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A Pathways Approach to Lead Mining in Rural Central China

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Abstract

This article adopts a “pathways to sustainability” approach to study lead mining in rural China. Through an in-depth case study, it reveals how shifting mining practices are tied to institutional and political economic contexts, cost-benefit distribution, and changes in livelihood resources and strategies. It weaves together an analysis of livelihood practices with a study of attitudes to livelihood and environment, which are usually researched separately. In turn, it demonstrates that a longitudinal analysis may resolve the contradictory accounts of whether mining aids or hinders development, and whether local communities are victims or beneficiaries of such development.

INTRODUCTION: MINING AS DEVELOPMENT?

The proposition that mining should be evaluated in terms of its contribution to development is often advocated by governments, elites and mining companies. The narrative of mining as a path towards rural development and widespread poverty reduction has underpinned its liberalization, presented as an effective way to generate rural employment and new income sources. This trend has become increasingly prominent across the developing world (World Bank, 2009; Kamlongera, 2011; Ghose & Roy, 2007). On the surface, China's experience seems similar. China's long history of mining made a substantial leap after 1949, when the Communist state embraced it as an engine for rural development and rapid economic growth alongside rural industrialization (see Bramall, 2006; Tilt 2010; Wright, 2011). Mining activities increased even further after the partial liberalization and economic reforms began in 1978, allowing the emergence of small private mines alongside state-owned enterprises (SOE). It is estimated that in China, the mining industry created employment opportunities for over 6.52 million people in 1978, reaching a peak of 9.32 million in 1993 and decreasing to about 5.5 million jobs in 2010 (National Bureau of Statistics of China, 2009 & 2011). While these figures do not distinguish between rural and urban areas, it is reasonable to assume that the majority of these jobs are in rural areas (where most mines are situated), therefore boosting rural development. Yet the contribution of mining to China's rural development remains poorly understood (see however Gunson & Jian, 2001; Xu et al., 2008; Wright, 2011). This article aims to evaluate its importance and side-effects through one in-depth case study on lead mining in Qiancun village, Central China.¹

Any easy equation of mining with development is disproved by much scholarship which shows that its benefits and costs are unfairly distributed. A structural political economy of mining focuses on questions of resource ownership, access and control, and asymmetries of

economic and political power (Bridge, 2004, p. 234). This approach does not see mining as a path out of inequality but as one that entrenches it further (ibid., p. 240). However, the relationship between mining and development and the ways in which local communities relate to mining is much more complex than a narrative of victim vs. perpetrator would convey. Indeed, conflicts surrounding mining are not between monolithic and clearly divided groups such as mining corporations which extract wealth and poor local communities who suffer the effects of mining. The link between mining and development is contentious, delivering “adverse social, environmental and economic effects for the many, but significant gains only for the few”; but it is also ambiguous, “because of the abiding sense, among local populations as much as development professionals, that just maybe mining could contribute much more” (Bebbington, Hinojosa, Bebbington, Burneo, & Warnaars, 2008a, p. 887). Indeed, despite the high human and environmental costs, local communities often defend mining (see Kirsch, 2007). Extraction is symbiotically situated within local economy and society. As June Nash famously showed for tin mining in Bolivia, “we eat the mines and the mines eat us” (1979; see Bebbington et al., 2008a, p. 888). Similarly, Tim Wright (2004) demonstrated for coal mining in China that localities depend heavily on small mining operations to raise revenue and villagers rely on them for employment.

This article contributes to these debates by providing a genealogy of the ambivalent and shifting attitudes towards mining present in Qiancun village over a long time period. It illustrates how different relationships between mining and development may prevail in the same place at different points in time and therefore a historical approach is required to assess the relationship between them. In adopting the Sustainable Livelihoods Approach (SLA), it demonstrates that changes in China’s political economy and its policy context over the past six decades have triggered shifts in the role of lead mining as a livelihood resource and the rise of concerns with sustainability. In doing so, it provides a more nuanced and diachronic perspective on the extent

to which Qiancun villagers are able to rely on mining as a livelihood strategy, how costs and benefits are distributed, and how this affects local attitudes to mining. As mining damaged physical and natural capital with unequal financial returns, it motivated conflicts, demands for compensation and the current desire to continue mining despite awareness of its unsustainability. As such, this article contributes to understanding the complex relationship between mining and development, and the ways in which mining ultimately undermines sustainable livelihoods for those left behind by development. It shows that villagers evaluate the role of mining in local livelihoods not only in terms of its economic costs and benefits but also in terms of fairness and the distribution of opportunities and resources such as health and a clean environment.

SUSTAINABLE LIVELIHOODS AND THE PATHWAYS APPROACH

For over a decade, the study of rural development has employed the concept of livelihoods as a means to understand and respond to rural poverty (Scoones, 2009, p. 171). This line of research, also known as the “sustainable livelihoods approach” (or SLA) emphasizes rural people’s embedded and holistic view of their lives and environment (Chambers & Conway, 1992, p. 296; Conway, 2011, p. 87; Long, 1997, p. 11). This involves paying attention to context, livelihood resources, livelihood strategies and institutional processes (Scoones, 1998, p. 4) and to different types of capital, including natural, financial, human and social (ibid., p. 8). SLA aims to convey the complexity and dynamism of the lives of rural people in developing countries, and the range of factors which have an impact on livelihood strategies and outcomes (see Maconachie & Binns, 2007; Scoones, 2009; Stocking & Murnaghan, 2001).

SLA’s recognition of the diversity of rural experiences beyond farming is a useful tool for analyzing the complexity of rural livelihoods and the place of mining within them. However, livelihood studies have not examined in sufficient depth the potential of mining as a rural livelihood option. This article addresses this gap. We argue that lead mining has particular

potential for the application of SLA and for contributing to its development, because of the severe and largely irreversible damages mining causes, particularly to health and local ecology. By undermining its own sustainability, mining entails an inherent tension between the potential for producing wealth and long term damages. It therefore presents a good case study to understand temporal transitions between livelihood strategies and to highlight pressing issues of social justice to which SLA is committed. As both a threat and an opportunity for development, it presents a productive case to conceptualize livelihood in broader terms than simply economic ones.

SLA has been critiqued for a lack of attention to knowledge, politics, scale, and dynamism (Scoones, 2009). The volume *Dynamic sustainabilities* (Leach, Scoones, & Stirling, 2010) sets out to overcome these shortfalls. It proposes a “pathways approach” to critique monolithic and evolutionist views of development and progress and highlights that different social groups understand and value livelihood differently. In doing so, it emphasizes dynamism and flexibility, and giving space to multiple voices, particularly those who are typically marginalized. However, this volume is intended more as a methodological guide and does not contain detailed case studies. By contrast, this article applies the pathways approach to an in-depth case study of mining in China, thereby extending the geographic reach of the livelihood approach (and particularly the pathways to sustainability approach) to China and its thematic reach to heavy-metal mining.

This article adopts a critical approach to SLA in several ways. First, it advocates a study of longer timescales in analyzing the costs and benefits of mining and livelihood strategies more broadly. Several studies in the developing world have argued that mining enables livelihood diversification and provides an effective strategy to generate rural employment, technological skills, new income sources and economic development while reducing poverty and migration to

urban areas (Banchirigah & Hilson, 2010). For instance, in India (Ghose & Roy, 2007), Sierra Leone (Cartier & Burge, 2011; Maconachie, 2011; Maconachie & Binns, 2007), Ghana (Amankwah & Anim-Sackey, 2003; Hilson, 2010) and Tanzania (Kwai & Hilson, 2010), mining is seen as a means of poverty alleviation which provides a sustainable livelihood as a complement to agriculture. By contrast, this case illustrates that in areas of intensive artisanal small scale mining (ASM), and where potentially toxic materials like lead are involved, this relationship is only temporary. It does this by examining the uneven and shifting effects of mining on local livelihoods in different phases. In doing so, it highlights the fluidity of definitions of livelihood and shifts in strategies deemed suitable to obtain it, responding to previous critics accusing SLA of excessive stability. By engaging closely with a single case study, it showcases dynamism and provides an analysis of the specific institutional, political economic and ecological context and how it has shifted over the past 50 years. Tracing changes over time also allows us to understand present attitudes more clearly.

Second, it pays due attention to questions of social justice and structures of inequality by highlighting the uneven patterns of cost and benefit for different social groups at different times. This produces a portrayal of the political economy of mining in Qiancun and its shifting role within a heterogeneous range of livelihood strategies employed by villagers. Third, by focusing on the voices and experiences of villagers, it provides a village-centered redefinition of livelihood resources and strategies, and how the feasibility and desirability of mining is evaluated. Importantly, Scoones highlights that there is no neat quantifiable algorithm for objectively measuring sustainable livelihoods and that people may have diverse criteria to define them (1998, p. 6-7). This article shows how, why and with what effects these criteria changed over time in Qiancun. It does this by dividing analysis into different periods and considering how changing contexts, uneven spread of costs and benefits and unequal access to different types of

capital and livelihood resources affected perceptions of what counts as a livelihood and how to achieve it. This focus on the interplay between livelihood strategies and perceptions of the environment and sustainability in shaping local environmental subjectivities (Agrawal, 2005) is an innovative contribution to SLA.

Three mutually-shaping factors serve as a useful framework for analysis which could be extended to future studies of mining, livelihoods and development: (a) *time and scale of extraction*; (b) *social groups* (state and county, outside private investors, village elites, relatively privileged villagers, resource poor villages) and (c) *types of capital* (human, natural, economic and social). The table (table 1) below serves as a guide for the analysis undertaken throughout the article.

(insert table 1 here)

The article elucidates their interactions as follows. Different policies and institutional contexts in each phase influenced the scale at which development benefits and costs were distributed, the extent of participation by different social groups in the village, and the types of capital available to them. By affecting the distribution of land and access to natural resources, these contexts prompted shifts in livelihood strategies. Conversely, the ways in which villagers valued mining, profited from it and suffered its costs shifted over time in relation to shifts in the institutional and political economic context, their ability to mine (and draw financial capital from it), and the effect of mining on the natural and physical capital. But the article also shows that villagers did not simply adapt to a given context; they also tried to push the boundaries of what is possible by demanding the right to mine when they were denied it, and a cleaner environment and adequate compensation for losses. In doing so, it innovates upon SLA to show that local and national contexts do not inform livelihood strategies and subjectivities in a linear or easily predictable way, and that a longer timeframe is needed to grasp these complexities.

LEAD MINING IN CHINA AND ITS EFFECTS

Mining has played a crucial role in national development since the founding of the People's Republic in 1949. Initially, this relied on the establishment on state-owned mines, but since the opening and reform after the death of Mao in 1976, township and village mines were established alongside a growing number of relatively small private artisanal mines (ASMs).² These small, flexible mines have been a central force for rural development during economic reforms (World Bank, 2011, p. 23) and a key feature of rural industrialisation more broadly (Bramall, 2006; Tilt, 2010; Wright, 2011). By the 1990s, ASMs undermined the monopoly of state-owned mines, many of which were privatised. However ASMs also presented problems: low capitalization, which was a key to their success, resulted in a poor safety record and severe environmental effects. The Chinese state made various attempts to address this. Yet, the 1996 Mineral Resources Law fell short of managing ASMs effectively, and subsequent attempts over the past two decades to regulate ASM, including a second revision to the Mineral Resource Law in the early 2000s, have also had limited success (Shen, Dai, & Gunson, 2009, p. 151-4).

In part, limited regulatory success is due to the exponential growth of the sector. China's demand for mineral raw materials has grown by an average of 10 % over the past three decades, fuelling urbanization, industrialization and a growing consumer middle class (Hilpert, 2013, p. 51), and contributing to the recent global mining boom.³ As a consequence, the government has retained control of mining to a large extent and, particularly since 2005, it has strived to consolidate mining into a small number of large enterprises (ibid.; Hilpert, 2013; Shen et al., 2009). At the same time, private interests and market influences have also increased (World Bank, 2011, p. 24; see also Andrews-Speed & Cao, 2005; Shen et al., 2009). Chinese mines are still predominantly artisanal small mines (ASM), and regulating them efficiently remains a challenge (Hilpert, 2013, p. 54; IIED & WBCSD, 2002; Shen et al., 2009, p. 151). Yet closing

them is also unfeasible, as they made the unparalleled growth of Chinese mine production in the early 2000s possible (World Bank, 2011, p. 23). They are vital sources of work in areas where few other options are available (*ibid.*), employing millions of people and accounting for over half of China's mineral production (Shen et al., 2009, p. 150).

The vast majority of lead and zinc mines in China are ASM, underscoring the importance of an in-depth study of this form of mining and in turn supporting a focus on lead/zinc mines as representative of the ASM sector. China ranks second globally (behind Australia) for lead/zinc deposits but it ranks first for lead and zinc production and consumption (Zhang et al., 2012, p. 2269). In 2012 the Ministry of Land and Resources estimated lead and zinc deposits to be over 20 million tons, and encouraged investment in the coming years (Li, 2010; Ministry of Land Resources, 2012a). As for raw materials more broadly, the lead/zinc smelting industry has developed fast based on rich resources and relatively low labor costs. Although lead/zinc deposits of various types are widespread across China, most reserves are located in Yunnan, Inner Mongolia, Gansu, Guangdong, Hunan, Sichuan, Qinghai and Guangxi province (Zhang et al., 2011, p. 2514). The Ministry of Land Resources (2012b) describes Hunan province as “a land flowing with non-ferrous metals”, which accounts for one-fifth of total lead-zinc production in China. The Xiangxi region, showcased in this article, contributes most to this.

Lead mining is well known for its environmental and public health threats (Li, Ji, Yang, & Li, 2007; Li, Ma, Kujip, Yuan, & Huang, 2014; WHO, 1995; Zhang et al., 2012). While some of this pollution is well documented, distant, inaccessible small mines and smelters may be associated with serious, undocumented pollution (Zhang et al., 2012, p. 2270). The village examined in this article is one such case. Limited knowledge on many of these relatively remote mines makes this study valuable as it gives some indication of the additional widespread environmental health burden of mining which remains as yet little understood. Given the high

impact of lead mining on the natural and physical capital, this presents a particularly fruitful case for applying SLA and mapping the shifting role of lead mining as a livelihood resource, its effect on environment and health, and how and why villagers' attitudes to it evolved over time. Such severe environmental and health impacts make it essential that its contribution to development should be assessed in more holistic ways than simply its GDP contribution. The effects of mining, as we will show, need to be evaluated historically and across different scales (such as the village, the county and the nation) and social groups (villagers, local elites, outside workers and outside contractors).

The purpose of this study is not to formulate a universally applicable model of the balance between costs and benefits of development, but rather to emphasize that these relationships need to be understood within a historical frame and across different scales. Nevertheless, this study has a broad applicability for two reasons. Firstly, ASMs are widespread in China and this area is typical of the landscape of ASM by including several relatively small and low budget mines. The ways in which mining is situated in the locality – spreading benefits unevenly across social groups, causing conflicts, and causing a range of effects on livelihood, soil, agriculture and health – is typical not only of mining more broadly but also of rural industrialization. Both of these trends – mining and industrialization – respond to the same policy environment which has at once required economic development and recently tried to regulate and limit its environmental effects. For instance, loss of farmland and issues of adequate compensation for it (which are explored below), do not only affect mining regions, but rather they are a much broader concern for the Chinese government as it promotes urbanization and industrialization and attempts to coordinate rural and urban development (Long, Liu, Li, & Chen, 2010).

METHODOLOGY AND RESEARCH SITE

The fieldsite is Qiancun, a mountainous village located in Fenghuang, a county situated in Western Hunan province (Xiangxi) in central China and heavily reliant on mining. Qiancun itself experienced over 50 years of lead mining. In 1978, per capita GDP in China was 381 Yuan, with an estimate of 280 Yuan in rural areas, which steadily improved and exceeded 1644 Yuan by 1990 (National Bureau of Statistics of China, 2008).⁴ In Fenghuang county and Qiancun village, the income was lower than average. Qiancun village is remote and offers limited livelihood options. Fenghuang was classified as a poor county (*pinkun xian*) in 1986 and in 2002 it became one of the National Poverty Alleviation and Development Key Counties (The State Council Information Office of the People's Republic of China, 2002).⁵ Qiancun in turn is identified as a poor village (*pinkun cun*) with relatively low agricultural potential.⁶ This makes lead mining and related processing an attractive livelihood option in comparison to agriculture or migration. Qiancun consists of four sub-villages, located in a river valley surrounded by terracing. At present, there are 346 households and 1560 registered residents, of whom about 560 are or working age (between 16 and 64). Almost all male residents in Qiancun share the same family name, Li.

Research in Qiancun was conducted as part of an interdisciplinary team comprising scholars from medical geography, psychology, public health, as well as the article's authors, representing rural sociology and anthropology. Medical geographers have carried out pilot studies on levels of various heavy metals in the soil, water, and crops, and in the hair, blood and urine of local residents in the area for roughly a decade, and soil scientists conducted further tests in 2013 (discussed below). They show that mining has presented a risk to health in the area for many years, but that the levels of risk may vary dramatically at different times and in different locations in the village, further supporting the need to examine livelihood effects diachronically.

Social scientists, including the article's authors, complemented these findings by examining the social, economic and political context in which mining is situated. While qualitative retrospective accounts on the effects of mining on the local environment in different periods may not serve as objective evidence to measure its effects quantitatively, they nevertheless provide a sense of how locals evaluate the changes in mining.

This article is based on qualitative methods, including an extensive documentary research, semi-structured interviews and ethnographic fieldwork in Qiancun between 2010 and 2012. 35 formal, in-depth interviews were conducted with male and female residents aged between 22 and 71 in 2011. Ethnographic interviews with 60 residents were carried out in 2010 and 2012 in two subvillages most severely affected by mining, spanning across residents diversely positioned vis-à-vis mining and members of conflicting social groups identified during fieldwork, in order to include a variety of perspectives. These interviews were recorded, transcribed and analyzed. While on some topics we gathered divergent views, on others there was a remarkable degree of consensus among villagers. In such cases, we refer to villagers in general terms in section 5.⁷

Additional interviews were held with different stakeholders, including the village doctor, village leaders, local primary school teachers and staff in the county's Centre for Disease Control. Finally, a questionnaire on mining, livelihoods and perceptions of environmental health risks was administered to 170 respondents in 2011 employing random sampling across all four subvillages. The analysis was also informed by discussion with other research team members who focused on changes in land use, and risk assessment and perception.

MINING TRAJECTORIES AND LIVELIHOOD DYNAMICS IN QIANCUN VILLAGE

The development of mining in Qiancun village may be divided into 5 phases: (1) limited artisanal mining by villagers; (2) mining by State-Owned Enterprises (SOEs), (3) SOEs and small scale private mining, (4) medium scale and small scale private mining, and (5) medium scale privatized mining. These phases roughly correspond to the development of China's mining industry more widely, its policy context and political economic shifts, though timelines and turning points may differ (see Wright, 2011).

Phase 1: until late 1950s – limited artisanal mining

According to villagers, during the Ming Dynasty (1368-1644) Qiancun was known as “Peach Blossom Village” due to its numerous peach trees and a large pond. Elderly villagers reminisced about the rich natural capital – particularly clean and clear water full of fish, shrimps and crabs – before mining commenced. Before 1958, Qiancun was an ‘ordinary’ village, where residents depended on agriculture for their subsistence and economic capital was limited, even for those with relatively high social capital. In this initial period, only few villagers gathered lead ore in the fields and sold it to businessmen from the neighboring township. They used primitive mining techniques, working with hammers and other simple tools to dig out minerals which they separated manually before transporting and selling them. Therefore, local residents considered themselves to be farmers first and foremost, mining was seen to have little value and inequalities between villagers were limited.

Phase 2: late 1950s to late 1970s – SOE mining

Mining played a crucial role in national development after the establishment of a state-planned economy. Government policy and regulation on mining closely follow China's broader political development (Wright, 2004, p. 635). In the 1950s Chairman Mao Zedong introduced the

first Five Year Plan (FYP), which sought to boost China's economy by limiting its dependence on agriculture and by following the Soviet model of expansion of heavy industry. At the start of the second FYP in 1958, and in line with state-ownership of resources, a significant number of state-owned mines and processing plants were established. Following this trend, Fenghuang county authorities laid claim to mineral deposits on behalf of the nation and medium-scale mining operations were initiated in Qiancun by a state-owned mine. With the development of technology and increased extraction of lead in the 1970s, the first state-owned processing plant was opened in Qiancun with a capacity of 30 tons. In order to contain the tailings and waste water from the processing plant, the first tailings pond was built by the county government in Qiancun in the late 1970s.⁸

The institutional context of a planned economy and collective ownership of land meant that mining was largely monopolized by the state.⁹ Therefore, no compensation was given to the village for loss of land, nor was any provision made for the negative effects mining might have on rural livelihoods or to ensure that local communities were able to enjoy the benefits of mining. Overall, at this time mining began to play a central role for the county's revenue, but still occupied a relatively low position as a livelihood resource and strategy for villagers. Over two hundred workers were recruited by the SOE mine as full-time workers earning fixed wages, but virtually no locals. Villagers resented the lack of employment opportunities and loss of their land and demanded the right to mine. In 1972, an agreement was reached – still valid in the present – between the SOE mine and representatives from the village and township government (respectively called brigade and 'people's commune' at that time) to clearly mark the SOE mine precinct with a "red line" and to allow villagers to mine outside it, in areas with lower quality deposits.

As a consequence of this institutional context, the main axis of inequality was between villagers and the SOE mine and its workers. Social capital had little or no impact on villagers' ability to join mining operations; their financial capital was limited, relatively evenly spread and still mostly drawn from farming, which remained the foremost livelihood strategy. Average production of rice and corn with traditional crop varieties was about 250 kg and 500 kg respectively per *mu* per year before the 1980s.¹⁰ Mining operations began to have an effect on the natural capital by draining irrigated fields and polluting water sources and soil. In 1972 some local water sources were tested for the first time by the government's mining unit (*tankuangdui*) and found to be contaminated with lead.¹¹ However, damages to natural and human capital (health) were not yet fully apparent and concerns with pollution and its health effects were limited.

Phase 3: late 1970s to early 1990s - SOEs, TVEs, private and ASM

After the death of Mao and the start of a period of economic liberalization in 1978, township and village enterprises (TVEs) were allowed to open (including mines) in order to absorb rural labor surplus and launch rural economic development (Tilt, 2010; Kanbur & Zhang, 2009, p. 1; Gunson & Jian, 2001), giving rise to "local state corporatism" (Oi, 1992). While China's post-1978 economy also benefited from many of the social and infrastructural investments of the pre-1978 period (Ravallion & Chen, 2007; cf. Bramall, 2003), liberalization is typically seen as the force that lifted hundreds of millions of people out of poverty. Strong incentives for local governments to achieve rapid economic development partly account for China's fast growth after reforms (Zhang, 2007). The national support for rural industrialization (including mining) as the key to development forms the political-economic backdrop for the expansion of mining in China, though diverse choices between agriculture, migration and

industry as development pathways were embraced in different parts of China over this period (Bramall, 2006).

The encouragement to rely on local natural resources to fuel local development in line with national policy as in the widespread dictum “when near mountains, rely on mountains; when near water, rely on water” (*kao shan chi shan, kao shui chi shui*) was a key driver for the growth of lead mining. National demand for lead in the 1980s and aspirations to export lead abroad also caused a price increase and a mining boom. Both these factors underpin the opening of a growing number of smaller and less regulated mines, some private and some collectively owned (at the village or township level). Indeed, several lead-zinc and mercury mines and smelting plants were established in Fenghuang at this time. In 1983 Fenghuang county government formally established the Lead Zinc Ore Development Headquarters. This was a period of very active artisanal and small scale mining (ASM) activities in Qiancun and the scope of the processing plant was extended to 250 tons.

These changes greatly affected villagers’ livelihood resources and strategies. Residents in poor rural areas like Qiancun faced a new and wider set of livelihood options, each with different costs and benefits. Firstly, as in most of rural China, following a nation-wide land reform in 1982, the village collective distributed irrigated farmland and hillside land to registered individual households by allocating 0.8 mu of farmland per registered individual resident, and by dividing hillside land equally among households regardless of the number of members (Tilt, 2008).¹² After the 1980s, with the increased use of hybrid crop species, fertilizers and pesticides, productivity of rice and corn increased twofold to 500kg and 1000kg respectively. Secondly, migration became possible and attractive, following the establishment of export processing zones and urban development in coastal China. Jobs in manufacturing, construction and services offered wages considerably above income from agriculture, but they also meant long spells away

from home and long hours in often dangerous working conditions. Thirdly, and most prominently, mining became a key livelihood strategy. Indeed, some who had migrated in the early 1980s soon returned to the village and almost everyone (except for old and infirm people) became involved in mining.

All villagers experienced the advantages of a cash income, though levels of income were uneven. Several outsiders came to the village and expropriated land for lead mining. Inspired by them, some political and economic village elites (village and sub-village leaders and some richer households), who were in a stronger position to secure funds, opened their own small-scale mines. In addition to financial capital, elites had the social and political capital to secure needed permits and to gain knowledge about the location of mineral deposits. Those who lacked the capital to open their own mines joined in as members of the labor force. As mining increased, more land was also required to dispose of waste and to build additional tailings ponds. Since land at this time was contracted out to individual households (unlike during the previous phase), villagers affected were offered financial capital in exchange for the loss of natural capital (land) in the form of compensation. Villagers' gains were limited (certainly as compared to those of the SOE and its workers) as they were only allowed to mine where mineral quality was lower, and they were obliged to sell minerals to the SOE for a reduced price. But as compared to the livelihood strategies they had embraced thus far – farming and limited employment – mining offered opportunities for much better income and without requiring migration. This may explain their enthusiasm for mining and relative disregard for environmental losses at this time.

More opportunities opened up as side-effects of the mining boom. Locals could become businessmen or provide services such as selling vegetables in the market, opening restaurants and operating mini-buses for transport as Qiancun village experienced an influx of migrants (Hilson & Banchirigah, 2009). The possibility of getting rich, accompanied by the sense that

mineral reserves were endless, led villagers to focus more on immediate gains than on their long-term future. This orientation was also reflected in the economic rationale behind ASM. Low capitalization was crucial to the economic success of TVEs and private mines. Profit considerations determined methods of mining and processing, with little regard for longer-term environmental impacts (Wright, 2000, p. 123).

As a result, damages to the natural capital soon became apparent. Particularly in areas of the village situated downstream from extraction and processing, such as the sub-village of Fengcun, water pollution became a severe problem. Villagers recalled that at that time the water in the local stream turned black and smelly, they would develop itchy skin rashes if they came into contact with it and prawns and fish died. Here, where pollution was most prominent, some villagers began to be concerned about the effects of mining on the natural and human capital. The response to mounting evidence of pollution was a series of petitions in the 1980s, including two petitions to the central government in Beijing, but there were no visible outcomes. At this time of boom, villagers increasingly focused on mining as a livelihood strategy and regarded it as a path towards a better life, largely conceived in terms of financial wealth. Given that effects on the natural capital were still relatively limited and agriculture was no longer labor intensive due to the increased use of fertilizer and pesticides, average households – especially poorer ones – could oscillate between mining and agriculture as complementary livelihood strategies.

Phase 4: early 1990s to 2007 – the privatization of the SOE mine and the rise of villager-run mining

While TVEs no doubt were vital to rural economic development, they also undermined the monopoly of the state sector, physically encroached on SOE minerals, and used their electricity and drainage facilities (Wright, 2000, p. 113-9). The success of TVEs and private enterprises posed a competitive threat to SOEs, which had higher investments and higher costs to

provide for employees' welfare. By the middle and late 1990s, most small and medium SOEs were privatized or experiencing large numbers of layoffs. At the same time, huge demand for minerals from both international and national markets, especially in the 2000s, spurred the growth of ASMs and attempts to regulate them were limited and ineffective.

Qiancun's experience reflects these policy and political economic changes. In 1994 the Fenghuang county government sold contracts to the mines and processing plants to a wealthy private company from outside of Qiancun.¹³ Taking advantage of increasing demand and of partial privatization of the sector, a growing number of villagers started to invest in their own mines instead of being employed by others, especially as lead prices peaked again between 1993 and 1998. More than two thirds of the research participants stated they had tried to collect money (by borrowing, loaning, or through establishing cooperative unions) to invest in the basic machinery and to open up their own mines between the 1990s and 2007 (reference removed).

In this phase, villagers' income from mining increased. Indeed, many remarked that all new houses in Qiancun were built with income from mining. According to a survey conducted in 2011, mining contributed 55.9% to the households' annual income in 2006 (when the price of lead and mining activities peaked), far more than migration (16.5%) (reference removed). In 2006, villagers who owned a mine earned on average 96,000 Yuan per capita per year (an astonishingly high figure for rural China), and mine workers could earn 15,000 Yuan per capita per year, while farmers could only earn an average of 3,840 Yuan per household per year from crop production. While in phase 3 mine owners were almost exclusively members of the village elite, now most villagers were mine owners or co-owners. Some mines were operated by individual households, which were able to fulfill all the labor requirements of the mine, but others developed a cooperative mining system to pool resources. Typically, a family which was in charge of mineral-rich land would team up with other families to raise the financial capital to

purchase dynamite and the machinery required, and to share labor. Households would invest cash and labor equally and the profit from selling minerals was split between the shareholders, with an additional 5% for the household which provided the land. Social capital played a significant role in establishing cooperatives, as those with reliable networks or kinship relations were also in a stronger position to pursue and maintain collaborations. By contrast, when mineral-rich land was contracted to particularly poor households who could not raise the funds to start a cooperative union, they would rent their land to other villagers. As a result, by the end of 2007, there were over 200 mine shafts in Qiancun. The proliferation of mine shaft gave rise to “resource wars” (Wright, 2007, p. 194) between villagers and with outside contractors when mine shafts joined underground.

In sum, direct access to minerals for villagers increased in this period and mining (through ownership or joint ownership) was the foremost livelihood strategy. Gains, however, were unevenly distributed. Those with more social capital and who therefore had already established mining operations by the early 2000s were well positioned to benefit from another peak in the price of lead between 2004 and 2007. By contrast, those households which had not yet invested in mining by 2006, were unable to secure sufficient capital to mine successfully before the new closure policy was issued in 2007. Members of these households lost the funds they had invested and earned nothing in return. Villagers’ attitude towards mining was a mixture of enthusiasm in the hope of securing the desired wealth, and resentment when it failed to materialize. While they regarded wealthy and well-connected families to be in a better position to extract minerals, there was also a prevailing sense that mining was ruled by luck. This engendered a sense of a future beyond one’s control, characterized by both hope and by a dawning sense that minerals are not endless and may not provide wealth for all.

Feelings of ambivalence were exacerbated by the increasingly clear and unevenly distributed negative effects of mining (see Saha, Pattanayak, Sills, & Sinqha, 2011). Loss of natural capital including loss of farmland, loss of water and pollution of water, soil and crops were substantial. According to a survey of land use in 2006, nearly 50% of farmland was affected by mining; 35% of respondent households claimed their farmland had been occupied or polluted and 31.9% stated their paddy fields were transformed into dry land due to mining beneath them (reference removed). 61.3% of households believed that farmland was significantly degraded over the past few decades by a decline in the soil's water retention, decline in fertility, soil hardening and pollution (reference removed). This severely compromised villagers' ability to make a living from farming or even achieve self-subsistence, and forced them to buy food from the market.

Data collected by medical geographers over the past decade suggests that lead content in the surface soil in paddy fields seriously exceeds national safety levels (though this may not be used to extrapolate levels of lead in the crops in any straightforward way, reference removed). National standards recommend lead content below 250 $\mu\text{g/g}$, but in Qiancun lead content in the majority of sites tested exceeded this figure fivefold, and in one case it almost reached 2500 $\mu\text{g/g}$, with cadmium (Cd), mercury (Hg) and arsenic (As) also in excess. Likewise, lead content in rice in some fields exceeds the national food safety standard, with lead content up to 2.2 $\mu\text{g/g}$, well above the recommended maximum of 0.2 $\mu\text{g/g}$. Cadmium, mercury and arsenic are also in excess. According to this research, rice consumption was the main pathway of lead exposure (reference removed). Soil pollution however varies in different areas of the village depending on proximity to mining, slag heaps and tailings ponds, as well as on water flows, soil Ph, quality and moisture, and type of rice grown (FORHEAD, 2014). While data collected is based on

limited sampling, and therefore cannot provide a complete picture, it nevertheless offers some insights on the levels of damage and exposure.

Mining also affected groundwater levels and quality, in turn affecting soil fertility and food safety. Use of water by mines also reduced the available amount of drinking water and polluted it. 83.2% of survey respondents believed that the quality of surface water such as in the local stream and ponds declined as a result of mining. Tests on surface water in Qiancun revealed the majority of samples were in excess of China's water category V (0.1 mg/l), reaching levels of 0.25 mg/l (reference removed).¹⁴ Such high heavy metal contents exceed the river's capacity to dilute them and gradually become cleaner. While water is secondary to food as a source of exposure, it also poses a significant risk, given that 51.2% of irrigation water is derived from surface water (reference removed to retain anonymity). Tests carried out by the Hunan Province Labor and Health Institute of Occupational Disease Prevention in the 1990s found some local water sources unsafe for drinking (reference removed to retain anonymity). However, little progress was made with regard to safeguarding or recovering natural capital. Some families, individually or in small groups, connected to water sources above the mine shafts (which they assumed to be safe as a consequence), but water provision remained unreliable and may be contaminated with lead.

Such extreme levels of pollution resulted in loss of human capital, most prominently through high lead levels in locals' blood. WHO recommends keeping blood lead levels below 200 µg/L (United Nations Environment Programme, undated, p. 8), and lower for children and women of childbearing age, on whom the effects of lead exposure is more severe. In Qiancun, however, most villagers tested were found to be in excess of maximum recommended levels, with some reaching up to 600 µg/L. Blood levels of cadmium, mercury and arsenic were also in excess (reference removed to retain anonymity). 80% of those working in mines suffered from

lead poisoning (references removed to retain anonymity). While not necessarily representative of the entire village, these findings provide a sense of the severity of the environmental health costs of mining. This combination of circumstances – heavy reliance on mining, increasing pollution and land loss – set up the conditions for the predicament villagers found themselves in during the following phase, and had an important impact on their views of sustainability, livelihood, and the place of mining within it.

Phase 5: after 2007 – the crackdown on mining

Phases 3 and 4 were regarded as a boom period for mining in Qiancun, driven by high lead prices and domestic and global demand for lead. However, in 2007 the price of lead began to fall and the Xiangxi district government issued the “2007 Lead and Zinc Industry Pollution Treatment Plan” which demanded the closure of all illegal mines and safety regulation of all mining-related activities (interview with township official, 2011). These regulatory efforts were strengthened in 2008, following a serious accident in an illegal mine in Shanxi province, in which a slag heap collapsed, killing 254 people and causing serious injuries (Xinhuanet, 2008). This accident inspired a nationwide movement to regulate, manage and control safety problems related to slag heaps. These plans resonate with a classic narrative of ecological modernization whereby “new mining”, which is capital intensive and is socially and environmentally responsible, replaces “old mining”, which was dangerous for the environment and workers alike (Bebbington et al., 2008a). Given that the Chinese government encourages lead mining (Li, 2010; Ministry of Land Resources, 2012b), this tightening of regulation is not intended to curb lead extraction and processing (see section on lead mining p.7-11). Indeed, new mines were opened and approved by the government in the township neighboring Qiancun in 2012.

The benefit distribution related to old and new mining is clearly different: in the former case, villagers may only hope to be employed as laborers (though in Qiancun they often are not);

in the latter, villagers draw direct benefits as owners of the mines. The policy affected most adversely those with limited financial and social capital to secure permits or to avoid a crackdown. In 2010, purportedly all small-scale mines were closed by the local government on safety grounds, yet 12 illegal private mines continued to run without formal licenses (fieldwork by second author, 2010). Given the remoteness of the village from county officials, mining bosses with the funds and social capital to secure the support of relevant officials continued to operate. Some of these mines were closed during a further crackdown in 2011. Yet as lead prices began to rise again in 2011 there were sustained efforts by outside investors to resume mining. In general, the only mines which continued or resumed operations were contracted by wealthy outsiders. Most villagers by contrast could not afford the cost of permits, did not have the social capital necessary to secure them and they were forced to close. By 2013, a brief visit by research team members found that mining by outsiders was on the rise.

The effects of this policy on villagers' livelihood resources are profound, as almost all villagers were involved in mining by 2007, and many of them had opened their own mines. In response, villagers attempted to diversify their livelihood strategies. Those (typically men) who had developed mining skills (such as using dynamite and drilling) were able to migrate and find work in other mines when local mines did not employ them. Those who lacked these skills began to migrate to cities in search of work, often becoming poorly-paid manual laborers, or to search – largely unsuccessfully – for construction work in the neighboring townships. While in phase 4 mining made a foremost contribution to annual household income, in 2010, mining contributed only 15.8% of the annual income and migration income had, in turn, increased to 51.4% (reference removed to retain anonymity). The final livelihood resource available is a return to farming, and indeed most families continued to farm, and some tried to make a living based on farming alone. However, mining has literally undermined farming and only few households have

been able to produce enough to sell their agricultural products in local markets. In 2010-11, a group of older men who were physically unable to engage in hard labor and find employment attempted to rehabilitate hillside land and planted honeysuckle and kiwi. But their attempts to earn a living from cash crops failed to deliver the desired income.

More widely, attempts to eke a living from agriculture were hindered by the extreme damages to the natural capital which became prevalent since phase 4. Most of these damages could not be recovered even after the crackdown. By 2011, mining had percolated through 200 mu of Qiancun land, with almost 200 abandoned mine shafts, 11 smelting factories and 3 tailings ponds. These sometimes lack sufficient storage capacity and therefore overflow or burst their banks. In the latest accident of this kind in May 2012, 10 households lost their 20 mu of adjacent farmland. Given the high levels of pollution and the degraded landscape, agriculture in Qiancun village is now facing a crisis in both food security and food safety, though the most recent tests suggest that food safety impacts are complex and uneven (reference removed) (FORHEAD, 2014).

If inability to achieve self-sufficiency through farming was not a crucial matter of concern during phase 4, it became important once again in phase 5. Survey respondents in 2011 claimed nearly 70% of the irrigated land in Qiancun has been converted to dry land due to long-term lead mining, and vegetation on the hillside has radically declined. Some of the interviewees stated they had to buy rice and other food in the market, with a cost of roughly 1,400 Yuan annually. As a result, attitudes to mining became distinctly critical and focused on its environmental damage. When mining was in full swing for villagers, as in phases 3 and 4, compensation mattered relatively little as a livelihood strategy. But once mining stopped in 2007, it became much more important. Villagers complained that compensation was inadequate and insufficient to secure a livelihood, and some claimed it

ceased altogether since 2009. Some tried to petition, but success was limited, required repeated efforts and energy, and entailed the risk of threats from village leaders.

As for phase 4, effects on the human capital from contaminated water and crops may be severe, though they may also be uneven, depending on the water sources used and on the location and soil composition of the fields, affecting the extent of contamination on crops. The most recent tests showed that levels of heavy metals may have decreased since the closing of local mines. Indeed, only a small percentage of rice samples tested in 2013 were over the limit (reference removed). Measuring ongoing health effects of previous exposure is made more complex by the growth of migration, whereby some villagers who are suffering the effects of lead poisoning are no longer in the village (see Holdaway, 2014). Regardless of actual health effects, tighter controls on small-scale mining exacerbated villagers' sense that the local human and natural capital is suffering the effects of mining closures without reaping any of the benefits.

THE RISE OF SUSTAINABILITY CONCERNS AND THE PARADOX OF MINING

The closure policy affected villagers' attitudes to mining in three important respects. First, since mining has continued for those who can secure permits, recent policies have done nothing to convince locals that mining *per se* should stop. Indeed, the state still supports lead mining. Just as it was before liberalization in the 1980s, mining has become a matter of access to resources. While the recent appropriation of resources (phase 5) was legitimized in the name of safety, previous experience with larger outside contractors and indeed with the SOE itself suggest that larger does not mean cleaner or more responsible. Medium-scale mines historically excluded locals and polluted the environment. Likewise, current investors often employ outsiders, leaving villagers with meager employment opportunities in the mines, limited livelihood

alternatives and severe environmental health costs. Crucially, villagers feel the proclaimed premise for these closures (safety) is not in fact the real driving force behind them. Permits are largely seen to be (and often they actually are) a matter of financial and social capital.

In this context, continued willingness to mine on the part of villagers is born of a sense of injustice. They oppose the fact that outsiders and local elites take the lion's share of the benefits and resent their limited ability to rely on it for their livelihood. Their resentment is stronger now than it was in phase 2, since they have experienced the benefits of mining directly for over two decades. In addition, the closure policy does not demand clean-up of existing pollution or compensation for losses and therefore it does not present an effort to make livelihood in the village sustainable. An analysis of the longer timeframe in which villagers experienced mining shows that their current demand for access to resources is not only an economic response to the current livelihood crisis, but also a moral response to what they see as unfair treatment without much concern for a more even distribution of benefits or for the village's long-term livelihood resources (see Bebbington et al., 2008b; Bebbington & Bebbington, 2011).

Second, as mining has been ring-fenced from villagers, it has made them reflect more on the uneven distribution of costs and benefits, including between villagers. Indeed, mining contributed to the market, both nationally and internationally and helped China realize its industrialization goals, but it trapped future generations in an emerging structural poverty. Benefits are closely correlated to social capital and unevenly spread between elites (typically village cadres) who opened mines the earliest, those who opened their own mines later, those who opened through cooperative arrangements and those who only served as workers. In the most successful cases, social capital (social networks) improved villagers' ability to engage in mining and secure financial capital, which in turn safeguarded human capital (health) by

allowing them to move out of mining areas, following the Chinese dream of a modern, urban and safe future.

Many more however lost out by failing to extract good quality minerals, losing land, becoming ill as a consequence of hard labor in the mines and failing to secure income from farming. Middle-aged men (and less so women), who were injured while mining or suffer from chronic conditions linked to working long hours inside mines or carrying ores, were unable to find any employment. Many of those left behind potentially suffer the ongoing contamination of crops and water, erosion of land, and food insecurity, though these effects are unevenly spread. In Fengcun, the most downstream of the 4 sub-villages where 3 tailings ponds were located, some interviewees estimated that two-thirds of their former farmland was lost to mining. Ultimately, mining in Qiancun has operated to entrench poverty for those who did not, or could not, escape to the city. Conversely, levels of income which could be secured through mining (particularly by owners and co-owners) set high expectations which could not be met after the closure policy was enforced. In addition, higher income in the county town derived from tourism made villagers reflect painfully on their structural inferiority in the absence of mining and on its detrimental effects on other livelihood resources. Unlike studies of mining in other parts of the developing world, which optimistically argue that mining can serve as a complementary livelihood strategy to agriculture (see pp. 4-5), Qiancun's case shows that a historical perspective on mining betrays its unsustainability and its detrimental effects on alternative livelihood resources and on livelihood diversification. In doing so, this article highlights the importance of adopting a longer timeframe in the study of natural resource extraction to assess its costs and benefits more adequately.

Third, without income from mining to mitigate the loss of farm-based livelihoods, villagers have become increasingly wary of the slow, but severe and partly irreversible, effects of

mining on agricultural production, water safety, environmental degradation, health and household livelihoods (reference removed to retain anonymity). Concerns with pollution had begun to emerge as soon as mining commenced, especially in Fengcun, the most downstream sub-village and therefore the most affected. Petitions against pollution have been presented since the 1980s, but concerns about pollution became more acute after the closure policy. These effects are also much more pronounced now than they were in the 1970s, when villagers were also excluded from mining. As villagers realized that mining had seriously compromised the local natural capital and their ability to draw a living from it, they expressed distress about the future. Many asked rhetorically, “what is the next generation going to eat?” Villagers developed a painful awareness that life in Qiancun had become unsustainable. Yet they also expressed a desire to continue mining. Some saw mining as a means for them to accumulate the necessary capital which would enable the next generation to leave. As one put it, “We will not leave, but we want to earn some money from mining and enable our children to get out of here.”

The intersection of these three key concerns has engendered a seemingly paradoxical situation whereby villagers are aware of the damages of mining and yet willing to mine. The diachronic approach adopted in this case study enables us to understand these apparent contradictions and unpack the complexities of environmental subjectivities as they respond to shifting livelihood resources and strategies. One event may serve as an example of these complexities. In 2011 a group of locals compiled a letter for the local government in which they collated complaints about pollution, what they considered evidence of higher cancer rates linked to it (whether this is indeed the case is a different question entirely) and a list of compensation amounts owed. This demonstrates that villagers are concurrently concerned about health, environment and income. That they demand compensation, and do so more forcefully now than they did in the past, is due to their limited alternative livelihood opportunities. Given that such

income is vital to face healthcare costs or to buy bottled water and secure food when villagers are unable to farm, demands for compensation should not be regarded as only oriented towards financial gain. For villagers, compensation, income from mining, pollution and health are all part of the same “lifescape” (Edelstein, 1988; see also Auyero & Swistun, 2009). Concerns with financial capital are inseparable from concerns with physical capital and natural capital and concerns about the decline of the latter two forms of capital trigger (largely unsuccessful) demands to boost the former.

These are crucial points for studies of local communities’ attitudes to mining and livelihoods more broadly. When current attitudes are examined in light of past experiences and by adopting a more holistic definition of development, they may be revealed in all their complexity, as more than the manifestation of a solely economic concern. The longitudinal analysis embraced in this study provides an original contribution to sustainable livelihood approaches by highlighting the historical shifts in how livelihood strategies and the environmental subjectivities they engender are formed. It illustrates the complex intersections between concerns for the environment as a livelihood resource, tensions over access to resources and the nuances of current attitudes to mining and development.

CONCLUSION

This article innovates on the pathways to sustainability approach by adopting a long-term view to examine the shifts in livelihood strategies in different phases, changes in how villagers defined livelihood, and in the importance they granted to sustainability. Such a longitudinal study has several advantages which could be extended to future studies of sustainable livelihoods and in particular to those focusing on natural resource extraction. Firstly, it enriches our understanding of the relationship between livelihood strategies and subjectivities. It demonstrates the complexity of local attitudes to environment, mining and development,

which involve a combination of simultaneous concerns for securing and protection economic, natural, human and social capital. It also illustrates that these concerns are deeply rooted in past and present policy contexts and experiences with mining.

Secondly, a historical analysis shows that the answer to whether mining contributes to or hinders development depends on how development is defined and on the scale at which it is assessed. If development is defined solely as economic gain, then mining doubtlessly contributes to it, but such gains are much higher for the former SOE and wealthy investors than they are for individual villagers. Defining development more holistically to include natural and human capital by contrast must account for the vast damages mining causes to environment and health. This is particularly important when mining involves highly toxic heavy metals such as lead. Taking a long-term view of mining suggests that, rather than offering a complementary or alternative livelihood, mining compromised Qiancun's natural and human capital and undercut farming as a livelihood resource. Ultimately, the ability of the local community to survive has been weakened by damage caused by all previous mining activity (which undercut possibilities for livelihood diversification) and by a ban on small-scale mining (which prevents villagers from benefiting in any significant way while they continue to suffer its effects). This is an important lesson for studies of mining and livelihood more broadly.

Finally, this approach interrogates who is the subject of development, what its benefits are and how they are distributed at different times. It resolves the apparent contradiction between accounts which suggest that local communities are victims of mining and those which see them as beneficiaries. Indeed, they are both, depending on what phase is the focus of attention, and how benefits are defined. This case study highlights an uneven distribution of benefits both within the village as well as between the different scales of the village, the county, and the nation. Such diverse patterns of cost-benefit distribution resulted in different attitudes to mining among

villagers in different phases. As a whole, this analytical stance emphasizes the importance of examining local perspectives on mining and its contribution to development within their broader historical, institutional, and political economic contexts.

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NOTES

¹ All names (except for the county) have been changed to protect research participants.

² More details about these and other policy developments are provided in relevant subsections within section 5.

³ While rich domestic deposits feed much of this growth, they are often of poor quality and therefore expensive to mine (Hilpert, 2013, p. 52). Given growing demand, it has become necessary to exploit domestic resources more effectively while also acquiring control over foreign resources (World Bank 2011, p. 22-3). China's dominant position in the rare earth industry has been a particular concern for the global community (see Chen, 2011; Kefferputz, 2010; Ma & Shi, 2012; Tse, 2011).

⁴ In 2012-13, £1 GBP was roughly equivalent to Y10, but its value would have been much higher in the past.

⁵ Poor counties were identified in 1986, 1994 and 2006 by the State Council Leading Group Office of Poverty Alleviation and Development. In 1986, counties whose rural per capita net income was below 150 Yuan were defined as poor counties (State Council Information Office of the People's Republic of China, 2002).

⁶ 'Poor villages' (*pinkun cun*) were identified by the county government according to the economic levels compared with other villages, though criteria for doing so are unclear.

⁷ For more detail on interview methodology see (reference removed).

⁸ Tailings ponds are intended to store wastewater and slurry generated as by-products of mineral processing. If discharged without treatment, the contents of tailings ponds can seriously pollute water and soil.

⁹ According to The Law of Land Administration of the People's Republic of China, urban land is owned by the state, and rural land is owned by collectives (villages or sub-villages) (the Central People's Government of the People's Republic of China, 2005).

¹⁰ 1 *mu*=0.67 hectares.

¹¹ This may be due to high content of lead already in the soil, not necessarily to mining.

¹² Land was allocated with a view to its potential agricultural productivity, with no consideration of mineral resources. In China, in principle, all mineral resources belong to the state.

¹³ Since then, the contractors changed several times due to financial instability.

¹⁴ Water in category V is deemed unsuitable for any use, too toxic even to touch.

HISTORICIZING SUSTAINABLE LIVELIHOODS

Table 1: phases of mining in Qiancun

Phases/scale of extraction	Benefits of mining to different social groups	Types of capital available to villagers
(a) until late 50s: limited artisanal mining by villagers	limited benefits to village elites; outside investors and the state do not engage in mining	natural and human capital uncompromised by mining, limited economic capital offered by mining; social capital necessary for mining
(b) late 50s to late 70s: mining by State-Owned Enterprises (SOEs)	benefits unequally distributed between village and the county; mining intended for national development, extraction only by county-run SOE mine; virtually no economic benefits to villagers;	natural and human capital still relatively high, allowing livelihood based on farming; economic capital low; social capital cannot secure access to minerals
(c) late 70s to early 90s: SOEs and small scale private mining	benefits unevenly distributed within the village; SOE mine still exploiting minerals; some outside investors and village elites open private mines; resource-poor villagers still excluded from mine ownership but have employment opportunities	economic and social capital (connections) important to open private mines; increased economic capital: diverse occupations available to villagers and almost all villagers employed in mines; damages to natural and human capital begin to become apparent

HISTORICIZING SUSTAINABLE LIVELIHOODS

<p>(d) early 90s to 2007: large scale and small scale private mining</p>	<p>SOE mine privatized, wealthy outside investors and local elites exploit minerals; more villagers open mines, including through cooperative unions; benefits to villagers from mining increase, but still unevenly distributed</p>	<p>villagers' economic capital increased, particularly for those with strong social capital; natural and human capital suffer increasingly severe damage</p>
<p>(e) 2007 to the present: large scale privatized mining</p>	<p>economic capital from mining almost exclusively in the hands of outside private investors or local elites</p>	<p>villagers have limited access to economic capital; social and economic capital needed to obtain mining permits: natural and human capital still suffer severe damage, effects on land limit capacity to farm</p>

Response to editor:

The key themes your paper addresses concern the sustainable livelihoods approach and the relationship between mining and livelihoods. Although one of the reviewers highlighted the new literature on mining in China, this body of work remains still limited compared to the larger literature on mining and livelihoods. I would like your discussion section to highlight explicitly how your contribution through this case study speaks to the larger literature on mining and livelihoods.

RESPONSE

We have tackled this both in the early parts of the article (p.3) and in the final discussion. On p 3 we pointed out that livelihood studies have not examined in sufficient depth the potential of mining as a rural livelihood option and that this article addresses this gap.

On pp. 4-5 We have highlighted more clearly our key contribution to the study of livelihood in terms of promoting a longer-term framework for analysis. We argue that this is instrumental in showing the uneven contribution of mining to local livelihoods. On p.29 we highlight that this article's temporal analysis and more holistic definition of development serve to understand local livelihoods and subjectivities in all their complexity. We highlight the complex intersections between concerns for the environment as a livelihood resource, tensions over access to resources and the nuances of current attitudes to mining and development more prominently as a key contribution to this literature.

I also think your work can engage the writings on sustainable livelihoods both more critically and effectively. What are the new insights you have to offer those who tend to use the SL approach primarily in relation to renewable natural resources.

RESPONSE

We revised the introduction, discussion and conclusion to formulate a more systematic and more critical account of this case study's contribution to SLA. In particular, we argue that in contrast to previous SLA studies of mining in the developing world which view it as a feasible livelihood strategy, the longer timeframe adopted in our study shows that mining ultimately undermines livelihood diversification.

In the early part of the article, we have made clearer where our approach innovates upon existing SLA studies, particularly in terms of a temporal analysis and in terms of reflecting on the relationship between livelihood strategies/resources and local attitudes and subjectivities. We also reiterate these points in the discussion section and in conclusion, in terms of the value of these innovations, in particular for future studies of mining.

We also highlight a further innovation on SLA: that local and national contexts do not inform livelihood strategies and subjectivities in a linear or easily predictable way, and that a longer timeframe is needed to grasp these complexities.

Finally, your paper makes implicit references to subject positions and subjectivity in the context of the environment. You might reflect a little more on how environmental subjectivities change or are formed.

RESPONSE

We did not expand substantially about environmental subjectivities, as I already published a piece which focuses primarily on this, but in the early part of the article and in the discussion we highlighted the importance of studying how such

subjectivities shift in relation to livelihood strategies and resources, and argued this is an original contribution to SLA, which otherwise does not examine how subjectivities develop.

I appreciate your point that the environment is not a separate domain of life for those whose livelihood depends on direct actions through which they connect to what might be called the environment. Some more elaboration of this point will be appropriate in my view.

RESPONSE

We have revised the discussion part to reflect further on the embeddedness of concerns with the environment within concerns with economic gain and with health.

With your revisions, please provide a point by point response to the comments above and an indication of the changes you made (you are not required to accept these changes but to respond to them effectively) so as to facilitate editorial review of the revised manuscript.

Original response to reviewers

We are grateful to the reviewers for their encouraging, insightful and helpful comments. Please see below a detailed account of how we have responded to their suggestions and revised the article accordingly.

Editor in chief: consider the latest contributions to this important topic [mining in China], and highlighting the key contributions of your paper adequately.

The section on lead mining has been substantially revised with reference to literature on mining in China to highlight its position more prominently.

Reviewer #1: The major objective of this paper is to understand the complex relationship between mining and development in rural central China, and the ways in which mining ultimately undermines sustainable livelihoods for those left behind by development, using a "pathways to sustainability" approach. The general research question addressed in this paper is interesting. The paper is well-written and the story line is quite clear.

I would recommend that this paper be published with minor revisions.

(1) A full historical perspective of China's rural development is suggested to be further incorporated into the analysis of this paper. Please see: Building new countryside in China: A geographical perspective. Land Use Policy, 2010, 27(2).

We have added this reference and other relevant work such as by Tilt and Bramall and highlighted a fuller historical perspective on rural development throughout subsections in part 5. The policy and political economic contexts have also been extensively addressed in the revised section 3. This also responds to similar comments by R2 (point1)

(2) According to the administrative regionalization of China, Fenghuang County of Hunan province, the case study area of this paper, belongs to central China instead of southwest China.

This regionalisation has been amended.

(3) The contents of the latter part of "3. LEAD MINING IN CHINA" failed to focus on the theme.

This section has been substantially revised in response to R3.

Reviewer #2: It is a very interesting article and provides much more practical survey information about the case study site. Some comments are given below for authors' reference:

1) The classification of five phases of the period from the until 1950's to the present as mentioned in the article should take into accounts of holistic policy and institutional changes of China. Four most significant policy changes in China's history could be highlighted: the economic liberalization and opening policy in the late 70's, the encourage policy to the Town & Village Enterprises (TVEs) in the mid-80's, the re-modification of Mineral Resources Law of PRC and the closure-up policy in the mid- and late-90's, and the resource consolidation campaign starting in 2005 and continued up to date. Different stage of policy had separate objectives, though this policy shift may greatly undermine the attitudes toward sustainability at different levels of governments (either central or local), companies, and local communities. The key point lies in rational evaluations on different policy implementing effects on the lead mining of China in general and of QianCun in particular.

A fully revised section 3 tackles this criticism by detailing the development of the mining sector nationally. The very structure of section 5 divided into time periods which map onto policy and political economic changes is also made in recognition of these broader institutional changes. We have now highlighted this more systematically in each time period for Qiancun's case. We have also added (section 3) reflections on the ways in which mining is in fact not dissimilar from rural industrialisation more broadly, which also point to its position vis-à-vis shifting development models. This also will increase the significance of the analysis for a broader set of audiences.

Each section deals with the policy and broader national political economy at the very start, and this is presented as the context for analysis on changing mining practices, distribution of resources across scales and social groups, effects on different types of capital, and the impact of all these elements on livelihood strategies adopted and the value attributed to mining. (this also responds to concerns by R3 regarding making analysis in section 5 more systematic).

2) The representativeness of samples is not convincible. This is because the case study site, QianCun, with 346 households and 1560 registered residents, only occupies a small share within the large amounts of small-scale mines (SSMs) rich villages in China. There were more 130,000 SSMs before the year of 2000 over China. If some interview pictures, statistical tables and comparisons with outside villages were added, its conclusions and findings would be more feasible.

The methodology adopted here, a case study approach, does not in itself make claims to representativeness and the authors deemed a statistical analysis of mining in China to be beyond the scope of this paper, and not part of its original contribution.

Revisions to section 3 on lead mining in China should nevertheless give a better sense of how typical small scale mining of the kind analysed here is in the rest of China.

We have tackled the question of the potential generalizability of the case in two ways. First, we briefly explained how typical Fenghuang is in the landscape of mining in China [see section 3]. Second, we also point out that the significance of this analysis goes beyond mining because many places in rural China have experienced rural

industrial development that has had a similar effect on natural capital and given rise to social conflicts similar to those discussed here. While points about generalizability are important, we stressed the purpose of this study is not to formulate a universal model of how the balance between costs and benefits of development works out everywhere, but rather to emphasize that these relationships need to be understood within a historical frame.

3) The implication and understandings of sustainability have shifted globally and locally from the only economic aspect to the broadly integration of social and environmental dimensions. The case of QianCun case study clearly justified this change. More approaches are required to realize this objective of sustainable mining development, including economic and ecological compensations, mined land reclamation, livelihood diversification, community integrated development, and most but last community rights to mining and development.

In response to the reviewer's recognition of the importance of these aspects we have further highlighted them and stressed in particular this article's main contribution to this debate: that a historical approach to sustainable development can show the complexities of this term; that sustainability and development are understood and operationalised differently at different times depending on local political economy and national policy; and that different relationships between mining and development may prevail in the same place at different times and therefore a historical approach is necessary to assess their relationship.

Reviewer #3: There is much to like about this paper. It proposes a novel and exciting framework for taking the sustainable livelihoods approach forward, and contains much interesting and original primary material on the effects of mining in China, a sector about which little is known in the literature.

The first two sections of the paper are strong and construct a good case for a 'pathways' approach to the SLA, and particularly the engagement of a temporal element to the livelihoods recognising the significant shifts that the community had experienced over the past decades.

The third section is less compelling, largely because of the somewhat scattergun approach to the empirical data in this section. It needs to be far more up to date and more authoritative (there is currently a lot of material being published on the place of Chinese mining and mineral use in the global context that could be drawn on (one such reference is Kefferputz and Mildner 2012). There should also be a comment here on the geographic spread or concentration of the industry in China - is it more common in some areas rather than other? and if so, which ones?

This section has been completely revised to include discussion of relevant literature on mining in China, including work by the authors suggested. We have also included a discussion of the geographic spread of lead mining and small scale mining.

The 4th section is fine and contributes background to the study.

The fifth section - the core of the analysis - needs some refinement: the English is weaker here and there are some missing references (Ran 2012, Li 2012).

Ran 2012 and Li 2012 were omitted in the references because they may reveal details about the project which would undermine the anonymity of the submission. They will of course be included in the final submission.

More significantly, each of the time periods places different emphasis on different capitals - which is fine - but does not even mention some of the capitals at all at different times - they seem to come and then disappear selectively at different times. Perhaps the 'spider-web' approach to the shifts in the importance of the capitals could be used here.

We have ensured that all types of capital are mentioned at different times, though of course their importance is uneven at different times, granting uneven amounts of attention across the sub-sections. The table has also been updated to include mention of all types of capital in each period.

Also, and the author(s) need to be very up-front about this in this section or in the methodology, the bulk of the material is anecdotal and/or stated in quite general terms: 'Generally'/ 'Typically' etc. This needs to be tightened: perhaps tables with figures could be used to support some of the discussion here.

This has been discussed in the methodology section. The general term villager is used when there was a high degree of consensus and similar statements were encountered in several interviews or experiences were commonly shared. In phases c, d and e where differences between social groups are relevant (for instance between village elites and other villagers, between those who owned mines, o-owned mines and those who only served as workers) they have been made explicit.

On page 23 para 2: the distinction between 'these two types of mining' is not clear - is this 'old' and 'new' mining that is being referred to? Further down in the same paragraph statements about the 'alleged' (purported may be a better term) and the 12 illegal mines still operating could use a source. And further down... what grounds were used to close the mines? Was it environmental, for instance?

The distinction between types of mining has been clarified. The source for the closure of the illegal mines was removed to retain anonymity and will of course be included in the final piece. We also made it clearer that the grounds on which mines were closed was safety, predominantly defined in terms of work-place safety rather than environmental concerns.

Overall, it is not the findings of this section which I take issue with, it is the somewhat loose way they have been presented.

The final section provides a good discussion of the implications of the study - and the central argument that local conflict over mining is concerned with access to and control over resources rather than the environment per se is one I have found and written about elsewhere. Social capital does seem to be missing from the discussion on pages 27-28.

Social capital is now highlighted more clearly in the discussion

The conclusion is a little blunt and probably slightly off-target in places (do people really frame their struggles as ones about 'capital accumulation through dispossession?') but it does tie the paper together effectively.

The paragraph discussing accumulation through dispossession has been deleted because there is insufficient space to develop this point more fully in this article. The

conclusion has been revised to focus more closely on the key issues raised in the article about the importance of a historical approach and of studying how attitudes to development and livelihood strategies shift over time.

Overall, with some refinement as indicated, I think this paper would make a strong contribution to the literature.