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A framework for policy formulation for small-scale mines: the case of coal in China

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Abstract

The effective management of small-scale mines is one of the major challenges for governments in the mining sector. Small-scale mining may bring tangible, short-term benefits to the communities involved. However, these benefits are frequently outweighed by the costs incurred in terms of illness, injury, pollution, waste of natural resources and market distortions. Governments, international agencies and advisers are generally able to draw up lists of actions which are required to regulate and manage small-scale mines more effectively, but turning plans into sustained action has proved more difficult. Two aspects of policy implementation are crucial to success: the alignment of interests, and the attitude and effectiveness of government. Using a case study of township and village coal mines in China, this article develops an approach to analysing these issues that could assist regional policy makers and advisers in formulating policy, in identifying key obstacles to policy implementation, and in identifying particular parties which need to be influenced or educated in order for the policy to succeed.

Keywords: Small-scale mining; Coal; China; Government; Policy

1. Introduction

In the 1970s and 1980s, the efforts of advisers and academics in the field of mining policy were, to a great extent, devoted to addressing the need to attract large-scale investment into the mining sectors of developing countries. The 1990s saw a gradual change in emphasis as social and environmental issues came to the forefront. This in turn has provided opportunities for small-scale mining[1], previously the poor relation in policy terms, to appear higher on the agenda of international agencies.

Widespread agreement has existed for many years on the main problems of small-scale mining across the world. These include: social and environmental problems; the waste of natural resources; the appalling safety record; low technical and economic performance of the mines; and the distortion of the markets caused by small mines. The immediate causes of these deficiencies are usually abundantly clear and can be attributed to the inadequacies of the legal, regulatory and financial systems, to the nature of the market, and to the shortage of skills and technology. Potentially viable approaches and solutions have been recommended which cover the reform of laws, regulations, institutions and markets, and the provision of training, funding and other services for small mines (e.g. Kumar and Amaratunga, 1994; Burke, 1995; Solomon, 1997; ILO, 1999; Bugnosen *et al.*, 1999). However, many of the published guidelines lack

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[1] This article does not dwell on the definition of the term "small-scale mining", but rather follows the approach of Kumar and Amaratunga (1994), who include both artisanal mines and larger mines owned by small firms. The critical feature is that the output from such mines is small relative to the output from 'large' mines.

Table 1. Statistical data on output and ownership for township and village coal mines in seven provinces in China in 1995 and selected economic and social data for 1997

		Shanxi	Hebei	Sichuan	Shandong	Yunnan	Guizhou	Jiangxi
Total TVCM output per year	mt	157,290	23,827	55,667	11,756	17,998	44,840	16,430
TVCM output/total coal output	%	45	29	58	22	64	82	57
Number of TVCMs		6,700	2,303	7,767	535	5,343	14,431	4,347
Of which: – collective	%	86	77	67		20	19	18
– private	%	10	16	27		80	79	80
Average TVCM output per year	t	23,500	10,300	7,200	22,000	3,400	3,100	3,800
Contribution of different scales of mine to total TVCM output								
More than 30,000 t/yr	%		18	25	59			20
10,000–30,000 t/yr	%		62	41	36			31
Less than 10,000 t/yr	%		20	35	4			49
Proportion of TVCMs at different scales								
More than 30,000 t/yr	%		4	5	33		1	2
10,000–30,000 t/yr	%		42	19	49		7	10
Less than 10,000 t/yr	%		53	76	18		92	88
Net coal imports per year	mt	–235,000	+31,000	–4,000	+17,000	–100	–13,000	+2,000
Net coal imports/total coal production		–68%	+37%	–4%	+20%	–0.3%	–21%	+8%
GDP per capita (1997)	Y	4,774	6,077	3,952	7,644	4,000	2,194	4,171
Rural income per capita (1997)	Y	1,738	2,286	1,680	2,292	1,357	1,298	2,107
'Minority' population (1997)	%			5.0		26.8	22.2	

Sources: Ye and Zhang, 1998, China Statistical Yearbook, 1998.
Notes: t = tonnes; mt = thousand tonnes; Y = Yuan renminbi, Chinese currency.

prioritisation, and fail to recognise heterogeneity within the small mining sector, even for a single mineral within one country (e.g. Labonne, 1994; Barry, 1996).

It is our contention that the failure of small-scale mining policies to date may be traced to the neglect of the main requirements for effective implementation of policy: an alignment of the various interests, and committed and effective government. These requirements have been explained by other authors (e.g. Wälde, 1988; Hollaway, 2000). The aim of this article is to use the case of township and village coal mines in China to develop these ideas and to present a framework for addressing how policies for small-scale mines may be developed so that subsequent implementation has a relatively high probability of success.

Concerning the definition of small-scale mining, we concur with Labonne (1994) that the "need for a definition for small-scale mining [is] a non-issue" and with the International Labour Organisation (1999) that "small-scale mining is in the eye of the beholder". This article follows the approach of Kumar and Amaratunga (1994) and the International Labour Organisation (1999): small-scale mines are characterised by a high level of labour intensity and a low level of mechanisation, but the absolute scale of output may be highly variable depending on the nature of the mineral and the commercial structure of the enterprise (e.g. Solomon, 1997).

2. Township and village coal mines in China

China's coal sector provides a useful testing ground for any general policy framework for small-scale mining because of the large scale and economic importance of small-scale coal mining in that country, and because of the complex structure of the coal industry and of government.[2]

China's coal production is the largest in the world and reached nearly 1.4 billion tonnes in 1996 (China Coal Industry Yearbook, 1998). Some 45%, or more than 650 million tonnes, of this production came from more than 75,000 so-called township and village coal mines (TVCMs). A large proportion of these mines are owned and controlled by local governments at township and village level, and are known as collective mines. A substantial minority of the TVCMs, usually the smaller ones, are privately owned. In a few provinces, such as Yunnan, the private mines are in the majority (Table 1). Other TVCMs are owned by a variety of state companies and agencies, including the army, the prison service and large-scale mining companies.

The TVCMs were overtly encouraged by all levels of government from the 1970s when China faced an energy supply crisis. The few laws and regulations were ignored and flouted in the interests of economic growth. Even new laws and regulations developed in the 1980s and 1990s to cover safety, environmental protection and licensing were not applied to the small-scale coal mining sector with any rigour until the late 1990s.

In addition to providing much-needed energy, the small-scale coal mines provided a basis for local employment and development in many poor and remote areas of China.

[2] The ideas presented in this article were developed during a study to evaluate the system for regulating township and village coal mines in China. This involved extensive interviews in Beijing and interviews and site visits at various locations in Shanxi Province, north China.

Possibly as many as four million people were employed in these mines at the time of peak production.

Small-scale coal mines exist in almost every one of the 32 provinces and regions of China, but about 90% lie in just 16 provinces (Huo *et al.*, 1999). Their aggregate output, individual capacity and workforce are highly variable between provinces. The percentage of provincial coal output derived from TVCMs varies from 22% in Shandong Province to 82% in Guizhou Province (Table 1). The average output of these coal mines varies from as much as 23,500 tonnes per mine per year in Shanxi Province to 3,100 tonnes per year in Guizhou (Table 1). In Shanxi Province, some township mines have a capacity in excess of 100,000 tonnes per year. At the other end of the spectrum lie thousands of artisanal mines with outputs of a few hundred tonnes per year.

These coal mines act as a magnet for hundreds of thousands of under-employed peasants in China. In parts of Shanxi Province, which has the largest aggregate output from TVCMs, a high proportion of the mine workforce, maybe 50%, comes from outside the province. In poorer provinces, such as Guizhou, Jiangxi and Anhui, most TVCM workers are locals (Ye and Zhang, 1998).

Although the size of some of China's township and village coal mines exceed most people's definition of a "small-scale mine", this category of mines is characterized by many of the same problems as conventional small mines: large numbers of illegal mines; irrationally located mines; poor standards of environmental protection and safety; and low recovery rates (Thomson, 1996; ILO, 1999; Huo *et al.*, 1999; Wright, 2000).

Two distinctive features of China's small-scale coal mining sector relate to ownership and regulation. As mentioned above, local governments own many of these mines, and they operate them either by appointing the mine manager directly or by contracting out the management. The same local governments are also responsible for regulating the mines. This lack of separation of ownership and regulation is a key obstacle to the reform process. The second feature of the TVCMs is the complexity of the institutional structure for regulation. Five levels of government may be involved in the regulation of small mines: central, provincial, city or district, county or suburb, and township (Fig. 1). At each level a number of different agencies are involved in one or more tasks such as policy formulation, issue of mining licenses, issue of production licenses, safety control, environmental protection and a host of other activities.

From the early 1980s until the late 1990s, the central government encouraged the TVCMs but failed to develop an effective regulatory framework. Production grew at a prodigious rate, but legal, technical, environmental, and safety requirements were ignored. Short-lived and half-hearted rectification campaigns failed to make any significant impact on the behaviour of miners or local governments.

From late 1997 to 1998 there was a sudden drop in demand for energy in China, and the coal industry was affected

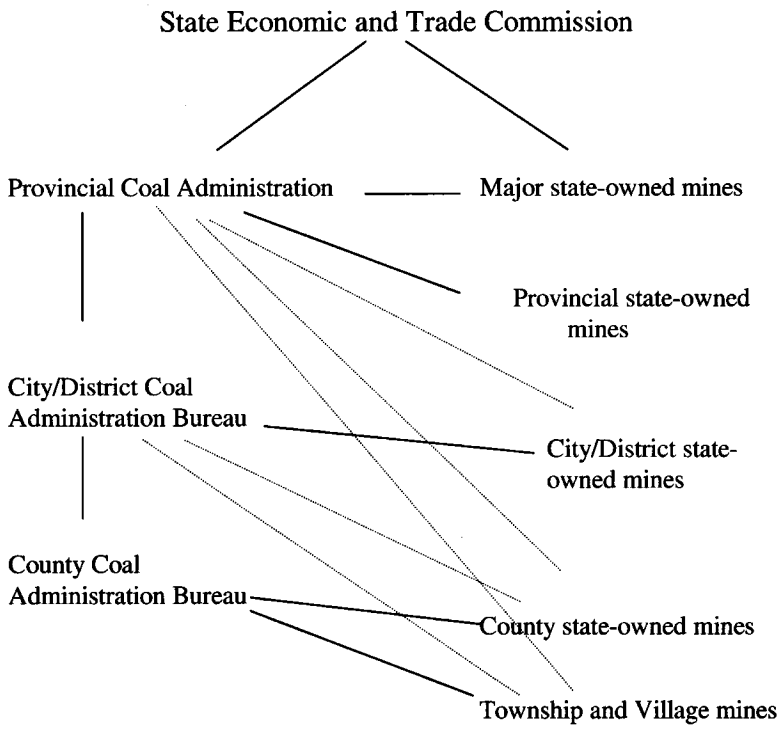

Figure 1. A simplified scheme showing how different levels of government are involved in the regulation of different types of coal mines in China. A bold line indicates direct responsibility. A dashed line indicates overall supervisory responsibility

more than other energy industries (Sinton and Fridley, 2000). Stockpiles grew to hundreds of millions of tonnes and prices in the domestic market plummeted. In early 1998, production from some state mines was suspended for two months in order to ease the oversupply problem. By the middle of the year it became clear that this was not a temporary phenomenon; drastic action was needed to protect the interests of the state mines into which large amounts of state investment had been poured.

A plan was announced to close some 25,800 illegal and 'irrational' mines (mainly TVCMs) by the middle of the year 2000 in order to reduce output by 250 million tonnes per year.[3] By July 1999 it was announced that this number of mines had already been closed, resulting in an effective reduction of 130 million tonnes in national annual output. At the beginning of 2001 some 43,000 small-scale coal mines had reportedly been closed, removing 390 million tonnes from annual production. In addition to TVCMs, a number of larger mines near the end of their lives were also closed and some enterprises went bankrupt.

The county governments were the key level of government for the implementation of the TVCM closure campaign. They faced a potential conflict of interests. On the one hand, closure of some TVCMs provides protection for county-owned state mines; on the other hand, TVCMs provided an important source of employment and revenue from taxes and fees. Despite this potential conflict of interests, the county governments in many locations appear to have carried out their closure programmes with a high degree of diligence.

The TVCM closure programme has been driven in a top-down manner by the central government with little apparent regard for geographic heterogeneity or for local socio-economic impacts. For these reasons, the policy has been criticised by some Chinese commentators (e.g. Shi, 1999; Chang, 1999; Lin *et al.*, 2000; Wu and Li, 2000). Further, it remains to be seen whether the "closed mines" remain closed. Economic hardship and the need for fuel supplies could yet render the closure programme at least partially ineffective.

The sheer diversity amongst China's thirty provinces means that a single policy for TVCMs is unlikely to be appropriate or effective. Thus, China provides an ideal testing ground for the ideas being developed in this article concerning the alignment of interests, government commitment and government effectiveness.

[3] The unreliability of Chinese reports and statistics regarding recent reduction in emissions and closing of coal mines has been pointed out. However, the data used in this article has been deliberately taken from 1995, when Chinese coal mines were at their peak, before the recent closure programme. In view of the fact that statistical errors are rife for the small-scale mining sector in all countries, the level of accuracy of the data in the present article is considered adequate for the purposes of the arguments made.

3. The alignment of interests

3.1. Principles

The wide range of potential benefits and costs associated with small-scale mining has been documented by a number of authors (e.g. Kumar and Amaratunga, 1994; ILO, 1999) and it is commonly stated that small-scale mining should be encouraged in those places where the benefits outweigh the costs.

Setting aside the problem of actually quantifying these costs and benefits, this approach raises two questions:

- At what geographical scale should such cost-benefit analysis be carried out — national, provincial or local?
- How can the quite different perceptions of costs and benefits held by different parties be identified and then addressed?

Central government may be able to argue cogently that the aggregate costs incurred by small-scale mining far outweigh the benefits at a national scale; but the balance of costs and benefits at the local level may be quite different, either in reality or in perception. Likewise at any scale of evaluation, different parties are likely to place different weights on the various individual components of cost and benefit, and will therefore arrive at a different assessment of the balance.

The key to resolving these conundrums lies in the identification of the various interest groups, understanding their interests and then developing a policy which addresses as many of these interests as possible, either directly or indirectly. The balance of costs and benefits for the different parties will vary depending on the geographical location, the mineral under consideration, the economic conditions, the moment in time and the level of education of the parties. It is almost certain that a substantial effort will need to be expended on information dissemination and education which can allow the interest groups to re-evaluate their points of view.

3.2. Application to China's TVCMs

In order to align interests it is essential first to identify the interested parties and the key issues likely to influence their perception of the balance of costs and benefits of small mines. In the case of China's TVCMs we illustrate two types of province: one which has a surplus of coal supply and has alternative sources of employment for redundant miners, and another which needs the coal from the TVCMs to satisfy its energy demand and which has few alternative sources of employment.

In the case of a province which has a plentiful supply of coal and alternative sources of employment, a wide range of stakeholders are likely to perceive the costs of the TVCMs outweighing the benefits (Fig. 2, above line 1). Most levels

	Parties	Key issues	
Costs outweigh benefits	• Central govt • Province govt • Large mines	• Oversupply of coal • Threats to own mines • Pollution • Waste of resources	1
	• County govt • Wider consumers • Wider community		2
Benefits outweigh costs	• Township govt • Village govt • Local mine workers • Migrant mine workers • Private small mine owners • Local consumers	• Tax revenues • Employment • Local development • Local supply of coal	

Figure 2. Summary of the key issues which will determine how different parties are likely to view the balance between costs and benefits of township and village coal mines. Lines 1 and 2 separate those parties which see the costs outweighing the benefits from those which see the benefits outweighing the costs in two different types of province. See text for discussion

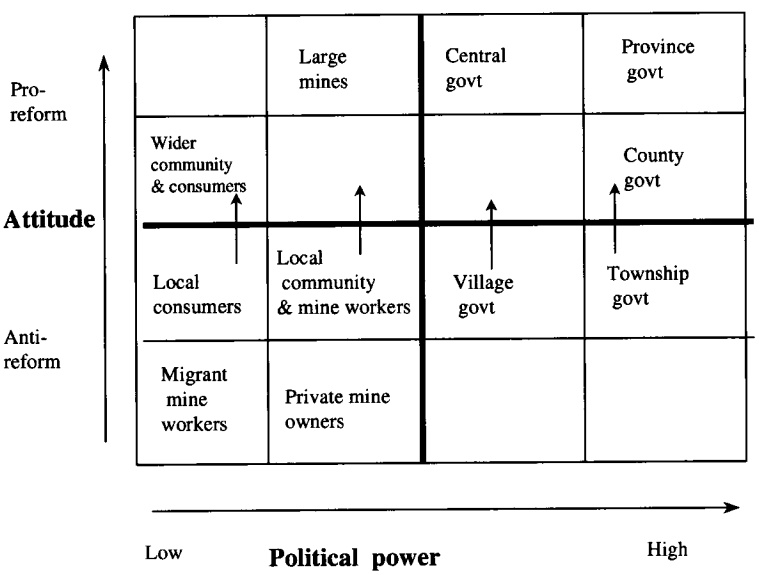

Figure 3. Simplified representation of attitudes towards and power to influence radical reform of township and village coal mines in a province with a surplus of coal supply and alternative sources of employment. The arrows indicate the need to change perceptions

of government and the wider community in and beyond the mining areas are likely to be concerned over the pollution and waste of resources. Any large mines will also want the encroachment into their resources by TVCMs to be controlled. These parties will probably support efforts to reform and regulate more tightly the TVCMs, through radical measures if necessary.

Lined against them are the more local interests that are directly involved in and benefit from the TVCMs: local government, local and migrant workers, private mine owners and local consumers. These parties see direct short-term economic benefits from these mines and are likely to resist reforms (Fig. 2, below line 2).

The simplistic "attitude and power" matrix (Fig. 3) summarises the range of interests, and shows that not all interests will initially be aligned in support of reform. According to this interpretation, the key parties for higher levels of government to influence are the township governments and village authorities which in turn can try to gain the support of the local community, local consumers and local mine workers. The migrant mine workers and the owners of private small-scale mines would then remain isolated interest groups requiring special measures. The key players in the TVCM closure programme are the provincial, county and township governments. If they are acting in concert, any programme to close or reform the TVCMs stands a high chance of

Box C **High socio-economic need** **Low commodity need** Alignment of interests will require socio-economic needs to be addressed. Closure policy may be viable if economic need is addressed. e.g. Shanxi	**Box B** **High socio-economic need** **High commodity need** Alignment of interests very difficult. Closure policy may not be viable in the short-term. e.g. Yunnan, Guizhou, Sichuan
Box A **Low socio-economic need** **Low commodity need** Alignment of interests may be straight-forward. Closure policy may be viable in the short-term. e.g. a few restricted locations	**Box D** **Low socio-economic need** **High commodity need** Alignment of interests will require needs for commodity to be addressed. Closure policy may be viable if energy need is addressed. e.g. Shandong, Hebei, Jiangxi

Figure 4. Two-by-two matrix showing how the ease of alignment of interests may depend on whether the small mines are required for the commodity itself or for wider socio-economic purposes. The specific examples are for illustrative purposes only

success. If the township governments cannot be persuaded of the benefits of the policy, implementation is likely to fail.

On these grounds we argue that the central government should be able to enforce an aggressive mine closure policy in a province which needs neither the coal nor the economic activity, provided means are found to address local pockets of unemployment or energy supply shortage.

This case falls into the category of "low socio-economic need and low commodity need" (Fig. 4, Box A). It is unlikely that any of China's provinces which have substantial TVCM activity fall into this category, as the available data suggest that most TVCM output occurs in provinces that either are poor or need the coal. However, locations may exist where abundant supplies of energy and adequate employment opportunities exist. In these restricted areas, the government should be able to implement the closure policy with relative ease.

The alignment of interests is quite different in a province with a shortage of both coal and alternative employment. Such a province may be characterised as having a high socio-economic need and a high commodity need for the TVCMs (Fig. 4, Box B). Here the higher levels of government and the large mines are likely to be isolated in their perception of the costs and benefits of TVCMs (Fig. 2, line 1). The requirement for a local supply of coal and for jobs results in a quite different perception of costs and benefits for most interest groups, and places many of the parties in opposition to the policy of reform (Fig. 5). The task of aligning interests is much more difficult than in the case of the province with a surplus of coal and alternative sources of employment for redundant miners. First, the county governments will have to be persuaded of the benefits of reform and tighter regulation. They in turn will have to expend great efforts enforcing the policy at township and village level as nearly all these local interests will be ranged against the policy.

In a province which requires both the coal and the economic activity, a policy of rapid mine closure, if successful, would have a devastating impact on communities. Potential exists for widespread loss of employment and a shortage of energy. Whilst the energy deficit might be relatively easily addressed by improving energy transport systems or developing alternative sources of energy, the issue of unemployment is less tractable. In some provinces of China, the mine workers are migrants who would return to their homes in other provinces or move on to new areas to

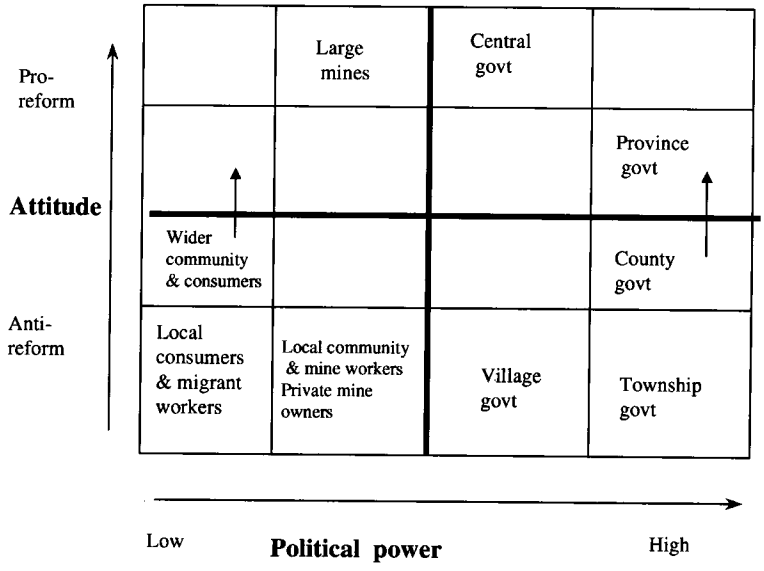

Figure 5. Simplified representation of attitudes towards and power to influence radical reform of township and village coal mines in a province with a shortage of coal and few alternative sources of employment. The arrows indicate the need to change perceptions

search for work. Thus the problem of redundant labour can be shifted from the province enforcing the closure to another province. Where the miners are locals, it will be the task of local governments to promote alternative forms of economic activity, something that cannot be achieved in a short space of time.

Yunnan, Jiangxi and Sichuan Provinces have low average rural incomes and require much or all of their coal output for use within the Province (Table 1), and thus they may be examples of provinces with a high socio-economic need and a high commodity need for the TVCMs (Fig. 4, Box B). In such provinces, a policy of encouraging the small coal mines, but under a more rigorously enforced regulatory regime is perhaps more appropriate in the short term than a programme of widespread mine closure.

Boxes C and D in Fig. 4 lie between these two extreme cases. Some provinces do not need the incremental supplies of coal from the small mines but do require a means to stimulate economic growth (Fig. 4, Box C). For example, Shanxi Province has a relatively poor rural population, but is a major exporter of coal to other provinces in China (Table 1). The challenge for central and provincial governments in such cases is to develop economic policies which obviate the need for small-scale coal mining. Though a policy of closing TVCMs may be desirable, it is not viable in the short term where the indigenous population rely on mining for their livelihoods. In Shanxi Province, the large mines could easily supply coal to the rural inhabitants, though the government might have to examine the peasants' ability to pay for this coal. However the key challenge is to develop alternative sources of employment for these people.

In those cases where a majority of mine workers are migrants from other provinces, the temptation to undertake an aggressive closure programme may appear more attractive to the local government concerned, but the problem of surplus labour is merely transferred to another location and is not solved.

Provinces which require the coal, but not the economic activity related to the small-scale mining itself (Fig. 4, Box D), may include Shandong, Hebei and Jiangxi (Table 1). The key issue in such provinces is the availability of alternative sources of energy. This may be in the form of coal transported from other provinces or in the form of new energy supplies such as hydro-electricity or gas. Here the closure policy may be viable, but should only be implemented as quickly as alternative energy supplies can be delivered to the consumers.

This section has shown that a consideration of the alignment of interests in different types of province may assist in the identification of key parties to be influenced and in the development of complementary measures which should be introduced in parallel to the mine closure programme. An aggressive closure policy may be viable in regions which need neither the socio-economic nor commodity benefits which TVCMs bring (Fig. 4, Box A), but such locations are likely to be few and far between. Most regions of China with TVCMs have socio-economic or commodity needs for the TVCMs, or both, and therefore they lie in Boxes B, C or D of Figure 4. In these places, an aggressive closure policy is likely to lead either to a substantial reduction in welfare for those currently benefiting from the mining or to systematic evasion of the policy through inaccurate reporting by local government and illegal re-opening of 'closed' mines. A gradual and balanced approach could be developed which combines a programme of phased mine closure with a systematic attempt to improve the quality of regulation of those mines remaining operational. This would allow time for the local need for the TVCMs to be reduced by developing alternative economic activity or alternative supplies of energy. Such an approach would encourage the alignment of interests and enhance the probability of success that a sustainable policy for the remaining TVCMs could be developed and implemented.

4. Government commitment and effectiveness

The previous section has examined how policy development may be assisted by considering the alignment of interests. An alternative, which has some common features with this approach, is to examine the commitment and effectiveness of government. Government commitment refers to the political will of a government to implement a particular policy, and effectiveness refers to its ability to successfully implement policy. Though political commitment may be related in part to the effectiveness of government, these two aspects of government performance are usefully considered separately.

Figure 6 shows how a government may be classified simplistically in terms of its commitment to a policy and its effectiveness at policy implementation. For each category of government two attributes have been identified: the probability of the government implementing a given policy successfully, and what might be required in order to increase

Box G **High commitment** **Low effectiveness** Implementation requires resources and/or institutional or legal changes. Moderate probability of success.	**Box F** **Low commitment** **Low effectiveness** Policy implementation will be very difficult. Massive effort required. Low probability of success
Box E **High commitment** **High effectiveness** It should be possible to implement policy relatively easily High probability of success	**Box H** **Low commitment** **High effectiveness** Implementation requires a change of political outlook Moderate probability of success

Figure 6. Two-by-two matrix showing how government commitment and effectiveness may affect the ease of policy implementation

Table 2. Possible determinants of government commitment to tighter regulation or closure of township and village coal mines in China

LOW COMMITMENT	HIGH COMMITMENT
Socio-economic issues	
High rural unemployment	Low rural unemployment
Non-diverse TVE sector	Diverse TVE sector
Low education levels of officials	High education levels
Energy and industry	
Energy importing	Energy exporting
Energy-intensive economy	Less energy-intensive
Coal sector	
Coal importing	Coal exporting
Coal-dependent	Diverse sources of energy
Few large coal mines	Many large coal mines
TVCMs	
TVCMs far from large mines	TVCMs close to large mines
High % of local workers	High % of migrant workers
High % of coal output	Low % of coal output

Note: TVE: township and village enterprises.

the chance of successful policy implementation. A change of political outlook is needed to enhance commitment, whilst resources often combined with institutional and legal reform may be required to raise the level of effectiveness.

4.1. Government commitment

The commitment of any level of government in China to undertake radical reform of the TVCMs under its control will depend on the balance of energy and social needs discussed in the previous section. Table 2 lists a selection of parameters which might be expected to affect a government's perception of the balance of costs and benefits of small-scale coal mining within its territory of authority, and thus its commitment to reform.

The socio-economic parameters listed reflect the ability of the region to develop alternative economic activities. While it is difficult to measure this precisely, it can be stated in simple terms that most provinces in the east of China, such as Shandong and Hebei, are likely to be better placed to develop new industries than remote provinces in the interior such as Guizhou and Shanxi. Yunnan, in the far south-west of China, is indeed isolated from the coast but trade with neighbouring south-east Asia is set to grow in the coming years.

We have added the education level of officials on the grounds that government officials with a higher level of education may be more likely to take a relatively balanced and longer-term view of the trade-offs between costs and benefits of small coal mines, and may be more willing to undertake a programme of reform or closure.

As discussed above under the heading "alignment of interests", the willingness of government at any level to undertake radical reform of the TVCMs in its region of control will depend on the structure of its energy supply, the importance of the TVCMs in that supply and its ability to draw on other sources of energy supply. Most provinces in the north of China produce substantial quantities of coal from large mines, for example Shanxi, Hebei and Shandong Provinces. These provinces also lie along the routes of a major natural gas pipelines, either commissioned or planned. For these reasons, the TVCMs are no longer necessary for energy supply in these provinces, and central government should be able to gain the commitment of lower levels of government to the TVCM closure programme.

Provinces in the south of China, such as Yunnan, Guizhou and Sichuan are highly dependent on the TVCMs for their supplies of coal, yet they also host substantial hydro-electricity resources which are being exploited at an increasing level (China Energy Databook, 2001). The commitment of local governments to TVCM closure will be enhanced if they are convinced that the local energy need for TVCMs will decline as more hydro-electricity projects are developed.

Another factor likely to have a significant bearing on the commitment of local government is the percentage of migrant workers in the TVCM labour force. In the main coal-mining regions of Shanxi Province, where there are long-established large mines, a considerable proportion of the TVCM workers are migrants from other provinces. Here city and county governments may close TVCMs without fear that large numbers of local people will be laid off, though there will be a knock-on effect for all economic activities dependent on the TVCMs. In contrast, local governments in provinces where most TVCM labour is indigenous, such as Guizhou and Jiangxi, are likely to show less commitment to a closure programme until alternative economic activities can be developed.

4.2. Government effectiveness

Characterising the effectiveness of government to implement policy is a much more difficult undertaking. In the context of China's TVCMs, Table 3 lists a number of features which may be indicative of greater or lesser government ability in this field, assuming that is it committed to

Table 3. Possible determinants of government ability to effectively implement reform of township and village coal mines in China

Low effectiveness	High effectiveness
Socio-economic issues	
Low per capita GDP	High per capita GDP
Officials have low level of education	High level of education
Communist Party less powerful	Party more powerful
Large 'minority' population	Small 'minority' population
TVCMs	
Geographically dispersed	Geographically concentrated
TVCMs far from urban centres	TVCMs close to urban centres
TVCMs far from large mines	TVCMs close to large mines
Short history of TVCMs	Long history of TVCMs
Small average size of TVCMs	Large average size of TVCMs

the task. As with the determinants of government attitude, these parameters relate to both general socio-economic issues as well as energy-specific issues. Of particular relevance are: the wealth of the region, the level of education of officials, the power of the Communist Party and the proportion of minority nationalities.

The wealth of the provinces may be assessed in general terms using per capita GDP (Table 1): the local governments of Shandong and Hebei provinces should, in general, be better funded than those in Yunnan, Jiangxi, Guizhou and Sichuan, and therefore should be in a better position to pay for measures necessary to implement policies effectively. Data on the population of national minorities living in designated minority districts are also available (Table 1). The tentative inference is that a higher proportion of minorities in a province may make the task of government more difficult because of the need to manage a range of sensibilities — assuming that these minorities are indeed involved in TVCMs. Information on the relative power of the Communist Party and the level of education of officials is not available. The simplistic conclusion from the data on wealth and minorities would be that effective government is more likely in provinces such as Shandong and Hebei than in Yunnan and Guizhou.

Whilst the inherent competence of government is one consideration, another is the character of the TVCM sector in the area concerned. Provinces, such as Shanxi, which have a large coal mining industry and long history of coal mining in both the state sector and in TVCMs will have developed a high degree of technical and administrative expertise in both government and mining enterprises. Government departments in such provinces are likely to be relatively more effective at policy implementation.

The task of regulating the TVCMs will be easier where these mines are geographically concentrated and lie close to urban centres or larger coal mines, as for example in Shanxi, Shandong and Jiangxi Provinces (Ye and Zhang, 1998). The effective regulation of TVCMs will be inherently more difficult where the mines are small, dispersed, far from urban centres and from larger mines, such as in Sichuan and Yunnan Provinces, and in provinces with a shorter history of small coal mines and therefore little experience in their regulation, as for example Guizhou (Ye and Zhang, 1998). Further, it could be argued that underground mines are more easily closed or regulated than open-cast mines, because of the difficult access and technology requirements of the underground mines.

4.3. Implications for probability of success

The different combinations of low and high levels of commitment and effectiveness of government are shown as a two-by-two matrix in Fig. 6. This chart allows a higher level of government, or an outside agency, to judge where resources and effort are best directed. The reform or closure policy can be implemented in Box E with relative ease. In contrast, the effort required in Box F is likely to be so great that a long lead-time would be required for sustained reform. Therefore, resources are best directed at Boxes G and H where a moderate probability of success exists.

The economic and energy conditions in Shandong, Hebei and possibly Shanxi Provinces make it likely that these provincial governments will be committed to the TVCM programme and will have the ability to implement it effectively, i.e. high commitment, high effectiveness (Fig. 6, Box E). However, in the more remote and poor parts of these provinces, their effectiveness may be reduced unless supplementary measures are introduced to offset the economic or energy impact of the closure programme.

Given that many of the factors which determine commitment also determine effectiveness (Tables 2 and 3), in reality the provinces or regions of China are likely to form a spectrum ranging from low commitment and low ability to high commitment and high ability. A pessimistic view might suggest that most of the other provinces considered fall into the category of "low commitment and low effectiveness" (Fig. 6, Box F) on the basis of the issues addressed in the previous section. Much more information is needed to judge fairly the commitment and effectiveness of government.

As discussed in section 3 on alignment of interests, the key challenge for central government is to identify which features of a province provide the opportunity to increase the alignment of interests at each level of government. Of particular importance are measures which might provide alternative economic activities or alternative sources of supply. Thus the commitment of the local governments of Yunnan Province could easily be enhanced through continuing to build economic ties with South-East Asia and to develop hydro-electric projects, thus shifting them from Box F to Box G in figure 6. Raising the effectiveness of these governments may take rather longer. At the other extreme, considerable effort and imagination will be required to gain the commitment and raise the effectiveness of government in a poor, remote and mountainous province like Guizhou.

5. Conclusions

The heterogeneity of small-scale mines and of the political, social and economic context in which they operate, requires a high degree of flexibility in policy formulation. At the same time, flexibility should not result in policies which are entirely ad hoc. This article has explored how a framework for policy formulation may be developed for small-scale mining, using the township and village coal mines of China as an illustration. We have examined three parameters which we believe are fundamental to the successful formulation and implementation of policy for small-scale mines: the alignment of interests, government commitment and government effectiveness.

Though governments and international organisations may perceive the costs of small-scale mining outweighing the benefits, these mines exist because a number of parties see a net benefit. Any organisation or government seeking to formulate a new policy for small-scale mining in a particular region should at an early stage identify the interests of all the parties involved, and evaluate which parties' interests will be more difficult to align with the new policy. If the legitimate interests of these parties will be damaged significantly by the policy, then their concerns should be addressed as part of the programme.

An alternative and complementary method requires an evaluation of the commitment and effectiveness of the relevant levels of government which will be charged with implementing the policy. This allows an early assessment of the probability of successful implementation, and should help identify what issues need to be addressed in which areas in order to increase the chance of success.

Though developed to address problems specific to small-scale coal mining in China, these approaches can provide a starting point for analyses of other minerals or other countries. The small-scale mining sector in any nation or region will have some degree of heterogeneity with respect to mineral type and socio-economic context. A single policy for small-scale mining will not be viable even in a small nation. Governments should develop a portfolio of policies which can address the needs of the main interested parties in different mineral industries and in different locations.

Likewise, international organisations and those involved in providing advice and support for the small-scale mining sector across large parts of the globe could use these tools to develop regional strategies, to prioritise those countries or minerals in which new policies stand a good chance of successful implementation and to identify key complementary policies which can raise the probability of success.

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References

Barry, M., (Ed.), 1996. Regularising informal mining. A summary of the Proceedings of the International Roundtable on Artisanal Mining. Washington D.C., May 1995. *Industry and Energy Occasional Paper No. 6.* World Bank, Washington D.C.

Bugnosen, E., Twigg, J., Scott, A., 1999. Small-scale mining legislation and regulatory frameworks. *Minerals and Energy*, 14 (2): 35–38.

Burke, G., 1997. Policies for small-scale mining: the need for integration. *Journal of Mineral Policy, Business and Environment*, 12 (3): 11–14.

Chang, Y., 1999. Problems and countermeasures in the process of closing the mines and restricting the output. *Energy Base Construction*, 3: 15–16 (in Chinese).

China Coal Industry Yearbook, 1998. China Coal Industry Publishing House, Beijing.

China Energy Databook, 2001. Lawrence Berkeley National Laboratory, Energy Research Institute, California.

China Statistical Yearbook, 1998. China Statistics Press, Beijing.

Hollaway, J., 2000. Lessons from Zimbabwe for best practice for small- and medium-scale mines. *Minerals and Energy*, 15 (1): 16–22.

Huo, Y., Wang, W., Li, R., 1999. Investigations into the township and village coal mines across China. Coal Policy Research 1999, 47–52 (in Chinese).

International Labour Organization (ILO), 1999. Social and Labour Issues in Small-Scale Mining. International Labour Office, Geneva.

Kumar, R., Amaratunga, D., 1994. Government policies towards small-scale mining. *Resources Policy*, 20 (1): 15–22.

Labonne, B., 1994. Small- and medium-scale mining. The Harare seminar and guidelines. *Natural Resources Forum*, 18 (1): 13–16.

Lin, D., Jia, Z., Yan, M., Shi, X., 2000. Closure and reduction: where and how? *Coal Enterprise Management*, 2000 (5): 6–10 (in Chinese).

Shi, X., 1999. Considerations and suggestions for closing the mines and restricting the yields. *Coal Economic Research*, (6): 18–21 (in Chinese).

Sinton, J.E., Fridley, D.G., 2000. What goes up: recent trends in China's energy consumption. *Energy Policy*, 28: 671–687.

Solomon, M.H., 1997. Small and mid-scale mining in South Africa: beyond the rhetoric. *Journal of Mineral Policy, Business and Environment*, 12 (3): 23–30.

Thompson, E., 1996. Reforming China's coal industry. *The China Quarterly*, 147: 726–750.

Wälde, T., 1988. Mineral development legislation: result and instrument of mineral development planning. *Natural Resources Forum*, 12 (2): 175–180.

Wright, T., 2000. Competition and complementarity. Township and village mines and the state sector in China's coal industry. *China Information*, 14 (1): 113–129.

Wu, Y., Li, J., 2000. Centralised development — the strategy for coal enterprises survival and development. *Coal Economic Research*, (4): 4–11 (in Chinese).

Ye, Q., Zhang, B., 1998. Township and village enterprises in China. Coal Industry Publishing House, Beijing (in Chinese).