

# Environmental and Resource Degradation Associated with Small-Scale Enterprise Clusters in the Red River Delta of Northern Vietnam

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## Abstract

The paper reports on an empirical study of the environmental and resource degradation observed in small-scale handicraft clusters in the Red River Delta of northern Vietnam. Most entrepreneurs in these clusters face important challenges, including depletion of natural resources, linked to acute shortages of capital and land. Such issues are identified as the main cause of overcrowding, poor working conditions and extreme environmental degradation. The study also highlights some industrial ecology practices at the enterprise level, and assesses the role played by the government in providing incentives for enterprises to invest in new technology and pollution control. Drawing from the analysis of a questionnaire survey of 56 handicraft enterprises, the study identifies the major constraints they encounter in adopting new environmentally clean technologies and engaging in environmental management. Shortage of capital and lack of knowledge about the benefits of new technologies were viewed as the most important barriers, followed by shortage of skilled workers, poor market conditions and scarcity of land appropriate for industrial production.

**KEY WORDS** *clusters; environmental degradation; Red River Delta; resource depletion; Vietnam*

## ACRONYMS

ICTs            Information and Communication Technologies  
LURCs        Land Use Rights Certificates

## Introduction

The growth of off-farm enterprises in developing countries has undoubtedly had a positive impact on their economies and the standard of living of their people. However, the rapid and often uncontrolled growth of these enterprises has also had negative repercussions for the environment and natural resources of these countries. The challenges of balancing business development with environmental protection are

evident in the small-scale handicraft clusters in the Red River Delta of northern Vietnam. The rapid growth of some of these clusters has undoubtedly brought concrete benefits, but also wide-ranging impacts on land-use patterns, increased pollution of water, air and soil, depleted natural resources, loss of biodiversity, and exploitation of workers.

Vietnam's market reforms, introduced with the *doi moi* (renovation) policy of the late

1980s, have promoted environmental capacity building. Local government, in particular at the provincial level, is now increasingly responding to public complaints and regulating industrial pollution. However, such capacity is considered 'too weak to counter the negative ecological effect of a dynamic industrial growth policy' (Weidner, 2002, 1356–7). Vietnam is seen as a 'conflicted environmental state', in which local environmental departments (agencies) are largely passive, ineffectual and argumentative, lack technical expertise, and carry limited weight in internal governmental debates (O'Rourke, 2004, 183; Khoa, 2006, 2).

The aim of this paper is to determine whether environmental degradation and resource depletion could undermine Vietnam's development strategy in the long term. The paper examines how local enterprises in Vietnam adopt new technologies and introduce industrial ecology practices, and sheds some light on the role played by the government in supporting such adoption. In the handicraft clusters of the Red River Delta, the issues of environmental degradation and resource depletion are becoming critical, and appropriate institutional reforms are crucial. Vietnam's experience of delegating implementation of policies to the People's Committees at the provincial, district and local levels appears to be conducive to the adoption of integrated measures to actualise industrial ecology practices. Such practices are mainly linked to new production processes and the introduction of specific technologies in a particular cluster. The ways in which the 'ecologicalisation' of institutions and organisations in Vietnam's rural agglomerations are stimulated and developed could be relevant to other developing countries, and especially countries in transition to a market economy.

With the help of an interpreter, face-to-face interviews were conducted with the owners or managers of a sample of 56 handicraft firms. Two databases of handicraft firms were used. These were made available by the National Institute of Science Technology Policy and Strategy Science and the European Chamber of Commerce in Vietnam. However, the databases were rather limited, and not every firm contacted was willing to participate, and so the sample had to be supplemented by randomly selecting additional enterprises. The firms in the final sample were located in Hanoi city and the surrounding province of Ha Noi, and the adjacent provinces of Ha Tay and Bac Ninh. Data were collected via a survey questionnaire,

affording a first-hand picture of the premises of handicraft firms, their production techniques, the kind of technology employed, the working conditions and the type of workforce. The visit also provided an opportunity to observe the pace of activities and the state of environmental degradation in various handicraft clusters.

This paper is organised as follows. First, it discusses the revival and remarkable growth of the Red River Delta's numerous handicraft clusters and the contribution they make in providing employment to a significant proportion of the local population. Second, it highlights the problems of environmental degradation and natural resource depletion experienced in a rapidly developing country. Third, it outlines the process of the institutionalisation of environmental policy in Vietnam. Fourth, it reports on the results of the survey of handicraft enterprises and the ecological transformations of the Delta's handicraft clusters. Finally, it suggests a number of institutional reforms that could be undertaken by all levels of government in Vietnam in order to improve environmental conditions and sustain the economic development of regional agglomerations in the country.

### **The Red River Delta's handicraft clusters**

Both in developed and developing countries, groups of similar small-scale enterprises often agglomerate in certain geographical locations. Those that are found exclusively in urban areas tend to specialise in fields such as the engineering of basic components, the making of shoes or toys, and textile and garment manufacturing. In southeast Asia, there are also many examples of small-scale, low-tech enterprises clustered in rural or semi-rural areas close to raw materials, and these tend to specialise in the production of traditional foodstuffs, such as fish sauce, cassava starch, soya curd (tofu) and noodles. A third type of small-scale enterprise agglomeration commonly found in villages throughout southeast Asia specialises in the production of handicrafts, such as ceramic products, wood-carving, furniture-making, silk production, embroidery, weaving, bronze casting, silver jewellery, basket making, and so forth (Wheatley, 2001; Konstadakopoulos, 2005).

There has been a major shift in the literature regarding the growth of small-scale enterprise clusters in recent years. The belief that such clusters produce mainly low-quality goods for their domestic market is no longer valid. Empirical evidence from developing countries

in various parts of the world, including that provided in the present study of northern Vietnam, suggests that small-scale enterprises are growing fast and are breaking into international markets. For example, Thailand is now a major exporter of gems and jewellery produced within a cluster of small workshops originally established in Bangkok in the 1970s to supply the local market (Scott, 2002, 148). Similarly, the Philippines is today one of the world's main exporters of cane furniture, due to a cluster of manufacturers based around Cebu City (Yusuf: 2003, 232).

Clustering is the tendency of enterprises in similar lines of business to concentrate in one locality. A cluster – a rather chaotic concept in economics – can be defined as a 'geographical and sectoral concentration of enterprises' (Schmitz, 1999, 466). All clusters have some common elements: *specialisation* based on a sophisticated division of labour that fosters inter-firm collaboration; *proximity*, which brings the necessary geographical closeness of the participating actors; and *technological spillovers* and *synergies*, which open up the efficiency gains that individual enterprises can rarely attain (Steiner, 1998, 3–4; Schmitz, 1999, 466).

The Red River Delta covers 14 812 km<sup>2</sup> and, in 2005, had a population of 18.0 million, of which 76% was rural (General Statistics Office of Vietnam, 2007a). It is the most densely populated region of Vietnam, having 1216 inhabitants per km<sup>2</sup>. Administratively it is divided into eleven provinces: Ha Noi, Hai Phong, Vinh Phu, Ha Tay, Bac Ninh, Hai Duong, Hung Yen, Ha Nam, Nam Dinh, Thai Binh, and Ninh Binh. The Delta is the centre of economic activity in northern Vietnam, and two of the country's major cities – Hanoi, the capital, and Haiphong, a major port – are located in the region.

The vast majority of the working-age population in the Delta, as in the rest of Vietnam, is economically active. Official statistics indicate that 10.3% work in the State sector, 88.2% in the non-State sector and 1.5% in the foreign-invested sector. The rate of unemployment in the urban areas was 5.6% in 2005 (slightly down from 5.8% in 2003), while in rural areas it was only 1.1% (MOLISA, 2006). However, these figures do not reflect the fact that large-scale underemployment persists in rural areas. The economy is functioning below its potential, despite the spectacular increase in Vietnam's GDP per capita during the last decade.

The World Bank reports a trend towards greater inequality in terms of an urban-rural divide.

Such inequality, in the Red River Delta, as measured by the conventional Gini coefficient of income inequality, appears to have increased from 0.32 in 1993 to 0.36 in 2002 (World Bank, 2003, 12–13), and to 0.432 in 2006 (Euromonitor International, 2007). Nonetheless, Vietnam has achieved a comprehensive reduction in poverty levels. An important factor in this improvement during the last decade has undoubtedly been the redistribution of land to rural households, which resulted in increasing agricultural output, especially in rice. It is claimed that land reforms have helped reduce the poverty rate (Chaudhuri and Ravallion, 2007, 206). Although it is acknowledged that the consequent benefits have now been fully reaped (World Bank, 2003, 53), since agricultural production has peaked and there is little potential for future growth, poverty reduction in the Red River Delta in particular has been substantial, especially in the provinces around Hanoi, in which the proportion of the population living in poverty fell by nearly two thirds from 1993 to 2002. (In Vietnam as a whole, the proportion was halved.)

This dramatic reduction in poverty in the Delta has also been attributed to the rise of off-farm activities. Although 56% of the population is still engaged across the country in agriculture, forestry and fisheries, as much as 18% work in manufacturing and construction, and the remaining 26% in services (General Statistics Office of Vietnam, 2007b). In the Red River Delta, many people have found employment in the booming construction industry in Hanoi or have become self-employed (for example, in petty trading, food processing, or handicraft production), thereby enabling them to escape poverty (World Bank, 2003, 106). The handicraft industry also provides employment to a significant proportion of the Delta's population. In the early 1990s, for instance, handicrafts accounted for between 30% of non-State manufacturing employment in the province of Ha Noi and 75% in the province of Ha Nam. Around 60 000 households were involved full-time in handicraft production, while over a million farming households were able to work part-time in handicrafts, when farming work patterns allowed (Red River Delta Master Plan, 1994). Unfortunately, national statistics do not provide figures on employment in the handicraft sector. However, in 2003 one study suggested that as many as 337 000 workers were employed just in Ha Tay province's 409 handicraft villages (JICA-MARD, 2004).

The numerous craft village clusters in the Delta, and their most recent revival, are now a popular subject of research for Vietnamese scholars (Luong, and Unger, 1998; Duc, 2000; Ca, 2003; Ahn, 2006). International institutions and foreign aid agencies have shown a growing interest in Vietnam's handicraft clusters, and have provided financial assistance for their further development (Red River Delta Master Plan, 1994; Vietnam Competitiveness Initiative, 2003; JICA-MARD, 2004). The existence and growth of these clusters is a consequence of various historical factors: the accumulation of skills over decades, if not centuries; proximity to vital natural resources; and the presence of agglomeration economies (that is, the clustering of similar or related activities in the same area).

The emergence of private domestic firms – many of them household enterprises – and the reduction of the Vietnamese government's role in the economy have facilitated the growth of traditional handicraft clusters, such as the ceramic centre of Bat Trang in Ha Noi province, the silk manufacturing centre of Van Phuc village in Ha Tay province, and the woodcarving centre of Dong Ky village in Bac Ninh province (Figure 1). A high concentration of handicraft activity is also taking place in the city of Hanoi and in the semi-rural area surrounding it. There are now approximately 1000 handicraft villages in the Red River Delta area alone – one of the largest concentrations of its kind in southeast Asia (Duc, 2000, 24). Handicrafts are becoming

an important source of exports for the Delta region, and Hanoi's tourist shops are selling handicraft products in large quantities to the increasing number of tourists visiting the region.

Many small households in the Delta started engaging in handicraft production soon after reforms were introduced through the *doi moi* policy of the late 1980s. Local crafts were rapidly revived, and memories of old skills resurfaced and were upgraded. A household handicraft business now typically employs family members (full- or part-time) and hires additional labour on a daily or piecemeal basis. Despite the various problems facing such small household handicraft enterprises, their growth has been remarkable. Many of them eventually register as private companies and thus benefit from being under the jurisdiction of Vietnam's Law on Private Enterprises, and Company Law – both adopted in the 1990s – since they provide them with consistency and confidence in commercial transactions relating to contracts, land, taxes, labour, credits, bankruptcy, and arbitration.

In recent years, many of the Delta's handicraft clusters have experienced impressive growth. The revitalisation of the pottery industry in the village of Bat Trang, for example, has been extraordinary. The agglomeration has gradually evolved from a collection of vertically disintegrated enterprises producing low-quality ceramics, exclusively for the domestic market, to a major export sector supplying high-quality chinaware to large American and European multinationals, such as Wal-Mart and IKEA (Konstadakopoulos, 2005, 33). Similarly, Dong Ky – a thriving woodcarving and furniture-making village – is benefiting from a significant export demand from international consumers. There is evidence that the Dong Ky woodcarving cluster is becoming more dynamic, although the adoption of more energy-efficient technologies has been limited. Furthermore, a major repercussion of the revitalisation of the handicraft clusters in the Red River Delta has been the growth of environmental problems, as discussed in the following sections.

A further important development that accelerated the growth of the private sector was the land reforms in the late 1980s and early 1990s and the granting of individual property rights. The Land Law of 1993 permitted long-term lease of land from the State. Households were issued Land-Use Rights Certificates (LURCs), which gave legal recognition to a household's

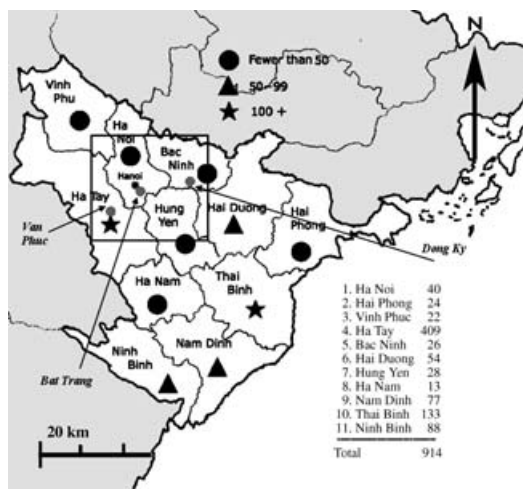


Figure 1 Distribution of handicraft villages in the Red River Delta by province. Source: JICA-MARD Report 2004.

use of land, and allowed LURCs to be transferred, exchanged, leased, mortgaged, and inherited. A revision of the Land Law (No. 13/2003, implemented on the 1st of July, 2004) extended land-use and mortgage rights, and gave landholders the opportunity to diversify away from agriculture. This allowed some households to concentrate on low-tech production, particularly handicrafts, which had virtually disappeared during the quarter-century of collectivism (Kerkvliet, 2005, 230). However, private enterprises, especially new ones, have encountered difficulties in obtaining LURCs, as the government approval process for such applications has been 'cumbersome, arbitrary and discriminatory against private enterprises' (Kokko, 2004, 86).

### **Environmental issues in the Delta's handicraft clusters**

In the Red River Delta, handicrafts are made mainly from timber, clay, stone, grass, plant leaves, seashells, metal, and animal horn or bone. However, the impressive growth of the Delta's handicraft clusters has brought about the depletion of many of these raw materials, which are sourced either locally to the cluster or elsewhere within the Delta. Almost a third of the handicraft villages in the Delta have problems of raw material sourcing (JICA-MARD, 2004, 62–63). For instance, the clay used by the Bat Trang pottery enterprises, which was available locally in the 1980s, was already, by the early 1990s, partly being sourced from the provinces of Hai Duong and Vinh Phu (Red River Delta Master Plan, 1994) – and still is, according to the enterprises surveyed. Moreover, copper, pig iron and other metals now mostly come from scrap (Duc, 2000, 26). Even the fact that many small villages in the Delta now recycle heavy metals has affected the local environment, particularly in the village of Dai Dong in Hai Duong province, where the large-scale recycling of copper has caused extensive contamination of the soil (Duc *et al.*, 2003).

The growth of certain handicraft clusters in the Delta has clearly had an adverse effect on the whole country's natural resources, and even those of neighbouring countries. Shortages of bamboo, rattan and wood are a major concern, due to indiscriminate felling (JICA-MARD, 2004, 62). Soil degradation has also been a problem. For instance, the weaving of floor mats from sea grass in the village of Giao Lac in Nam Dinh province was abandoned in the late 1980s

when its estuary plantation (a former mangrove forest) became unsuitable for cultivation because of increasing salinity (Hue, 2006, 42). Sikor and O'Rourke (1996, 608–609) note that the barren hills surrounding the Red River Delta have become 'a widely cited symbol of land degradation in Vietnam'. Forest cover in the country as a whole declined from 67% in 1943 (World Bank, 1995; cited in Sikor and O'Rourke, 1996, 613) to less than 38% today (General Statistics Office of Vietnam, 2005), and as a consequence the hardwood used for furniture making in Dong Ky is now mostly sourced from mountain forest areas beyond the Delta, or imported, legally or illegally, from Laos, Cambodia or Myanmar. Furthermore, despite the efforts of the authorities, illegal logging is practised in many parts of Vietnam, causing soil erosion, desertification and biodiversity loss (*Viet Nam News*, 2005). Although some reforestation is taking place, it will be many years before mid-twentieth-century levels are regained.

Nevertheless, industrial ecology practices, aiming at energy and material conservation (such as recycling activities), are found in many rural areas of the Delta. Farmers use animal waste as fertilisers for their vegetable gardens and rice paddies, and as feed in fishponds, whilst domestic organic waste, vegetable cuttings and animal manure are used to produce biogas for domestic lighting and cooking. Similarly, a handicraft cluster could organise waste exchange between its enterprises; however, experience of such exchanges within industrial zones suggests that they are 'carried out on an *ad hoc* basis without any systematic policy or management structure to support and increase them' (Dieu *et al.*, 2003, 51–52).

Raw material depletion is not the only environmental implication of the growth of small-scale handicraft clusters in the Delta; there have also been increasing levels of air pollution, noise, industrial waste and contamination of water supplies. For many enterprises, the main source of energy is still either highly polluting coal or firewood. The majority rely on mostly low-cost and low-efficiency old technologies, which are highly polluting. Such technologies put pressure not only on available natural resources but also on the natural sinks that absorb pollution over time. As O'Rourke (2004, 109) noted, technology that ought to have been consigned to a museum still remains in operation throughout Vietnam.

### The institutionalisation of environmental policy

The institutional structure in charge of environmental protection in Vietnam, which supervises industrial activities, including that of handicraft clusters, has recently been reorganised. The new Ministry of Natural Resources and Environment was created in 2002; its predecessor was the Ministry of Science, Technology and the Environment, set up in 1993. The Ministry's main environmental responsibilities are assigned to the Vietnam Environmental Protection Agency, which is also in charge of implementing the umbrella Law of Environmental Protection.

Industrial pollution is subject to Vietnam's Law of Environmental Protection, which was adopted in December 1993. The Law of Environmental Protection is a framework law that broadly outlines, in its 55 articles, the country's environmental protection legislation. Its main objectives are to control air and water pollution, manage and treat solid waste, and deal with those enterprises considered to be serious polluters. The law was revised in 2006, introducing some innovative provisions, including the notion of corporate environmental responsibility, a licensing system for waste producers, and community 'right-to-know provisions' (*Viet Nam News*, 2006). However, it is still not fully satisfactory, as some important provisions are absent, such as attribution of responsibility for historical land contamination.

Despite its name, the Ministry of Natural Resources and Environment is only one of the players in environmental administration, Vietnam being an example of extreme fragmentation of environmental functions. For example, the Ministry of Agriculture and Rural Development is in charge of protecting forests and fostering rural development, including the promotion of handicrafts; the Ministry of Construction is responsible for the provision of urban drinking water and waste water facilities; the Ministry of Industry monitors pollution from State-owned enterprises; and the Ministry of Fisheries manages inland and offshore fishing activities.

At the provincial level, responsibility for environmental management is in the hands of the various Departments of Natural Resources and Environment operating in the country's 61 provinces and its three largest cities (Hanoi, Ho Chi Minh City and Hai Phong). These departments, which are controlled by the provincial governments (known as the People's Committees), are important entities for the implementation of

environmental legislation in general, and for pollution control, including industrial discharges, in particular. However, the effectiveness of provincial departments varies from province to province, depending on various factors such as the size of the province, its level of economic development, the types of industry within the province, and the priority given by the provincial elites to environmental protection (Khoa, 2006, 24). Vietnam's environmental policy has been influenced by the collaboration of its public institutions with transnational governmental and non-governmental organisations (Weidner, 2002, 1349) and has benefited from overseas scientific and policy expertise.

With regard to such protection, Vietnam is seen as a 'conflicted environmental state', which is being forced by its citizens and local environmental entities to adopt new mechanisms for dealing with industrial polluters (O'Rourke, 2004, 183). Indeed, Vietnam's Law of Environmental Protection enables its citizens to complain about environmental pollution to the People's Committees and demand compensation from the polluter if they suffer from the effects of such pollution. For instance, some communes in the Delta impose fines on the owners of small brick-making factories located near paddy fields, following complaints about crop damage caused by heat and smoke from the kilns. Others invoke environmental regulations related to small-industry operations, forcing some factories to shut down at critical times of the year for farmers (Jensen and Peppard, 2004, 198). Dixon (2004, 22–23) points out that some non-governmental environment organisations have already emerged in rural areas, protesting over issues such as environmental degradation and the unjust allocation of natural resources.

### Empirical findings

The sample of 56 handicraft enterprises consisted mostly of firms located in Hanoi, along with the handicraft villages of Bat Trang (ceramics), Van Phuc (silk) and Dong Ky (woodcarving), and some smaller villages in Ha Tay province. Most of the enterprises were less than eight years old and employed an average of 125 employees. More than a third were headed by women entrepreneurs, particularly in firms specialising in silk weaving, garments, embroidery and accessories. As shown in Table 1, the amount of land to which the enterprises had access – a key factor in production – was on average just over 2000 m<sup>2</sup>. (Only 80% of firms disclosed this

Table 1 Enterprise characteristics, land ownership, adoption of ICTs, natural resources utilised, and inter-firm collaboration in the Red River Delta, 2003.

	Households (n = 11)	Private (n = 42)	Other (n = 3)	Total (n = 56)
Average number of years in operation	7.4	6.8	18	7.8
Average number of full-time employees	60	137	187	125
Average age of owners	37	39	45	39
Average number of years in owner's education	12	14.4	14.3	13.9
Gender ratio of owners (male/female)	6/5	32/10	3/0	41/15
Average amount of land access in m <sup>2</sup> (number of enterprises responding)	338 (9)	2623 (34)	300 (2)	2063 (45)
Main type of natural resource used:				
– clay	1	10		11
– timber	1	14	1	16
– silk, cotton	7	3		10
– rattan, bamboo and seagrass	2	5		7
– stone, metal, horn, bone etc		10	2	12
Number of enterprises having own fixed line and/or mobile telephone	11	42	3	56 (100%)
Number of enterprises having own personal computer and email	4	36	2	42 (75%)
Number of enterprises having a dedicated website	1	12	1	14 (25%)
Number of enterprises collaborating with other similar enterprises	5	24	2	31 (55%)

Source: author's Survey.

information, however, as land rights is still a sensitive issue.) Having access to land, which is a prerequisite for securing a business loan, is considered to be positively correlated to an enterprise adopting new technologies.

A previous statistical analysis of this sample (Konstadakopulos, 2005, 30–31) indicated that ownership of land, and the gender and educational level of the entrepreneur, are all important factors in the adoption of new technologies in general, and information and communication technologies (ICTs) in particular. A negative relationship is found between technological adoption and rurality, suggesting that enterprises based in or around Hanoi are more likely to adopt new technologies than those located in the more remote rural areas of the Delta. Furthermore, shortage of capital was identified by the majority of enterprises (60% of the sample) as the most significant constraint impeding their expansion. This was followed by lack of knowledge about the benefits of new technologies (mentioned by 55% of enterprises); shortage of trained workers (36%); and poor market conditions (31%). Land availability was also a significant constraint; a shortage of large plots of land was apparent in all clusters, but particularly so in the woodcarving village of Dong Ky, where a number of enterprises had been split into smaller units scattered around the village, due to the lack of sufficient land on which to

build one large unit. At the time of the author's visit in 2003, however, an enterprise centre was under construction on the outskirts of the village, following the release of land by both the provincial and local governments. These levels of government have considerable economic powers and resources and are influential in the operation of handicraft enterprises and the development of handicraft clusters. Not only can they release land for industrial relocation, but they are also responsible for issuing business licences and monitoring compliance with safety, labour and environmental standards. It was assumed, during the planning of the project, that small-scale enterprises would be highly dependent on information and support received from local authorities. However, as indicated in Table 2, relatively few enterprises – only 16%, and most of them rural – approached local government for support, at least in respect of technology. This suggests that entrepreneurs have the managerial autonomy to make decisions independently of local government in adopting new technologies.

When the level of environmental degradation reaches a critical point, local authorities emerge as active players. For example, in the most dynamic clusters, such as Bat Trang, fast-growing enterprises are adopting new and more energy-efficient technologies, in order to reduce air pollution. The traditional wood- and coal-fired ceramic kilns are being replaced by the more

Table 2 Enterprises seeking support from local government: n = 56: rural, 37; urban, 19.

Issue	Rural	Urban	Total (%)
1. Acquisition of new technology	8	1	9 (16%)
2. Marketing product beyond the local area	6	1	7 (13%)
3. Dealing with banks (new loans and rescheduling)	5	2	7 (13%)
4. Dealing with senior levels of government	2	1	3 (5%)

Source: author's survey.

environmentally friendly electrical or LPG kilns. This conversion was spearheaded by the government in its effort to halt deforestation. It is estimated that 40% of enterprises in Bat Trang have now converted to LPG (Total S.A., 2003, 15). In addition, damp clay, rather than dry clay, is used in the making of pottery, as it reduces the fine clay-dust deposited on houses and crops, which is a major health hazard. Furthermore, as revealed in the survey, those kilns that are still coal-powered are now obliged to build tall chimneys for better dispersion of pollutants such as carbon monoxide, nitrogen oxide and sulphur dioxide.

In the small textile village of Van Phuc all the manual looms in its 785 textile households are now electrically powered. Nevertheless, the village's 20 or so textile dyeing households release their wastewater untreated into the local stream, a tributary of the Nhue river. This waste contains toxic substances such as chlorine, alkaline compounds, and metals such as chromium, zinc and copper. The Van Phuc stream and the Nhue river are also heavily polluted by organic matter. Both suffer in addition from eutrophication, and high levels of biological oxygen demand and chemical oxygen demand. The village's sewerage and drainage system is incomplete, and the management of its solid waste is inefficient, compromising people's health (MARD-JICA, 2003, 6–3). Moreover, the noise from Van Phuc's electrically powered looms – of which there are roughly 1000 – creates a nuisance to its residents. In 2002, in response to all of these problems, the People's Committee of Ha Tay province approved the relocation of the textile workshops to a new craft zone, covering an area of 14.6 ha. As well as reducing the environmental impact of the industry, the number of looms and dyeing machines can now be expected to double (MARD-JICA, 2003, 6–1).

In the woodcarving village of Dong Ky, noise, air and soil pollution, and in particular water pollution from solvents and varnishes, has

reached a critical level, drawing complaints from nearby communities downstream. It was observed that only large companies can afford environmentally friendly technologies, such as spray chambers and energy-efficient wood-drying chambers. However, small enterprises, which lack the financial resources of the larger companies, are also aware of the environmental hazards caused by their production activities. They are doing whatever they can to minimise pollution; for example, using wet wood for sawing, which reduces the hazard of airborne dust from the wood. Furthermore, the resulting sawdust is used as fertiliser, and wood chips and other wood cuttings as fuel.

The rapid growth of the Delta's handicraft clusters has increased the use of its natural resources. Furthermore, some resources are being adversely affected; for instance, as some of the interviewees observed, surface water and groundwater are being increasingly contaminated, as organic and degradable industrial pollutants are replaced by those that are more toxic and persistent.

### Concluding remarks

The rapid growth of many small-scale handicraft clusters in the Red River Delta is having a negative impact on the availability of local natural resources used in the production processes. Moreover, the uncontrolled development of some clusters is affecting the natural environment's capacity to absorb the waste by-products deposited in the Delta's air, water and soil. On a more positive note, some enterprises are now starting to adopt new production technologies and ICTs, which are changing the economic performance and social structure of many small-scale clusters. Remarkably, amongst the enterprises sampled in this study, all have access to a fixed or mobile telephone and, more importantly, 75% have dedicated internet access. The findings highlight the significance of new technologies in the revitalisation of dormant or



static traditional clusters in developing countries (Sandee and Rietveld, 2001). These technologies support the growth of small enterprises, which in turn ease environmental stresses and provide employment opportunities for rural communities, and in the Delta this has reduced levels of poverty (Ahn, 2006). However, although the penetration of such technologies has been considerable within the handicraft sectors, it is notably uneven, being limited to the export-orientated enterprises based in Hanoi (Konstadakopulos, 2005, 31) and semi-urban areas such as Bat Trang, where adoption of the internet and environmentally clean technologies has markedly increased. This ceramic village is another good example of a cluster dealing successfully with environmental problems associated with rapid industrialisation.

Securing new production technologies and access to the internet are less significant challenges for small-enterprise clusters in rural parts of the Delta than are shortages of capital, land and educated workers, and the provision of basic infrastructure (Konstadakopulos, 2005, 34–36). In order to confront these challenges, and reduce the environmental degradation of the Delta as a whole, the following major issues need to be addressed and fundamental reforms undertaken in the coming years.

#### *Institution-building*

The limited capacity of public institutions and administration is impeding the private sector-led development of rural clusters. In some rural areas, the provincial, district and local levels of government are ill-equipped to handle the problems of building approvals, land allocation and transfers, infrastructure management, and environmental degradation (Marr, 2004, 48–49). Likewise, central government has not adapted well to the rapidly changing technological environment. For example, the responsibilities of central government agencies in managing and promoting information technology tend to overlap and can be unclear, resulting in unstable co-ordination among information networks at central and local levels (MARD-JICA, 2003, 1–3).

Since most of the handicraft households in Bat Trang, Dong Ky, Van Phuc and elsewhere use their own dwellings, yards and gardens as production places, environmental pollution is having a negative impact on nearby residential areas. Given the acute shortage of land in the Delta, the relocation of such enterprises to designated industrial estates is of great concern

to local and provincial levels of government, which have to procure such land and build the appropriate infrastructure. However, such relocation could be advantageous in other ways: for example, the cost of building common wastewater facilities could be shared between several household enterprises, and the cluster could develop an efficient organisational structure for environmental management, rather than merely shifting the pollution problem elsewhere. As Frijns observed (2003, 146) in his study of the advantages and disadvantages of the relocation of small textile and metal enterprises to industrial zones in Ho Chi Minh City, one should 'also strive for waste exchange opportunities, innovative utilization of space, sustainable building practices, and quality improvement and safeguarding through park management'. However, in their investigation of environmental management techniques practised in Vietnamese industrial zones, Dieu *et al.* (2003, 57) found that pollution control in such zones has been ineffective, due to weak environmental legislation and management, as well as the fact that no clear division of tasks and responsibilities exists among the plethora of State agencies involved in the environmental management of industrial clusters.

Other kinds of institutional arrangements – such as enterprise associations that raise awareness of available technologies and provide training, marketing and export assistance – need further development. Adger *et al.* (2001, 269) emphasised the importance of empowerment at the local level, which is necessary for developing opportunities that are responsive to 'local and regional environmental and socio-cultural circumstances'. More importantly, Vietnam needs to develop its banking sector and establish entirely new financial institutions, providing credit for the purchase of new environmentally friendly technologies.

#### *Strengthening environmental governance*

It is clear that the remarkable growth of handicraft clusters has come at the expense of air, water and soil quality, especially in the densely populated and congested urban and semi-rural areas of the Delta. In addition, the use of various natural resources found in the Delta is mostly unsustainable. Despite the adoption of a number of ecological practices, existing production operations in many handicraft clusters often result in localised land degradation, soil erosion, increased risk of flooding, compromises to

human health, and loss of biodiversity. These problems in turn could undermine the country's development strategy. Unfortunately, not all of the enterprises in a cluster have the capacity to solve pollution problems, since they lack adequate financial resources, technical knowledge and organisational capability. Moreover, the regulatory framework in which such enterprises operate is weak, and civil society and local authorities have limited power to address even the most pressing environmental concerns. As Khoa and Dieu (2003, 222) pointed out, drawing from their analysis of the ecological transformation of the tapioca processing industry (another common geographical agglomeration of agri-industrial activity in Vietnam), the implementation of an industrial ecology model should not rely on the role of provincial or local authorities, since their environmental priorities and resources are limited. Instead, with the help of ICTs, the authorities should aim to establish co-operative modes of interaction between households, and create networks that facilitate exchanges of knowledge on increasing production efficiency, which could come about by reducing waste and by recycling.

Awareness of Vietnam's environmental problems is undoubtedly growing among policy-makers at the highest level. The revised Law on Environmental Protection, which came into effect on the 1st of July, 2006, is an example of this trend. It is hoped that, properly implemented by the provincial and local authorities, the new law will help to improve environmental conditions, business growth, job creation and poverty alleviation in many of the Delta's handicraft clusters. At the same time, upgrading the physical infrastructure will broaden production options, and facilitate market access and the adoption of new technologies. Furthermore, it is likely that the way in which the 'ecologicalisation' of handicraft clusters in rural Vietnam is being encouraged and developed could be adopted by other countries that are in transition to market economies, such as neighbouring China.

The key to the sustainable development of small-scale enterprise clusters in southeast Asia and elsewhere appears to be the type of rural development policy that on the one hand prevents environmental degradation, and on the other encourages the adoption of new technologies. Vietnam, and some other developing countries, such as China, are currently pursuing maximum growth objectives, and are focusing on large, prestigious industrial zones, with

unacceptable environmental consequences. But whether they are ready to slow down their development in exchange for resource conservation and environmental protection remains to be seen.

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