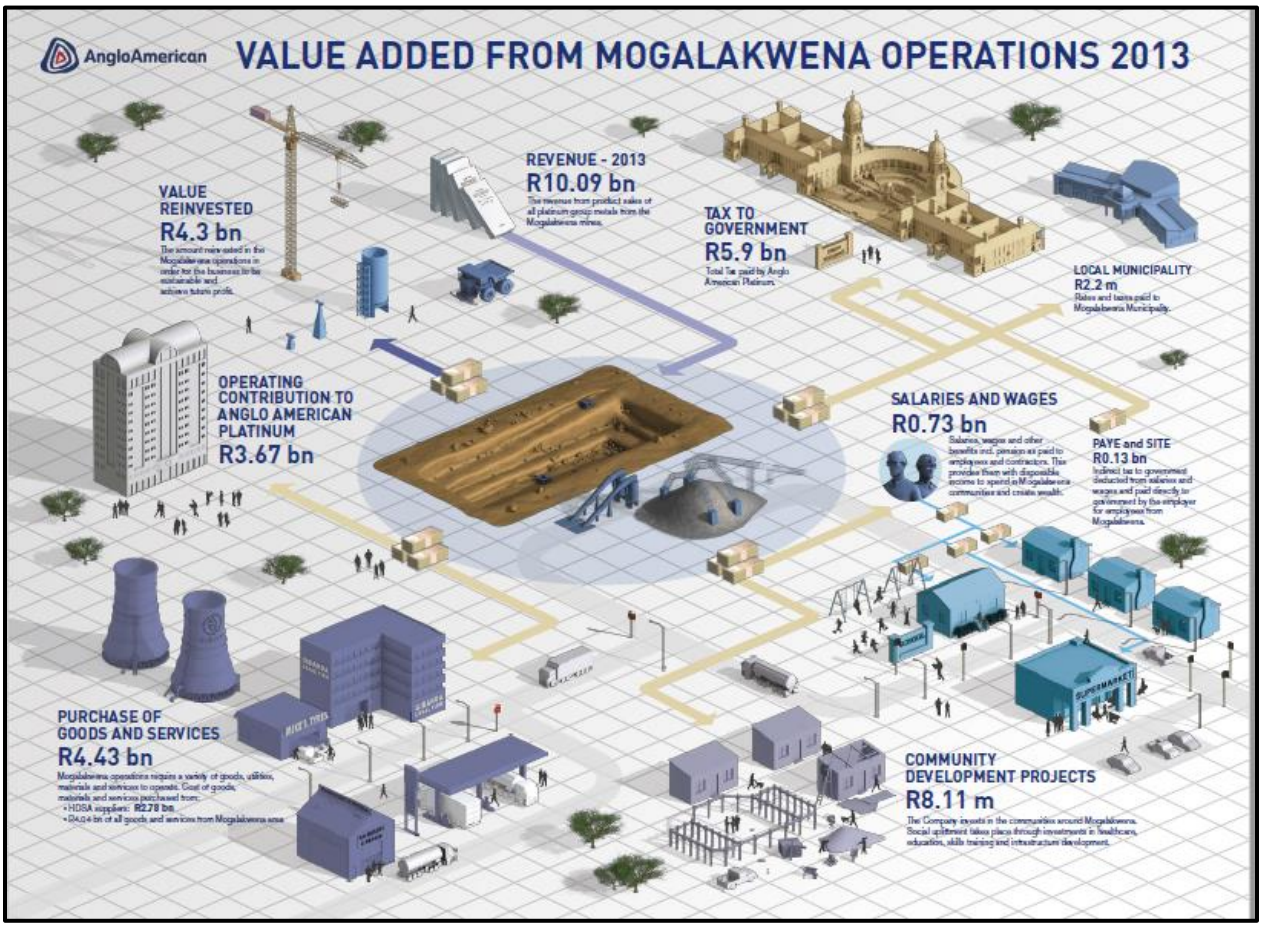
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APPENDICES

Appendix 1: Mogalakwena mine area layout.



Appendix 2: Mogalakwena Value added poster.



Appendix 3: Mogalakwena Mine's Stakeholders

