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BROWNFIELDS REMEDIATION AND REUSE: AN OPPORTUNITY FOR URBAN SUSTAINABLE DEVELOPMENT

Abstract. This paper focuses on brownfields remediation and reuse strategies as opportunities to favour environmental protection, improvement of economic and social conditions and enhancement of human health and safety. The reuse of brownfield sites can also promote and encourage urban sustainable development practices. Land management and soil protection are common priorities for all the modern Governments and the experience achieved by Western countries in this field may be of some utility for a sustainable urban regeneration policy in China. Finally, an overview of the main costs and benefits of brownfield redevelopment and cleanup projects and a brief introduction to the issue related to the economic valuation methodology used to quantify them will be investigated and discussed.

1. INTRODUCTION

Land management and soil protection are required to achieve goals of sustainability and therefore Governments worldwide have committed themselves to implement the necessary strategies. These strategies are largely intertwined because land is scarce and soil is a non renewable resource: land uses management and soil protection are the appropriate actions to be taken to ensure flexibility and a more rational way to use these scarce resources within a sustainable perspective of growth.

To protect the environment and to achieve the goals of improved land management and soil protection, the European legislation has been framed within the “polluter pays” principle: this implies both that the polluter may be required to invest in equipment and processes that reach environmental standards and, as in the new Directive on Environmental Liability, that responsibility for the cost of cleanup is placed on those parties who have contributed to creating the contamination problem. The system of environmental liabilities should both prevent future contamination problems and provide financing for any needed remediation.

In China the legal system is undergoing continuous and profound reforms (Cao *et al.*, 1997): the Government has committed itself to move in the direction of incorporating sustainability principles into laws and regulations related to environmental and natural resource protection, and to develop legislation to fulfil China’s international obligations in terms of environmental treaties and conventions¹.

In industrialized countries, soil remediation and protection stands out as a priority and programmes for redeveloping land are common: these programmes very often take place in urban areas and they imply large investments in cleanups which are the first step in the strategy of urban regeneration. Many major cities in China are facing the same challenge and experiencing the same problems of regeneration

of urban cores and these problems may be exacerbated by the continuous and rapid process of urbanization and the conflict between alternative land uses. Land scarcity is a distinctive Chinese problem and the ongoing trend of land consumption is raising major concerns (Brown, 1995).

Land remediation and recycling poses a vast array of financial and governance problems: reusing previously developed land (so called brownfield site) is attractive because very often these areas are placed in high value location within the inner city, but several drawbacks are possible because of contamination problems negatively impacting on the social fabric hosting them, and posing hazards on human health and the ecosystem. In Europe and the USA there has been a politically driven emphasis on reclaiming these sites and a huge amount of human and financial resources has been devoted and is still required to address this social and environmental challenge. Public sector funding and management is necessary to promote both cleanups and processes of urban regeneration, framing them within a sustainable urban and land planning and achieving the recycling of urban land while protecting greenfields and rural land. Most interventions require the joint efforts of private and public agencies because of the scarcity of public financial resources and the existence of a variety of stakeholders and property owners involved.

Economists would recommend that when making decisions about these projects their costs should be compared to the benefits: in this essay we want to develop this recommendation by discussing in detail brownfield sites remediation and reuse costs and benefits, claiming that the use of economic valuation tools may actively support a sustainable development strategy in urban regeneration policies.

The remainder of the paper is organized as follows. In section 2 we introduce the issue of brownfield sites in terms of diffusion of the problems, and extent of the cleaning up costs in the Western experience. In section 3 we analyze the main costs and benefits of the remediation and regeneration of brownfield sites and we address the importance of developing benefit cost analysis to improve decision making and public participation in environmental and urban regeneration policy. In section 4 we discuss some implications of the Western experience in land remediation and reuse for China. Section 5 presents the conclusions.

2. BROWNFIELDS REMEDIATION AND REUSE

Changes in the economy, in the industrial composition and in technological innovations in the last few decades have resulted in the creation of large areas of underused and abandoned and possibly contaminated land in cities and suburbs all over the world. These areas are called brownfields:

Real property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant².

Economy evolves and this evolution leaves behind the legacy of a previous pattern of location and land uses: it is a recurrent phenomenon which is important to understand in order to be able to react with proper economic and social policies. Other factors that have contributed to brownfields creation as pointed out by Pellow (1998) include: i) a demographic shift away from the city to the suburbs and urban

fringe areas; ii) expanded transportation networks that almost entirely by-pass the inner city and provide little incentive to develop there, contributing to suburban sprawl growth; iii) a regional shift of economic production and population centres that limits or restricts investment in the older industrial cities; iv) a global change in the technology of post-industrial economic production that renders much of the early 20th century development obsolete, particularly with respect to electronic communications; v) the rising global competition from trans-national corporations and their increasing drive to cut costs, maximize profits, and increase capital mobility.

The results on land use of these concurrent forces operating in the economy are impressive and some data may help to understand the scale of the problems involved. In the USA, the Office of Technology (1995) estimated 450,000 brownfield sites nationwide. A more recent report from the US Conference of Mayors provides a national tally of 600,000. The most contaminated brownfields are the 1,550 Superfund sites on the National Priorities List (USEPA, 2005).

In Europe, unfortunately, reliable data at the national level on the number of brownfield sites are not available for all countries. Almost 800,000 potential brownfield sites have been identified in Europe (Oliver *et al.*, 2005). More than 300,000 potentially contaminated sites have been identified in Western Europe and the estimated number for the whole of Europe is much larger (Van-Camp, 2004). The diffusion of contaminated sites in the territory, and the extent of contamination in soil, in water, and groundwater constitute a menace to the population's health and to the ecosystem, and legal rules work both to limit this menace in the future and to address ongoing problems by identifying responsible parties and at least in part solving the problem of finding adequate financial resources for cleanups.

The burden for private and public finance is heavy: for example, Probst and Konisky (2001) estimate that in the low case, the total cost from fiscal year 2000 through fiscal year 2009 will be approximately \$14 billions (or \$15.6 billions, adjusted for inflation), and in the high case, the total cost is estimated at about \$16.4 billions (or \$18.3 billions, adjusted for inflation), approximately 8.6% more than in the base case.

European official reports (EEA, 2000; and Van-Camp *et al.*, 2004), estimate that the total cleanup costs for the countries that have provided data are about 115 billion euros at current price, or 490 euros per capita.

It can be argued that land is a scarce and finite resource and that in theory a competitive market for land could be the solution to these problems. Obviously this is not the case: various institutional factors are affecting the working of the market for land: property rights regime and planning practices interact with demand and supply for different land uses and the rules and functioning of capital markets. In the case of brownfield sites a further element needs to be taken into account: the liability regimes for environmental and property damages. The liability systems have their own costs: brownfields may remain idle in part because of the threat of liability for brownfields developers under strict environmental laws (Urban Institute, 1997). In the US, the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), also known as Superfund law, is one of the most significant examples. Its severe liability regime with the characteristics of strict, retroactive and

joint-and-several liability has made developers, potential buyers, and owners diffident to invest in brownfields remediation and redevelopment. But, experience and the awareness of the potential beneficial gains accruing from redeveloping brownfield sites, have encouraged US federal governments to activate a series of initiatives to promote redevelopment and reuse of these sites. Examples of these initiatives are a targeted tax deduction for brownfields redevelopment, a reduction of liability risk under CERCLA for lenders that become involved with brownfield sites, and the voluntary cleanup programs aiming at fostering the cleanup of brownfield sites. The new European legislation, which came into effect on April 30th 2007, (2004/35/CE), draws heavily on the experience of the contaminated sites statute in place in the United States – Superfund, which was established 25 years ago – while trying to avoid some of its drawbacks.

While liabilities may constrain the market for brownfield sites redevelopment, there are also various reasons for the market to be able to overcome these constraints. Brownfield sites are generally old industrial sites located adjacent to core areas and inner-suburban areas and are close to existing infrastructure, jobs, and other resources. Porter (1995) asserts that inner cities have some competitive advantages that are connected to brownfields redevelopment, such as strategic location, local market demand, integration with regional cluster, and human resources. Brownfield sites are generally located near inner cities where the existence of high rent areas, business centres, and nodes of transportation and communication favour brownfields redevelopment policies. Local market demand refers to untapped purchasing power in inner cities that can make up for lower per capita income. Inner city residents are particularly underserved by financial, retail, and personal services. Brownfields redevelopment could result in wider availability of local services in inner city neighbourhoods. Integration with regional economies refers to the opportunity to take advantages of the existing clusters of regional economic activity and the possibility to compete in downstream products and services. The presence of industry clusters may increase productivity, efficiency in the access to specialized inputs, services, employees, information, institutions and may enhance the ability to perceive innovation opportunities. Hence, brownfields redevelopment could result in new inner city business and local employment growth. Finally, the inner city may have underutilized labour pools and unexploited capacities for entrepreneurship. Brownfields redevelopment can increase the supply of moderate wage, low to moderate skilled jobs and small business opportunities in inner city neighbourhoods.

Nevertheless, brownfield sites redevelopment may incur a variety of problems: these properties are derelict or underused; they have in many cases real or perceived contamination problems, and the financial costs to remediate and reuse them may be impeded by the overall decline of the urban areas in which they are located. Large, idle brownfields may have a wider negative impact on the regional level (RESCUE, 2004) and for this reason their cleaning up and reuse has been considered a priority in many countries.

Whether enforcement-based or relying on collaboration between private entities, such as developers and investors, residents, and governments (as in many recent “brownfields” initiatives), addressing the problem of contaminated sites is judged to

be an important component of sustainable urban regeneration. Remediation of contaminated brownfield sites of course needs to be combined with redevelopment policies to bring back these sites into their productive and socio-economic functions promoting urban revitalization while reducing development pressures of greenfields (Eisen, 1999).

RESCUE (2002) defines a sustainable regeneration of brownfield sites as the management, rehabilitation and return to beneficial use of the brownfields in such a manner as to ensure the attainment and continued satisfaction of human needs for present and future generations in environmentally sensitive, economically viable, institutionally robust and socially acceptable ways within the particular regional context. Within this framework, while contaminated sites remediation is costly, it also contributes to numerous benefits, offering economic and social advantages to the local and regional economy and to the community nearby. Benefits Cost Analysis is an appropriate economic valuation tool to understand the importance of remediation projects for urban regeneration policies.

3. IDENTIFYING THE COST AND BENEFITS OF BROWNFIELDS REMEDIATION AND REUSE

A comprehensive cost and benefit analysis of any brownfields intervention site must take into account various factors that can have positive or negative impacts on the value of the property, on the communities involved by the cleanup project of the site, and on the natural environment (Tonin, 2006). The costs of brownfields redevelopment and remediation can be divided into two broad categories: direct costs, linked to the remediation process itself, and indirect costs, i.e. costs related to

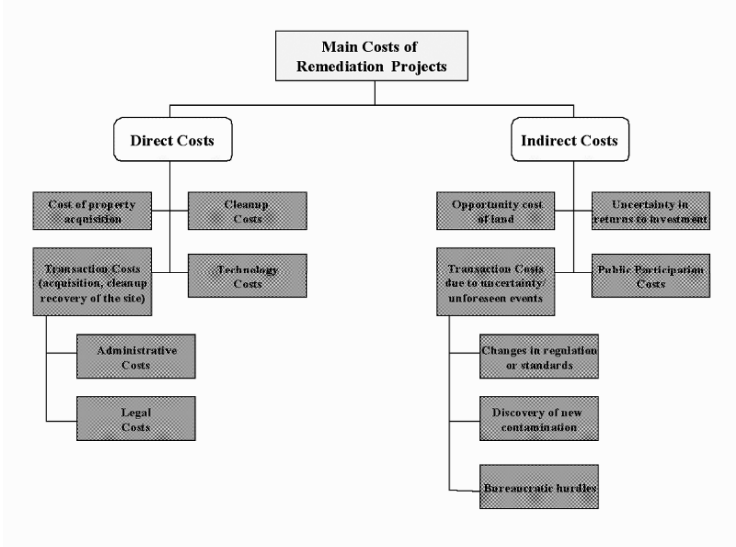


Figure 1. Main costs of remediation projects.

the effective management and implementation of brownfields redevelopment and remediation processes (see Fig. 1).

The direct costs depend on the type and severity of contamination (extent, mobility of contaminants), the characteristics of the site itself (location and historical conditions of the area), the choice of the best available cleanup technology, and finally the administrative and legal costs relative to the acquisition, cleaning and recovery of contaminated sites. Indirect costs are, for example, those due to the delay in using the land because the remediation process is slow, and those related to the uncertainty and the higher transaction cost of the project. Brownfield redevelopment projects pose higher levels of uncertainty to decision-makers than would occur with any other property investments, and especially greenfields. The higher risks refer to the site assessments needed to determine the type and extent of the pollutants, remediation planning, the execution of remediation plans, and the environmental damage liability claims associated with the past pollution of a site. Any one of these factors imply higher transaction costs that involve an array of measurement, information, bargaining, and contracting costs other than those associated with acquisition of unpoluted land. Other costs incurred due to contamination are related to the difficulties in accessing the necessary funding for development projects. Thus, although many contaminated sites have the potential for becoming profitable business ventures that generate new activities and new employment opportunities, public investment is often needed to catalyze private funds. This is because the cleanup interventions are very expensive, and financial capital is hard to find, and there is considerable delay between the initial investment and the time in which the site can be productively used again. According to OECD

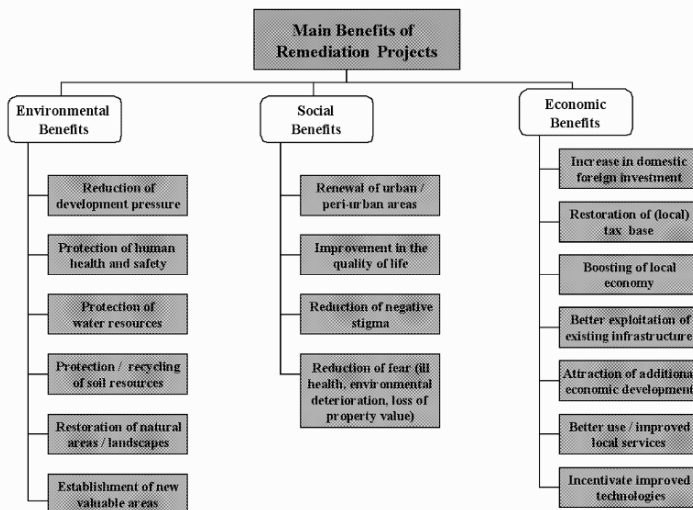


Figure 2. Main benefits of remediation projects.

(2000), the role of the public sector in these projects is to design the cleanup strategy, to pinpoint the appropriate areas for development, to initiate the remediation process, to provide funding and to encourage the participation of the private sector.

Economists recommend that the costs should be compared with the benefits of the project. Thus, focusing now on the positive side of the brownfields remediation and redevelopment process, the main benefits can be grouped into three broad categories: environmental benefits, social benefits and economic benefits (see Fig. 2).

The environmental benefits include the reduction of development pressure on greenfield sites, protection of public health and safety, protection of groundwater resources, protection and recycling of soil resources, restoration of former landscapes and establishment of new areas deemed to have ecological value. Restoring natural areas may also entail “non-use benefits”, such as the option to conserve a natural resource to use it in the future, and the enjoyment of knowing that natural resources are preserved for future generations.

The social benefits include, among others, the renewal of urban cores, the improvement of the quality of life, the elimination or reduction of the negative social stigmas associated with the affected communities by revitalizing them, the reduction of the fear of ill health, environmental deterioration, and loss of property values in these communities. Another important positive effect included in this benefit category is the reduction of fear and anxiety related to the perceived health risks. The deaths, illness and injuries avoided by various interventions are generally considered and valued in monetary terms. But little attention has been devoted to the dread and uncertainty associated with these effects. Schelling (1968) was one of the first researchers to introduce the concepts of anxiety and fear as part of the consumer interest in reducing the risk of death so that it is worth for the consumer to reduce it. The explanation that fear, in contrast with death, illness or injury, is too intangible to be recognizable by risk regulators, cannot entirely be accepted. In fact, wide ranges of intangible benefits are now routinely recognized within environmental economics: the value of fear should thus be estimated as well (Adler, 2003).

There are many potential economic benefits of remediation and redevelopment of brownfield sites. For example, domestic and foreign investment can be attracted by the restoration of the tax base of the government, especially at the local level. Brownfields requalification can also increase employment opportunities (number of short-term and long-term jobs) thus boosting the local economy, and can increase the utilization of and reinvestment in existing municipal services. Finally, brownfields remediation can encourage the development of remediation/decontamination technology; and the exploitation of existing infrastructure systems. By returning these facilities to productive use, cities can reacquire their economic and social vitality and be the catalyst for additional economic development. Case studies have illustrated economic advantages of building in already developed areas (De Sousa, 2003), such as less expensive development costs, lower operating costs, lower infrastructure costs, and lower fiscal impact costs to local jurisdictions; however this is not necessarily true for all sites when the cost of

environmental remediation is very high because of heavy pollution and the site location is not very attractive.

4. THE ECONOMIC VALUATION OF COSTS AND BENEFITS

In many situations, to estimate costs and benefits is not a trivial exercise: severe data limitation and methodological problems are well recognized and yet we contend that economic valuation tools are very important to support credible policies for a sustainable development.

The economic value of goods or services is generally captured by market price or, more precisely, by how much people are willing to pay to obtain them (WTP) or are willing to accept compensation for some given loss (WTA). There are however a number of goods, such as environmental quality, human health, and risk, which are not traded, and for which markets are absent. The monetary value of changes in society's well being due to a change in environmental goods is generally estimated through the total economic value (TEV) of the good to be appraised. Since an environmental resource provides a variety of services to society, the TEV can be disaggregated to consider the effects of any change on the well being derived from the existence of the good. The TEV is commonly divided into use values and non-use values. Use values include direct use values, which refer to the actual use of a resource; indirect values, which are society benefits from ecosystem functions; and option values, which refer to the values individuals are willing to pay for the option of using a resource in the future. Non-use values can take the form of existence value, which reflect the fact that people value resources for moral or altruistic reasons, unrelated to current or future use, and bequest values, which measure people's willingness to pay to make sure their heirs will be able to use a resource in the future.

The total economic value (TEV) of an environmental good is thus the sum of both use and non-use values:

$$\text{TEV} = \text{use values} + \text{non-use values} = \text{direct use} + \text{indirect use} + \text{option} + \text{existence} + \text{bequest values.}$$

Economists have resorted to a variety of techniques to place a value on these goods, which are generally termed non-market goods. In general, there are two main approaches for valuing non-market goods: revealed preference and stated preference methods (Freeman, 1993). With revealed preference techniques, preferences for non-market goods and income are revealed indirectly when individuals purchase other market goods that are in some way related to the non-market goods. Examples include the Travel Cost and the Hedonic Price Methods. By contrast, stated preference techniques ask people to report their willingness to pay in the course of an interview (Contingent Valuation) or infer preferences by asking people to choose among hypothetical alternatives (Conjoint Choice).

Some of the costs and benefits of brownfields remediation and redevelopment are not captured by market transactions: it is thus required to apply one of the non-market valuation techniques for the full assessment of the costs and benefits of these sites. This situation occurs more frequently to obtain sound estimates for the benefits

of a given project: human health benefits and environmental quality improvements are more difficult to obtain because markets are not well functioning or do not exist. For example, in our own research in Italy, devoted to the study of the benefits of remediation policies, we used conjoint choice questions to investigate people's preferences for different brownfield cleanup policies that vary in terms of lives saved, duration of the benefits, number of years necessary to complete a specific cleanup program, population involved and cost of the cleanup (Turvani *et al.*, 2006).

Further difficulties may arise when we have to measure uncertain costs and risks, such as those related to environmental liability, information asymmetry, other transaction costs, or costs related to the perceived extent and severity of environmental contamination. Again, our own research experience shows the effectiveness of these evaluation techniques: we examined different market-based mechanisms and incentives intended to promote the environmental remediation and reuse of brownfields, such as reductions in regulatory burden, relief from liability for future cleanups, and subsidies for regeneration of brownfields. We used a questionnaire based on conjoint choice questions to assess the responses of real estate developers to different mixes of these incentives (Alberini *et al.*, 2005).

5. BROWNFIELD REMEDIATION AND REUSE: A CHALLENGE AND AN OPPORTUNITY FOR CHINA

In 1994, the Chinese Government published China's Agenda 21 – as a platform document for guiding the country's social and economic development. As far as land management is concerned, the Program reports:

Implement the basic state policy of treasuring and rationally utilizing land and effectively protecting farmland, [...] Strengthen land resources survey, evaluation and monitoring [...] *Strengthen the management of land use for construction, control the scale of land use for such purposes, [...]* Improve land asset management, *deepening land-use restructuring by aggressively introducing a market-oriented approach* to land-use rights, improving the land pricing system and land tax system, and promoting efficient land use. Improve the land property system [...] Reform the land expropriation system. [...] Strengthen land legislation, improve laws and regulations and law enforcement.

More recently, China Council for international cooperation on environment and development (CCICED, 2006) reports:

More scientific understanding and measurement on environmental resilience and carrying capacity in urban and surrounding areas are needed. *Avoiding urban sprawl, thus preventing cities from expanding in an excessive and uncontrolled manner which has negative environmental and social implications, is of utmost importance.*

Furthermore CCICED gave the following advice:

After appropriate environmental impact assessment, the use of remediated brownfield sites for housing should be given priority over greenfield sites, to avoid affecting natural and agricultural areas.

The necessity to accelerate efforts to control the environmental impacts of cities and towns by setting in place essential laws, policies, knowledge and incentives

within the Chinese strategy of growth is clearly acknowledged. The focus of the strategy is on circular economy, which is a major feature of Chinese way of welding further strong development and environmental protection by means of resource saving efforts, inter sectoral efficiency and recycling (Chen *et al.*, 2001). Land recycling and brownfield remediation and reuse become relevant for this approach because urban growth and development carry large increase in the consumption of land and demand for space for residential, industrial and commercial uses.

As far as official documents are taken into consideration we may trust that China is on the right track and it is going to avoid, at least to some relevant extent, what has been the fate of major industrial cities in the Western World, where a phase of urban decay, including the abandoning of factories and the generation of contaminated brownfields, was the consequence of the changing sectoral composition of the economy and of people changing lifestyles. Of course, the situation is quite different in the Western World, where urbanization is still taking place but at a much lower pace and where economic growth is much lower than in China. Differences notwithstanding, recycling urban land, i.e. finding new uses for previously used land and addressing issues of contamination due to previous hazardous activities taking places within urban areas, is a necessity for a more rational and sustainable land use and a base for sustainable development. Urban regeneration has proved to be a process able to trigger economic and social development in many cases, improving the quality of life in cities and economic development in Western Countries (Fox-Prezeworski *et al.*, 1991) within a logic of sustainable development (Riddell, 2004).

China has shown great ability to learn from existing experience elsewhere in many fields: its ability to commit to sustainable development goals is demonstrated in some positive environmental improvements in cities thanks to ongoing policies and planning practices and, therefore we may trust that it will be able to capture the benefits of learning from Western success and defeats in brownfields remediation and reuse practices (Hanson, 2003).

Urbanization has been the distinctive feature of the rise of industrial societies throughout the world, but in China this process assumes a different character (Lin, 2002). A specific feature of urbanization in China has been the high number of floating population, due to the working of the *hukou* system³ of home registration, which was introduced in the 50's to control the movements of population, to hold down the costs of housing and the benefits of urban workers which were mainly provided by state employment.

A recent research (Fujita and Thisse, 2003) shows that urban population in China is more dispersed in smaller cities with respect to more industrialized countries, while the overall urbanized population is little over 40% of the total, a percentage well below that one of other similar countries for size and income (Henderson, 2004). Given this situation a further urbanization of the population is expected by 2020 with a continuous reduction of the labour force engaged in agriculture. Urbanization over the coming two decades could bring as many as 300 to 400 million more people into cities, attracted into industrial and service sectors. The location of these activities will be a key determinant for the use of land in cities and in the greenfields surrounding them (Small, 2002).

Furthermore, in the past the development of town and village enterprises (TVE) has been a major strategy to spread industrial development into the countryside and raise the level of revenue of rural population. This choice on the one hand favoured the location of industry in areas beyond the east coast of China, helping economic growth substantially, but on the other hand consumed large parcels of land and contributed to the diffusion of hazardous industrial waste and environmental contamination in many towns and villages (Hanson, 2003).

As we previously discussed, the impact of industry on land and water resources has been considerable in all parts of the world. The burden of past industrialization has proved to be heavy for the environment and for social life in cities when traditional industries reduced employment and relocated in other areas. Liability associated with contaminated “brownfield” sites turned out to be an expensive and contentious issue to deal with, especially in North America and in both Eastern and Western Europe. The effects of liability regimes on the possibility to find new uses for redeveloping land were largely negative, affecting investment in existing industrial operations by local and foreign investors.

From the financial point of view yet, many brownfield sites are considered as the most valuable lands for new uses, ranging to less polluting industries, residential and light commercial land uses. Being able to redevelop them can lower the impact on suburban land sprawl that arises from the desire of industries to build on “greenfields” and the desire of residents to move from decaying city centers. This is the experience of the West and it has become an experience also for China.

Many large cities in China have experience of redevelopment of land (Chen, 2005; Li, 2003) and relocation of heavy industry (Chengri Ding, 2003) and of course redevelopment and land recycling is much needed in the future to provide new space for both citizens and industrial needs. With regards to these redevelopments, two important issues deserve attention: one is the problem of possible contamination, with implications for human health, ecosystem and property damages; the other relates to social justice and equity, given that the costs and benefits of redevelopment programmes affect citizens in a very uneven way. Vast areas within the urban cores have been redeveloped, displacing people from their neighborhoods to give room to other land uses which can pay higher rents. In the short run it is an issue of economic redistribution and fairness; in a longer term perspective, and learning from Western Countries errors, it is important to remember that urban quality in cities asks for the preservation of mixed land uses and it requires avoiding the creation of huge suburbs working as a dormitory to maintain the well functioning of the dynamic forces driving economic evolution, which find their roots in urban life and agglomeration (Fuijta *et al.*, 2001; Jacobs, 1985), and to prevent the insurgence of costly and devastating social conflicts.

Contamination of land and underground water, due to polluting previous uses, poses similar problems to those encountered in Western Countries. The legacy of heavy industry and diffused polluting industries on the territory, in terms of soil and water contamination, may be enormous but it is also very important to look ahead and to avoid the continuous regeneration of such problems. Economy is an evolving system and even though land supply is fixed and scarce, land uses may change overtime. From this perspective it is important not only to have a full inventory of

the existing problematic areas but it is necessary to develop hazardous waste management practices to avoid further problems that may arise in the years ahead.

“The siting of toxic waste treatment centers, and the conditions and management of municipal land fills need careful attention. The culture of industrial development will need to shift so that both state-owned and private enterprises see themselves as stewards, prepared to invest in proper land care, and to leave sites in better condition than when they arrived. Special restoration funds set aside by companies for land management once industrial activities are completed is a workable mechanism that deserves attention in China (Hanson, 2003)”.

Western Countries have developed complex liability systems, by assigning responsibility for the costs of cleanup on those parties who have contributed to creating the contamination problem. These liabilities should both prevent future contamination and provide a base for financing the necessary remediation: as we noticed, these systems, though important and just in principle, may carry very high cost of enforcement and may imply huge transaction costs, especially when the issue at hand is the cleaning up of past contamination (Stone McGuigan, 2000; Turvani and Trombetta, 2006).

In China, liability systems even though necessary to avoid and limit future contamination may encounter further problems of application due to the nature of land use rights granted to industrial firms rather than ownership, which is retained by the state. The possibility of enterprise restructuring may find strong limits because their land rights may be their only valuable asset and this value varies according to location. Old, poorly located industries may face the necessity to continue their polluting activities beyond any optimal lifespan since they do not have the financial means to afford the costs of restructuring and relocating plus the cost of remediation. ‘It has been suggested by the World Bank that an administrative fund could be used to pool the revenues from sale of both high and lower value land use rights taken back from bankrupted enterprises in the region. The funds could then be used to meet social costs and rehabilitation fees of poorly-located industries wishing to declare bankruptcy (Hanson, 2003).

What has emerged from the Western experience is that the regimes of land ownership, title transfer and investment possibilities become very complex if uncertainty exists about who actually “owns” the liabilities associated with the land.

The ongoing system of land property rights and the way it is used by local governments to finance public urban expenditure and urban development by selling land use rights can be a major obstacle for the control of urban expansion and for the protection of greenfields surrounding cities and towns. The lack of well functioning property system may furthermore impede the development of an efficient land market and it has negative effects on the functioning of capital markets. The possibility to develop a workable system of liability to protect health, environment and property, not to say to enforce such systems, is necessarily constrained by the way property rights are now regulated and further reforms are needed (Chengri Ding, 2003). Furthermore many of the human health impacts associated with contaminated lands are not fully taken into account when counting the costs of land remediation while a public perspective on remediation costs and benefits should consider them. These costs may be quite relevant in financial terms and for the

pursuing of a sustainable perspective in development which needs to place high value on human life, health and justice.

6. CONCLUSION

The European Union states that

Protecting the environment is essential for the quality of life of current and future generations [...] Public participation is a central element in the common procedures applying across the EU for assessing the environmental impact of public sector policies and programs and of investment projects (http://europa.eu.int/pol/env/index_en.htm).

On the Chinese side, the same attention is given to environmental protection, to be developed in accordance with Chinese demand for economic growth. Active public participation and capacity building are high on the Chinese agenda:

The support and participation of public and social groups is essential to the achievement of sustainable development. The form and degree of their participation determine the rate at which the objectives of sustainable development are realized [...] New mechanisms are needed for public participation in sustainable development. It is necessary for the public to not only participate in policy-making related to environment and development, particularly in areas which may bear direct impact on their living and working communities, but also to supervise the implementation of the policies (<http://www.acca21.org.cn/chnwp20a.html>).

Urban regeneration programmes offer a unique opportunity to achieve a sustainable development strategy: they address the issues of environmental protection and economic growth while requiring the active participation of people. Land remediation and reuse and social and economic redevelopment of brownfield sites are urgent policies for local and national governments both in the West and in China. These policies may be quite expensive and they need the support of public and private sectors, together with the consensus of communities. Calculating and communicating the beneficial effects of cleaning up contaminated sites to the public may be decisive for the effectiveness and success of remediation policies and redevelopment plans, and of course it is necessary for improving public decision making. By referring to the Western experience and our own research we presented the reasons for and offered a detailed analysis of the ways to realize benefit-cost analysis for brownfields remediation and redevelopment projects, in the attempt to offer possible hints for similar projects in China.

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NOTES

¹ The Environmental Protection Law of the People's Republic of China is the cardinal law for environmental protection in China. The law has established the basic principle for coordinated development between economic construction, social progress and environmental protection, and defined the rights and duties of governments at all levels, all units and individuals as regard to environmental

protection. China has enacted and promulgated many special laws on environmental protection as well as laws on natural resources related to environmental protection. They include the Law on the Prevention and Control of Water Pollution, Law on the Prevention and Control of Air Pollution, Law on the Prevention and Control of Environmental Pollution by Solid Wastes, Marine Environment Protection Law, Forestry Law, Grassland Law, Fisheries Law, Mineral Resources Law, Land Administration Law, Water Resources Law, Law on the Protection of Wild Animals, Law on Water and Soil Conservation, and Agriculture Law (<http://www.china.org.cn/e-white/environment/e-3.htm>). To succeed in the application of the Ten Laws, China wants to commit to investigation of the major problems in the execution and enforcement of current laws and the collection and analyses of typical cases to serve as a basis for further action, investigation of the use of market mechanisms for enforcing environmental protection legislation. These measures could include environmental taxes, tradable permits, levies on pollution discharge ("polluter pays principle"), and economic incentives (<http://www.acca21.org.cn/pp1-1.html>).

² The Small Business Liability Relief And Brownfields Revitalization Act (2002).

³ Every Chinese resident has a hukou designation as an urban or rural resident. Hukou is an important indicator of social status, and urban (chengshi) status is necessary for accessing urban welfare benefits, such as schools, health care or subsidized agricultural goods. Without urban hukou status it is very difficult to live in cities. By limiting access to the benefits of urbanization, the hukou system ostensibly served as the world's most influential urban growth management instrument. (Ding, Chengri and Gerrit Knaap <http://www.lincolninst.edu/pubs/pub-detail.asp?id=793>) For a discussion of the implication of the hukou system for future rural productivity increase and urban life quality for citizen see http://www.cdrf.org.cn/2006cdf/pinglun5_en.pdf.

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