POVERTY REDUCTION AND DEVELOPMENT CAPACITY OF ARTISANAL GOLD MINING IN ZIMBABWE AND THE ROLE OF ICT

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Abstract

The role of information and communication technologies (ICTs) in poverty reduction and development has been mainly assessed in the context of the agricultural sector. In this paper, we discuss the use of ICTs in Zimbabwe's artisanal gold mining sector. The study uses desk research and a case study of Zhombe District in Midlands province. We contend that this line of inquiry deserves attention because of its huge impact on poverty reduction in Zimbabwe. The study concludes that there is little use of ICTs in the sector and highlights potential ICT applications that would enhance the sector's contribution to poverty reduction and development. For example, while the case study notes current use of ICTs (in particular, mobile phones) for addressing the need for coordination and for communicating the opportunities and dangers associated with this illegal trade, immense scope exists in use of ICTs for disintermediation of the marketing process. Key to the success of suggested ICT initiatives is the need for decriminalization and formalization of the sector.

Keywords: ICT, poverty reduction, artisanal gold mining, gold panning, small-scale mining, environmental impacts, legalization

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Introduction:

The main application of ICTs in the context of poverty reduction and development is in the automation of the knowledge, information and communication components of development activities, projects and programmes (McNamara, 2003). ICTs have been applied to various commercial, developmental, and governance activities (De & Ratan, 2009) with most poverty reduction studies centred on agriculture (Alemna &Sam, 2006; Tawah and Stark, 2010). In most developing countries, especially in Africa and Asia, agriculture has historically been the traditional source of income, livelihood and development. Thus, the focus of ICT4D studies on this sector is not surprising.

In Zimbabwe, artisanal gold mining has emerged as another major source of rural livelihood. The sector is a viable alternative to agriculture that (the latter) is seasonal and susceptible to erratic rainfall and changes in seasonal patterns. The prices of agricultural output in Zimbabwe have been heavily controlled and unattractive recently. In contrast, gold is one of the most strategic commodities in most countries and internationally, and its price is a key indicator of global business confidence. As a result, its price has generally remained robust or dynamically stable (How to Invest Today, 2011; Mlambo, 2011b). Apart from being a significant source of income for miners, artisanal gold mining has a multiplier effect on the rural economy as evidenced by the thriving business at rural shopping centres and by the acquisition of personal assets like cars and houses in the gold panning communities. Thus, it is probably time that ICT4D studies in Zimbabwe focus on this sector as they have done on agriculture as alluded to earlier. Adoption of ICTs by artisanal gold miners would be less affected by income inhibitors that challenge other rural sectors because of the short turn-around periods of the mining activities as well as the significant amounts of revenues involved.

Given the unprecedented ability to foster rural livelihoods than traditional sources of income like agriculture (Dreschler, 2001; Hentschel et al, 2002; Tesha, 2003; Hilson and Porter, 2005) and the consequent ease with which access to ICTs can be achieved in the sector, the dearth of research into ICT4D in the sector is surprising. There is need to investigate the poverty reduction and development capacity of artisanal gold mining in Zimbabwe and the role ICTs are currently playing and can potentially play in enhancing that capacity. Such role would not be limited to just enhancing income but also in dealing with other challenges related to the operations such as

legalization, regulation, monitoring, technology, expertise, finance, occupational health and safety and environmental considerations.

This study seeks to: (a) briefly demonstrate the poverty reduction capacity of artisanal gold mining activities in Zimbabwe by alluding to its economic importance; (b) highlight the technical and socio-economic constraints and problems associated with artisanal gold miners in Zimbabwe; and (c) discuss, with reference to (a), (b) and a specific field experience in Zhombe District, the role that ICTs have played and could potentially play in facilitating artisanal gold mining and its contribution to sustainable national and regional development.

The rest of the paper is organized as follows. The next section reviews literature on ICT4D including a case study of ICT strategy for artisanal miners in Peru. It also defines and characterises the artisanal mining sector in Zimbabwe. This is followed by a brief description (based on desk research) of the economic contribution of the small-scale gold mining sector in Zimbabwe as a general indicator of the poverty reduction and development capacity of a transformed artisanal gold sector. A treatment of the problems and constraints faced by artisanal miners in Zimbabwe in terms of processes, equipment, legal framework, occupational health and safety, environment, finance and marketing framework provides a context for discussion of ICT interventions in the sector. This is followed by a section on methods and research philosophy used on the case study of the artisanal gold mining activities in Zhombe District. A report on the findings of the case study leads to a detailed discussion in which the scope for beneficial ICT intervention in the sub-sector are elaborated. This detailed discussion draws from both the earlier desktop background research and the Zhombe District case study. This culminates in the conclusion.

Literature review:

ICT for development:

The role of ICTs in rural development has been studied by several scholars (McNamara, 2003; Nayak, Thorat and Kalyankar, 2010). There is a growing optimism that mobile ICTs will be more successful in supporting rural development than ICTs like VSAT, and telephone connected internet (Howard, 2008). Amid this optimism are challenges of sustainability due to cost, skills deficiency and lack of donor and government support. There are also challenges related to reluctance to provide ICT infrastructure to small market segments and non-mainstream interests,

yet these are often relevant to poverty reduction and development. Howard (2008) laments that a very limited investment in ICT infrastructure is available for services that are not suited to the mass-market.

ICTs have served rural communities given their ability to shrink distances between communicators, and to store, process and avail information on demand. Rural farmers have used ICTs for access to markets for their surplus produce, to bypass the middlemen and communicate with institutions as well as their peers. Institutions like the Grain Marketing Board and agricultural extension offices have supported farmers with both inputs and farming techniques. Of great importance, albeit less documented, is the sharing of knowledge between subsistent farming communities. Scholars have argued that rural people should not be regarded as information poor since they have a lot of knowledge to share among each other (Wilson, 2001).

Mobile phones have been used by poor people to reduce travel cost and improve economic activity (Tawah and Stark, 2010). Impressive mobile-based ICT4D solutions have been documented in literature (Walsham, 2010). Examples include the M-PESA of East Africa (Moraczynski 2009) and buyam-sellam by rural women in Cameroon. In The latter example women of low education and ICT literacy are using mobile phones for business and social connectivity as they travel between rural and city markets (Tawah and Stark, 2010). These applications provide lessons for use of ICTs in artisanal mining as we discuss below. Key to such applications is an understanding of artisanal small-scale mining in the context of poverty reduction and development.

Potential users' participation and knowledge of their ICT capabilities are critical considerations in the design and implementation of ICT initiatives (Mansell & When, 1998, as cited in Bossio, n.d., p.4). For ICT initiatives to be effective they should be viewed in a social context (Avgerou, 2000, p.14, as cited in Bossio, n.d., p.4) that emphasizes needs analysis, cultural considerations, user capacity and local participation in the whole project cycle. This is substantiated by the experience of failure with telecentres (rural) driven from central offices (in towns) (Davidzuk, 2002, as cited in Bossio, n.d., p.4).

The concepts of poverty reduction and development have been a source of contention between scholars (Daka, 2006; Zheng, 2009). Some scholars view poverty as lack of income, and development as improved productivity measurable by GDP per capita (Blake and Quiros Garzon,

2012). Others subscribe to the livelihood and utilitarian schools of thought. While admitting that income and economic growth are necessary for human development, Sen (1990) (like Aristotle) considers wealth as a means to other ends. Sen therefore judges quality of life by what people are able to achieve (functionings) hence his focus on human capabilities. The capability approach presents development as freedom to be what one chooses to be or to do economically, socially, politically and personally (Sen, 1992; Sen, 1999; Alkire and Deneuline, 2008). In line with this definition of development, UNDP[1] sees human development as encompassing long and healthy life, knowledge, resources and participation.

In addition to his criticism of opulence (i.e. income), Sen also criticizes utilitarianism (pursuit for happiness and fulfillment of desire) as inadequate in the assessment of human wellbeing and deprivation. Sen (1999) finds utility as an unreliable measure of wellbeing because it can be conditioned by the need to adapt to deprivation to a point of making people content with low standards of wellbeing.

Defining development as reduction in income poverty would clearly limit our assessment of the development potential of ICT application to a high-income earning gold panning activity vis a vis the unfreedoms emanating from engaging in an illegal trade. As Walsham and Sahay (2006) put it, ICT4D could benefit from an understanding of development as proposed by Amartya Sen. The capability approach will therefore be used for assessing the poverty reduction and development that ICTs may foster (Zheng, 2009) in the context of challenges faced by the rural poor engaging in a lucrative but illegal gold panning trade.

In Zimbabwe, ICT use varies greatly between large-scale mines and artisanal and small-scale miners (ASM) (Government of Zimbabwe, 2005, p.22). In large mines ICT find use in prospecting and ore body modelling, beneficiation, marketing, automation (control), database development and managment. It can also be used in financial modelling of mineral projects, in geographical information system applications during environmental impact assessments, and in all statistical analyses of any mineral deposit and mining data. Largely, these are also potential applications in the ASMs.

[1] UNDP (2004). Human Development Report 2004: Cultural liberty in today's diverse world. New York, UNDP. Cited in Bossio (n.d., p.3).

Greater use of ICT is cited as a means to envisaged strengthening of networking among ASMs within the framework of the Association for Responsible Mining (ARM) (Duque, 2005). The mandate of ARM (which is an international organization) is promotion of socially and environmentally responsible mining with emphasis on transformation of ASMs for better quality of life of local mining communities. Strategies of ARM include collaborations with relevant organizations, information/knowledge generation and dissemination, awareness campaigns among various stakeholders on importance of a transformed ASM sector to poverty reduction and sustainable development, applied research, networking, capacity building, et cetera. Considering all these activities the scope of ICT application is stupendous.

The case of Peru, which is summarized below, demonstrates the usefulness of ICT to ASMs in information access, training, communication and ability for miners to express themselves to the outside world (Bossio, n.d., p.1). However, critical to this usefulness of ICT is the need to: (i) understand the local conditions in terms of culture, information needs and communication tradition; (ii) make ICT projects sustainable through engendering participatory approaches from their inception, for example, involving local community based organizations and stakeholders; (iii) development, processing and management of relevant content and its accessibility; and (iv) training on ICT use. Thus, the process needs to go beyond technical issues and look at social ones also.

GAMA project and ICT strategy for artisanal miners in Peru[2]: a synopsis:

The ICT project for artisanal miners in Peru was preceded by and conceived within the framework of the GAMA project (Bossio, n.d.). The GAMA project sought to improve the standards of living of miners and the environment through addressing technical, legal, managerial and organizational needs or constraints of miners. Before the GAMA project the sector was informal, miners had limited citizen rights, were not organized, were not informed, were illegal, and their activities contaminated the environment. Achievement of legal recognition resulted in rapid integration with the formal economy and transformation of formerly illegal mining settlements into long-term growth communities. Miners then organized into associations with tendency towards becoming companies. Miners were empowered economically, socially and politically both as communities and as corporates.

[2] This section is wholly written from Bossio, n.d.

The second phase of the GAMA project focussed on technical knowledge upgrade for miners. Being then quasi-corporates and long-term growth units, information for decision-making had become an important part of the project, hence the need for an ICT strategy. The ICT strategy had three "C" components – content, capabilities, and connectivity. The ICT project began with a pilot telecentre with an interactive internet platform for artisanal miners and a knowledge management platform to which various stakeholders contributed. The choice of the software for the interactive platform (TIKI-WIKI) was based on two key criteria - interactivity and freedom to participate. GECO was used as knowledge management platform for responsible mining practice.

At the pilot telecentre the local community contributed partially to its construction, two young people from the local community were trained as telecentre operators, GAMA bought the equipment, while a community based organization (CBO) was created for management of the centre after GAMA project life span. The pilot telecentre was then replicated into a network of telecentres. For sustainability reasons GAMA proposed that further new centres be financed by the miners themselves. Training of miners and other stakeholders on ICT use up to the stage of inputting data into the knowledge management platform was a major component of the ICT project activities. It was however realized that not all miners would make content contributions but a few leaders would come to be in charge.

There were problems with little use of the GECO platform, attributed not to the platform itself (usability), but to the need to market it to students, Government officials, professionals (in terms of content contribution) and the need for enhanced promotion of the platform among miners as well as their capacity to use the platform. The other problem was absence of ICT infrastructure in the communities. The GAMA project makes several recommendations regarding ICT initiatives in the artisanal mining sector. These are listed in the next paragraph.

There is need to: (a) develop a critical mass of both ICT users from artisanal miners and contributors to the knowledge management platform; (b) develop content pertinent to the miners, such as prices, and attach calculators to this information to preclude any possible swindling by buyers; (c) adapt some distance learning platform (e.g. e-learning platforms) in order to make internet not only a source of information, but also a tool for training miners; (d) promote telecentre users to be content producers, hence the need for research on platforms, software and

hardware in terms of their usability; (e) promote sustainability of telecentres through participation of local people and local existing organizations (not necessarily creation of new ones); and (f) network telecentres and create capacities of the communities to use them.

Finally, as a result of the ICT strategy, organization of miners has improved, new technologies are being learnt, market information is available which is facilitating reception of good revenues for effort, miners are improving their knowledge of environmental impacts and respective adaptation of practices, and the miners voice is now on the internet.

The artisanal gold mining sector in Zimbabwe: background and definition:

The poverty reduction capacity of artisanal gold panning is highly documented (Dreschler, 2001; Tesha, 2003; Hilson and Porter, 2005). Research has been conducted in the Southern African Development Community (SADC) region (Dreschler, 2001) and other African countries like Tanzania (Tesha, 2003) and Ghana (Hilson and Potter, 2005) to name a few. In Zimbabwe research has been carried out with a view to address environmental (Billaud et. al, 2004) and health (Boese-O´Reilly, 2004) impacts of artisanal gold processing using mercury. It is, therefore, surprising that it remains under studied in terms of the role of ICT4D. ICT4D research has not paid attention to it as they have done to agriculture presumably because it is not as wide spread as agriculture, though that status is significantly changing.

The historical development of the mining sector in Zimbabwe dates back to the past 1 000 years (Roussos, 1988, p.95), probably even earlier. The earliest mining operations were small-scale being mainly artisanal. Exploration was by the naked eye, knowledge of tell-tell signs was limited and mining was not systematic since there were no elaborate legislations or procedures. Simple homemade implements were used. There were neither complex mineral markets nor large-scale and diverse industries to consume mining products as we do have today.

Agreed positive definitions of artisanal mining in literature have remained elusive, as definitions tend to be country, purpose and author specific (Hentschel et al, 2002; Kumar and Amaratunga, 1994). Much of what has been deemed artisanal mining in Zimbabwe is informal small-scale mining, characterised by: (a) small-scale operations, exploiting only marginal and/or very small

deposits; (b) manual or use of very simple unconventional mining implements; (c) low recovery of valuable mineral (inefficient); (d) individual or family labor; (e) haphazard exploitation due to lack of geoscientific knowledge and technical mining skills; (f) high mobility, with no fixed assets; (g) essentially seasonal mining operations alternating with agriculture; (h) informal (illegal or unregulated), without legal titles; and (i) environmentally unfriendly and occupationally unsafe.

The above characterizations, save for illegality, tend to be practically true also of many formal small-scale mines. Some writers have therefore used the terms artisanal and small-scale interchangeably, for example, Hentschel et al (2002). The rest of the characteristics above tend to be more emphasized with illegality, so that the essential difference between artisanal and non-artisanal small-scale mines has been regarded by other authors (for example, Dreschler, 2001) to be in registration in accordance with the Mines and Minerals Act or other relevant pieces of legislation. Thus, a working definition of artisanal gold mining for this paper is unlicensed small-scale gold operations.

Economic contribution of the small-scale mining sector in Zimbabwe as a general indicator of its poverty reduction and development capacity:

The importance of artisanal mining of gold and other minerals to poverty alleviation and rural development is appreciated widely and little disputed (See in Hentschel et al, 2002). In 2004, the contributions of the whole artisanal sector to Mining Gross Domestic Product and total earnings of the mining industry in Zimbabwe were 1% and 8% respectively (Central Statistical Office, July 2004, in Mungoni, 2008, p.1). The small-scale gold mining sector alone (both formal and artisanal miners) contributed 5% to gold production in Zimbabwe in 1996 (Chimsasa, 1996). The artisanal gold mining sector is greater than the formal small-scale gold mining sector in terms of employment and output.

The Mining Journal 1996 edition of the Mining Annual Review (in Chimsasa, 1996) estimated the number of people involved in alluvial gold panning alone in Zimbabwe to be about 300,000, which constituted about 70% of all small-scale miners. The number of artisanal miners (for all minerals) in Zimbabwe has grown over the years. In 2001 the total number of people directly dependent on artisanal mining including those who provide services to the miners as well as

dependencies was estimated at over two million (Dreschler, 2001, p.132), a greater percentage of which is related to gold panning.

Artisanal mining is characterized by very short implementation periods (short period required to set up and run operations). This has placed the artisanal sector in a strategic position to take full advantage of short-term booms in the mining industry (Maponga, 1991). The sector, while alleged to be haphazard, harbours an advantage in this – it can exploit small/disjointed deposits that normally prove unprofitable to bigger operations while also providing leads to large-scale deposits where mineralization proves continuous (Mungoni, 2008).

As alluded to earlier, gold panning has proved to be a viable income alternative to agriculture in the rural areas and, because it is all-season, it effectively addresses the problem of seasonal unemployment or underemployment naturally created by the seasonal nature of agriculture. Most small-scale mining (especially artisanal) is very labour-intensive with the advantages that it consumes little energy (Gocht et al, 1988, p.243) while also providing employment to the greatest number of people possible. It therefore, reduces rural-urban migration (Mungoni 2008, p.12).

There are also downstream benefits and positive synergies associated with artisanal mining, which are created in the rural economy. Increase in rural income has expanded the clientele base for rural business centres. This sector has created both capital and market for other income generating activities in the rural areas such as agriculture, carpentry, fabrication, foundry, et cetera, showing great potential to initiate and sustain a rural industrialization process (Mungoni, 2008; Gocht et al, 1988). It is especially in this potential contribution towards entrepreneurship initiatives amongst communities/villages and also its natural linkage with economic and social development external to the communities through marketing, that it is regarded as a vehicle for poverty alleviation.

This brief allusion to the economic importance of artisanal gold mining demonstrates that this sector has great capacity to reduce rural poverty and sustain development. Further demonstration of this capacity will be made under the specific case study of the mining activities in Zhombe District. It should be noted that this section has, in places, also discussed the poverty reduction and development capacity of the formal small-scale gold mining sector since once transformed the artisanal sector becomes the later.

Problems and constraints faced by artisanal miners in Zimbabwe:

Technical processes, problems and constraints:

Two types of gold deposits are exploited by artisanal miners in Zimbabwe, namely (a) alluvial or elluvial deposits, which are exploited through panning of gravels, and (b) reef deposits which are worked by underground operations (Mungoni, 2008). Prospecting for alluvial deposits is normally based on prior knowledge of deposits around the area, and panning is done randomly or metal detectors are used to identify specific areas where deposits/nuggets exist. Identification of deposits for underground mining by artisanal miners is essentially based on historical mining sites (old disused mines).

In underground mining, optimal mine design is not possible to achieve because of lack of geo-scientific data (Mungoni, 2008). Simple tools and techniques are used in sampling, sinking shafts and breaking rocks, such as picks, shovels and mine bars. Labour, water and ore transportation is done using manual windlass, buckets, ropes, ladders, torches (for lighting) and wheel burrows. Mining at a particular site normally ends prematurely when it becomes only slightly complicated, for example, due to water and ventilation problems. Miners normally avoid the later processing activity of crushing by seeking liberated ore, resulting in them disregarding mineral content locked up with gangue (worthless material). The concentration techniques used are basically ore sorting and hand picking, panning using dishes (a gravity concentration method), and mercury amalgamation.

The simplicity of artisanal processes (both mining and processing) has resulted in low efficiency in recovery, selective and destructive exploitation and environmental problems. These problems could be avoided if the miners were to use standard practices (Mugandani & Masiya, 2011; Mungoni, 2008). Many of the technical constraints facing these miners have to do with the small-scale nature of the sector, while others have to do specifically with their informal nature. In addition, lack of proper organization conducive for utilization of machinery provided by mining departments or other government assistance programmes has resulted in the artisanal gold miners being left out (Kumar & Amaratunga 1994, p.21).

The most significant technology issue is efficiency of beneficiation equipment and processes used – basically a question of recovery rate, which is quoted for gold at 30% with commonly used techniques. This rate is low since it means 70% of gold content in the ore is left, and this

leads to loss of potential revenue (Mungoni, 2008). Recovery has only concentrated on free gold by either amalgamation or the James table, leaving gold locked up in pyrites, with potential recoveries of even over 5g/t, to be thrown away as waste (Maponga, 1995, cited in Mungoni, 2008).

Legal framework, problems and constraints:

There is no Act specifically addressing the small-scale mining sector, and the Mines and Minerals Act of Zimbabwe does not distinguish between small-scale mining and large-scale mining. The Act does not at all recognize the existence of the artisanal mining sector. With illegality comes a host of constraints and problems related to artisanal mining ranging from financial, organizational, marketing, to environmental issues. In addition, because they are illegal, artisanal miners can be arrested by the law enforcement agents if found mining. That makes them feel unsafe. It also means that disputes, violence, thefts and any unfair practices among these miners or with dealers cannot be resolved effectively. The middlemen take advantage of this state of affairs to implement unfair practices.

However, the Mining (Alluvial Gold) (Public Streams) Regulations, 1991, regulate small-scale gold panning activities and authorizes RDCs to grant permits to panners and monitor and control their activities in their jurisdictions. According to these regulations: (a) only riverbed mining is allowed; (b) mining should take place at least three metres away from either bank of the river; (c) undercutting is not allowed; (d) excavation should be at most 1.5m deep; (e) all areas that are mined out should be backfilled; and (f) all produce should be sold to the Reserve Bank or its agents. However, the power to issue permits is obtained upon application by the RDC for Special Grants, and most affected RDCs have not applied because they feel they lack the technical capacity and resources to monitor panning activities. The existence of illegal (unregistered) panners also make the enforcement of regulations regarding depth of excavations and distance from the banks difficult since the illegal miners still work on the areas left by the legal ones.

Occupational health, safety and environmental problems:

Generally, the working conditions are hard and there is no adequate social security – minimum wages, safety levels, social services, et cetera (Gocht et al, 1988, p.241). Mine pits and tunnels left in the trail of artisanal activities have proved to be a hazard to both animals and humans. Pits have also provided breeding ground for mosquitoes in the wet season (Mutsambiwa, 1994; ITZ,

2003; all in Mungoni, 2008). Since much of the labor is individual or family, child labour is a common problem (Mungoni, 2008, p.13).

The issue of mercury poisoning is a serious health issue among artisanal gold miners who use mercury and open air retorts, since they end up inhaling the mercury (Dreschler, 2001, p.153). Miners have not shifted to closed retorts (which are more environmentally friendly and safer) because, among other reasons, many miners are not aware of the health hazards posed by mercury. Poor sanitation at mining sites, including non-existence of proper toilets as well as the use of disused pits, mineshafts, rivers and open wells as sources of drinking water has caused outbreaks of diseases such as cholera and dysentery (Maponga, 1995, in Mungoni, 2008, p.28).

Artisanal mining activities are associated with various negative environmental impacts, which impacts can be linked to equipment used, technical skill levels and techniques used (Mungoni, 2008). These impacts include: (a) water pollution by mercury and various solid waste; (c) river and dam siltation; (d) deforestation; and (e) land degradation due to excavations, underground tunnels, and waste dumps. The high mobility of artisanal miners, compounded by lack of regulation of their activities, has made it difficult to implement effective environmental monitoring activities, which has resulted in continued environmentally unsustainable practices and use of inappropriate technologies.

Economic, financial and marketing inhibitors:

The smallness of output of individual artisanal miners mean that operations are low-efficiency and high cost (Gocht et al, 2008). Selective/destructive exploitation, whereby high-grade ore is mined leaving low grade, has resulted in low mineral recovery and valuable by-products being ignored. From the perspective of national tax revenue, artisanal miners contribute nothing because of their informal nature. The sector's contribution to regional development is little as practically no technology transfer occurs and there is no development of infrastructure, which are the two main areas in which mining projects are normally expected to be facilitators of regional development.

Gold is a strategic reserve asset whose licensing and trading is regulated by the Gold Trade Act and all gold should be sold to the Reserve Bank of Zimbabwe (Fidelity Printers) or its agents. Only registered mine owners are allowed to sell gold to the Reserve Bank, and this, at a

minimum threshold of 50g (Dreschler, 2001). There is a long time lag between sale and payment of two weeks or more, which makes cash-flow a problem for a typical small-scale mine.

Artisanal miners tend to sell their gold to holders of producing or buying licences who then sell to the Reserve Bank of Zimbabwe or export through holders of Gold Dealers Licences. They also sell to millers at milling points. However, artisanal miners, being themselves illegal, sell also to illegal dealers who smuggle the gold out of the country. In all cases, artisanal miners get prices significantly lower than the Reserve Bank and the international market pay, creating lucrative business for middlemen. Because of lack of information on markets and prices, at times when the international price of gold would be rising the middlemen may continue paying old prices.

Lack of collateral (Dreschler, 2001) as well as the informal and unorganized nature of artisanal mining has resulted in lack of credit being advanced to the sector. Generally, credit is not adequately available in Zimbabwe due to low savings (Chamber of Mines, 2010). Though a number of banks have started to give loans to formal small-scale miners for investment capital and working capital, the rates of interest on loans (currently around 20%) are very prohibitive (See Mlambo, 2011a). Unlike other areas like forestry and agriculture, this sector has failed to attract elaborate donor or NGO support and the support of decentralized government agencies (Bugnosen, 1990, p.3).

Methods and research philosophy on the Zhombe case study:

In our endeavour to assess the ICT-enabled poverty reduction capacity of artisanal gold mining in Zhombe district of Zimbabwe's Midlands province, evidence was collected using semi-structured interviews. We found this approach ideal for exploratory research on how ICTs would automate an illegal and secret trade. It is also recommended by interpretivist researchers for its ability to help the researcher to interpret the respondent's in-put (Walsham, 1995). We adopt a critical strand of interpretivism as articulated by Walsham (2005) and Klein & Myers (2011). Interpretive research of critical orientation attempts to correct what is going wrong in the world, for example, due to power asymmetries (Walsham, 1993). We therefore clarified it to the participants that we were interested in equality of opportunities and in potential use of ICTs in changing things for the betterment of the poorest. According to Walsham (2006), the advantage of doing so is that it "is good for in-depth access to people, issues, and data. It enables observation or participation in action, rather than merely accessing opinions" (p. 2).

Seven in-depth interviews were conducted with people at Empress Business centre and Bee mine village and shopping centre. Four of the interviewees admitted that they were gold panners while the rest claimed to have knowledge of the trade without necessarily being involved. Our experience with livelihoods in rural Zimbabwe convinced us that their standards of living were above that of ordinary subsistent farmers.

We did not use any predefined process for selecting our interviewees. Interviewees were determined by their willingness to participate and knowledge of the trade. This was because of the challenge associated with getting people to discuss an illegal trade taking place in their area. While we wanted to interview those who were involved in the trade, we were aware that they would be reluctant to divulge the details of their secret trade to strangers. Due to the sensitive nature of the illegal gold panning trade, we could not use electronic recorder or be seen documenting the evidence on paper. This was meant to gain their trust and avoid being mistaken for law enforcement agencies. After the interviews the evidence was quickly dictated while being recorded using an electronic device. We transcribed the data using Microsoft word for deeper analysis. This approach was also used by Cibora and Navarra (2005).

Findings from the case study:

We found a modest use of ICTs, although income from gold panning had a significant impact on poverty and development in Zhombe area. The impact of gold panning was both positive and negative since it raised the standard of living for the participant and the cost of living to the disadvantage of non participants. The positive impact included the general improvement in the quality of dressing, housing and vehicle ownership among the gold panning communities of Zhombe. Of particular concern were the negative developments as local dealers priced their commodities for gold diggers and inadvertently rendering the ordinary subsistent farmers much poorer than they were prior to the gold rush. While this lies beyond the scope of this paper, we found that the negative developments like increase in school dropouts, violence and imprisonment for involvement in the illegal trade warrant urgent attention from both policy makers and law enforcement agencies. In the following paragraphs, we discuss use of ICTs during the mining and marketing as well as relative to the gender component. In general, the use of ICT among artisanal miners in Zhombe is restricted to mobile phones.

Team forming and risk management:

Gold panning tends to be done in gangs in order to manage the risk involved in the trade. The Makorokoza (a Shona word for hustlers) use their mobile phones for advising their team mates about the availability of opportunities and the presence of danger. It is common for Makorokoza to fight over a gold find; hence, affiliation to a strong group is important. When gold is found in an area, the team has to move fast before it is exhausted by other groups. As respondent 6 advised:

Politics doesn't usually affect us, but in Kwekwe you need a card to enter the new place they have just found. If you don't have a Zanu PF card you better forget it because there is no time to go and get one before the gold is finished. The only option is to borrow one from a relative who has a card.

Gold panners use mobile phones to communicate warnings regarding the presence of law enforcement agencies and to strategise their escape or physical defence or how to chase the police who may be guarding a site. The prison sentences that artisanal gold mining attracts are so high that Makorokoza take desperate steps to evade arrest. Colleagues make sure that their teammates are not apprehended because they need them in their next assignment. We found that sometimes the Makorokoza resort to negotiating with law enforcement agencies for them to enter a restricted field. Under such circumstances the police would also use their mobile phones to warn Makorokoza to escape if their bosses arrive. As respondent 5 advised: "The police had to rule on how many gangs and how many machines would go in". In that case the police and the machine owners would share their gold in half. The gold buying middlemen, who are always waiting to buy would pay them off immediately and leave. This represents a use of ICTs for combating lack of opportunity freedoms (Sen, 1999).

Marketing:

Gold panners have limited market options. On being asked if ICTs were being used for seeking market information and arranging sales, the panners advised that they rarely ever sell to any buyers other than those that come to the field. They cited the danger of moving around with gold, being robbed or sold out by jealous colleagues or buyers. As we discuss latter, the failure to use ICTs for marketing limits Makorokoza' choices to rent-seeking middlemen.

Respondent 1 narrated a story about youngsters from the neighbourhood who were jailed for attempting to sell gold in Kadoma, a nearby city. The youngsters had decided to seek an

alternative buyer instead of waiting for the dealer to get enough money for their gold. When they refused to leave the gold with the dealer, the latter tipped the police and they were arrested as soon as they left his premises. Most of the dealers are local shop owners, while some come from big cities.

Gender differentiation:

Women usually avoid the trade because of the rigorous nature of work involved. According to respondents 3 and 4, who admitted that they were active Makorokoza, there are other jobs that women can do at the digging field, including selling food, mobile phone airtime and beer. There are also instances when women take part in processing by assisting with fetching water and pouring it on the excavated earth during the panning process. However, this process was no longer widely practiced due to increased reliance on metal detecting machines. These findings are at odds with other studies that suggest that of the 25% of women in SADC region 50% are from Zimbabwe, less than 10% of which are claim owners (Dreschler, 2001). The role of ICT in promotion of gender equality in terms of mining opportunities has been limited.

The process:

The whole artisanal process in Zhombe begins with the discovery of gold in a site. The Makorokoza bring their picks and shovels, and the machine owners bring their gold detecting machines while the buyers bring money and scales. In the most advanced processes the machines go in first and they hover their gold detectors over the place. When they detect any metal the Makorokoza dig as the machine checks if they should dig deeper or if it would have been shovelled to the heap of earth. This makes it easier to identify where to dig and also to sift gold from the earth. Above all, it serves the environment from random excavation and the gold miners from unfruitful labouring.

In the primitive process, the Makorokoza just dig blindly and they carry the earth to a river where they use water for separating the gold. In both cases when the gold is found the buyers weigh it and calculate a price. The Makorokoza are then paid while the buyer takes the gold to the market. In other sites there may be more middlemen to be paid depending on how access was granted. For instance, we were told of cases where police and farm foremen grant access to miners for a fee. However, the labourers always suffer since they share their loot with middlemen that would disown them if they were caught.

Discussion on potential use of ICT in addressing the problems identified above in general and in case study:

Technical:

Significant scope exists for application of ICT in improving the technical side of the artisanal mining sector in Zimbabwe. In general, ICT can play a pivotal role in generation of information and data, its storage, processing and communication to and among artisanal miners. Geological modelling of reef deposits using computer programs would facilitate optimal underground mine design and methodological mining which optimizes resource extraction and reduces destructive exploitation. Geological databases of deposits suitable for small-scale exploitation can be developed by central authorities, for example, the Zimbabwe Geological Survey (ZGS), to aid small-scale exploration, which can be made freely accessible to miners. Central repositories of sound exploration, mining and processing practices can be developed. Simple templates can be designed on small-scale mine valuation and disseminated via an ICT based central place or the internet/emails. Geographic information system (GIS) can be useful in mapping the distribution of alluvial mining activities and in monitoring their dynamics.

All the potential ICT applications indicated above imply that ICT capacity in terms of hardware and software needs to be built for national offices like the ZGS, Rural District Councils, miners and mining communities. They also imply the need for ICT training for these stakeholders. Great scope exists for communication of technical information to miners, including responsible mining practice, through mobile phones, central repositories at the Rural District Councils, mobile internet, mobile video shows, community telecentres with interactive and knowledge management platforms, et cetera.

ICT can be very useful in developing proper organization conducive for utilization of machinery provided by governments or other government assistance programmes (Kumar and Amaratunga, 1994, p.21). The starting point would be development of a simple database of the miners, the minerals they mine, the locations, implements used and so forth – which can be facilitated by the RDCs. Then deliberate efforts to network the miners with each other into associations can be made. Once organization is fostered many initiatives, including formalization, credit, training, et cetera can be pursued.

Legal:

We argue that ICT applications could have been as numerous as they are in agriculture if the gold panning trade was legal given the sector's income generating capacity. While there are ways of acquiring legal papers for mining and dealing in gold, they are too complex for Makorokoza most of whom have never left their villages to visit cities. Like most scenarios inhibiting access to opportunities by the poorest, bureaucratic systems in developing countries always favour non-victims of poverty while erecting walls of restrictive prerequisites for the marginalised poor. We contend that ICTs should therefore be used for facilitating unintimidating remote registration at low travel cost to the poor. ICTs can be used in promulgation of the legislations among the artisanal miners as well as their enforcement – through use of newsflash, mobile video shows, telecentres and online education.

Having mentioned that the Alluvial Gold Mining Public Streams Regulations of 1991 allows RDCs to licence gold panners if they prove that they have the capacity to monitor them and that lack of capacity inhibits them, we suggest that ICTs can be used for addressing this capacity deficiency. Enforcement of regulations can be strengthened if the Rural District Councils could be provided with the technical capacity to monitor and control the activities of the small-scale miners in their areas. Their lack of technical knowledge could be addressed by use of computer-based information data repositories. ICTs could also perform some routine processes like online registration and hence freeing labour resources for less computerisable and discretionary duties like field visits. ICTs can also be used in monitoring and control systems by the RDCs.

The legal threats on the exploitation of gold deposits by the poor represents what Sen (1999) defined as lack of capability freedom. Marginalised groups like women, the elderly and other non risk takers avoid this lucrative trade because of freedom limiting constraints. Even the brave that venture into it can only overcome income poverty in the utilitarian sense while capabilities expansion remains unachievable. Such man-made limitations need the attention of policy makers since they restrict development enhancing freedoms.

From the case study in Zhombe, we noted that the Makorokoza are fully convinced that legal constraints are sacrosanct and they feel guilty for their involvement in it as one of them put it: "How can anyone depend on an illegal trade? We need jobs, those who work are better than us". We view such talk as desire for peaceful trading since most of the respondents vowed to keep on with their trade than leave it for the less remunerating jobs that other labourers do. This

unfreedom has implications on the design of ICT platforms for facilitating and managing the activities and programs related to informal miners. There would be a need to overcome the fear factor emanating from years of evading the police. It would be useful to have regulations in local languages presented in simple form since most of the miners are of low literacy level.

Occupational health, safety and environment:

ICTs can help in promulgation of related legislations and regulations as well as their enforcement and monitoring. A database of environmental indicators can be created which would then be used to indicate environmental dynamics related to the work of artisanal miners. Occupational health and safety statistics (baseline) can be developed and monitored over time and space. ICTs can be used in the dissemination of information on the dangers of mercury poisoning (radios, internet, newsflash on mobile phones, etc) and in introduction of cleaner and more environmentally friendly technologies such as retorts. Interactive platforms at telecentres could be useful in relaying disease outbreak alerts to health authorities and other mining communities and in their control.

The use of ICTs like websites, radio and television for main streaming gold panning would enable the much needed information on safe and environmentally friendly methods to reach those that need it. We argue that while the negative environmental and social impact of gold panning make it unacceptable, legalising it would address most of them. Legal inhibitors remain key as one interviewee complained that they receive mixed signals from Zimbabwean authorities. On one hand politicians tell them to repossess their land yet the police arrest them for mining it. Legalising and regulating gold panning could reduce the environmental impact by using the risk of losing licence against anyone who fails to rehabilitate the land. ICTs could be used for remote licensing, remote sensing and capturing data on the volumes being mined. This would enforce rehabilitation of the land, guide taxation and limit smuggling.

The current monitoring approach which is motivated by the need to stop the illegal trade worsens the secrecy and hence crime and the environmental impact. We have mentioned how it limits poverty reduction efforts to an inadequate utilitarian sense. The use of ICTs for enabling instead of criminalising the trade would court the cooperation of miners, improve heath and safety and reduce the environmental impact. It may also help reduce the concomitant crime since currently they cannot report their aggressors to police for fear of arrest. De-criminalisation will therefore

elevate the poverty reduction and development approach to the capability enhancement, which surpasses the discredited utilitarianism (Sen, 1999; Daka, 2006).

Economic, financial and marketing:

More efficient methods of mining and recovery can be promoted through ICT initiatives e.g. videos (videos can be used in all areas of education/training and awareness activities). ICT initiatives can promote proper keeping of data on miners and their organization so that financial and technical assistance can be facilitated. Better organization can facilitate lobbying for donor support, support of central government and access to pooled bank loans. Creation of databases by Rural District Councils and the Reserve Bank of Zimbabwe as well as monitoring activities and reporting requirements can go a long way in curbing gold smuggling hence enhancing revenue to fiscus. Thus, ICT initiatives can make the miners more efficient from a technical perspective, expose them to financial and support opportunities and make them contribute usefully to the fiscus.

Lack of access to information on prices denies miners the chance to hold on to their produce until the best time to sell. At the moment any intention to withhold their produce exposes them to both arrest and robbery. Applications of ICT enabled capability expansion need to look beyond central information repository access by miners. We contend that this mystification of the knowledge component of the trade could be demystified by use of ICTs in informing Makorokoza of the true value of their gold. This is especially the case because ICTs allow them to access the information without braving the danger of being prosecuted, as is the case when one visits the government offices. ICT initiatives must also include information creation and sharing systems between miners because they also have context specific information to share among themselves (Wilson, 2001).

In other aspects of ICT4D, information technologies have been used for disintermediation. ICTs can be useful in availing information on prices of equipment, sources and costs of geological, analytical and evaluation services, markets, prices, and available financial opportunities. The Reserve Bank of Zimbabwe could keep a database of miners and use mobile ICT to communicate official local and international prices to equip the miners in the field to negotiate with middlemen from an informed point of view. Through internet access, artisanal miners can check the world market for themselves. Specially created market information databases by

authorities, which the miner can access on their mobile ICT or through a village-based internet kiosk, or which the authority can send to the miners' mobiles as news flash, can effectively eliminate the role of rent-seeking middlemen.

Conclusion:

The study demonstrates that the capacity of artisanal gold mining in Zimbabwe for poverty reduction and development is very significant. This capacity is in terms of employment, reduction of rural-urban migration, an exploratory and complementary role to formal large-scale operations and various upstream and downstream benefits. However, the sector is beset with problems and constraints related to their technical operations, which are inefficient, a legal framework that does not formally recognize their operations, various occupational health, safety and environmental issues, and an economic, financial and market framework that has ensured that the miners get less value for their effort. The poverty reduction and development capacity of the sector and the highlighted problems and constraints are substantiated by the case study of Zhombe District.

Little current use of ICTs is concluded in spite of great potential for use in automating the knowledge components of the trade as well as in facilitating regulation and monitoring. This limits the sector's contribution to poverty reduction by engendering low-efficiency operations and restricting the economic opportunities to rich middlemen who are sometimes external to the rural communities. The paper highlights the scope for ICT applications in improving livelihoods and addressing the negative impacts on the environment and health of gold panning communities.

The study, however, demonstrates that the effectiveness of ICT interventions in the sector hinges on the willingness of authorities to bring the sector into the mainstream economy by formalization and appropriate legislation. Legalising gold panning, coupled with ICT interventions, could improve its poverty reduction capacity from achieving mere income poverty to the expansion of the capabilities of rural communities as articulated by Sen (1999). In this study, it is also apparent that ICT can be better applied to the expansion of capabilities of gold panning communities if gold panning were to be given the attention that ICT4D scholars have applied to other sectors of the rural economy.

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