Journal of Cleaner Production 57 (2013) 200–208

Contents lists available at SciVerse ScienceDirect

Journal of Cleaner Production

journal homepage: www.elsevier.com/locate/jclepro

A sustainability framework for redevelopment of rural brownfields: stakeholder participation at SÃO DOMINGOS mine, Portugal

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ARTICLE INFO

Article history:
Received 22 May 2013
Accepted 27 May 2013
Available online 12 June 2013

Keywords:
Local sustainable development
Mina de São Domingos
Stakeholder participation
Rural brownfields
Post-mining area
Rehabilitation

ABSTRACT

Planning the redevelopment of brownfields according to the principles of sustainable development is a significant challenge, particularly for rural brownfields that have little hope of attracting private investment. In this paper, we propose a sustainability framework for rural brownfield redevelopment planning that incorporates the concerns and expectations of stakeholders in the process, aiming at the integration of various forms of place making. This work is part of the ongoing REHMINE project. The area studied is the São Domingos mine in southeast Portugal, part of the Iberian Pyrite Belt region. The methodology included the mapping of stakeholders in the São Domingos mine redevelopment process; semi-structured interviews with those stakeholders; and content analysis of the interviews. The results from the field were then crossed with a detailed analysis of the literature on brownfield regeneration and validated by a participative process. The outcome was a sustainability redevelopment framework that illustrates how the integration of different perspectives and forms of place making can lead to a locally adapted sustainable development overview that can support the redevelopment planning of a brownfield in a rural setting.

1. Introduction

The last decade has witnessed research attempting to rise to the difficult challenge of how to plan, manage and assess brownfield redevelopment in accordance with sustainability principles (Bleicher and Gross, 2010; EPA, 1999; Franz et al., 2006; Lange and McNeil, 2004; Nijkamp et al., 2002; Schädler et al., 2011; Wedding and Crawford-Brown, 2007; Williams and Dair, 2007; Worrall et al., 2009; SuRF, 2011). Thus far, however, less attention has been paid to brownfield regeneration processes in rural areas, despite their potential to boost regional development. In fact, rural brownfields face obstacles that are almost nonexistent for those located in urban areas. The most prevalent obstacles are a lack of funding, awareness and staff expertise, plus unresolved liability cases and property rights issues (BC, 2008; NADO, 2001). Furthermore, land prices are usually lower in rural areas due to less demand and a greater availability of alternative sites for development that lack the costs associated with cleaning up a brownfield (NADO, 2001).

This paper contributes to an important research area that has received little attention thus far: the redevelopment planning of brownfields in rural areas within the confines of sustainable local and regional development. It discusses the design of a sustainability framework for rural brownfield redevelopment planning that responds to a contextualization process by including the concerns and expectations of stakeholders, following a modified approach from Bleicher and Gross (2010) and supported by Healey's (2000) concept of "place making". It also illustrates how the linkage between scientific and local knowledge can contribute to an understanding of the implications of contextualizing sustainable development (henceforth SD) (Bodorkós and Pataki, 2009).

A determining factor for the success of local SD is the ability to contextualize it, which can be achieved through the involvement of local actors. Stakeholder participation can aid in the design of policies, plans or projects that better respond to the needs of local actors (Brugha and Varvasovszky, 2000) and is therefore useful in promoting SD (Kasemir et al., 2003). Furthermore, establishing a locally specific governance strategy triggered by a prior participation process might reduce the uncertainty associated with the future redevelopment and promote investment (Healey, 2000; Lange and McNeil, 2004; McCarthy, 2002; Nijkamp et al., 2002).

We begin by providing a scientific background through an analysis of existing theoretical approaches to the redevelopment or regeneration of brownfields and also the relevance of stakeholders' involvement for SD contextualization. We then describe the case

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http://dx.doi.org/10.1016/j.jclepro.2013.05.042

study. Next, we present the methodology that determined the categories of each dimension for the sustainability framework. Finally, we assess and discuss how these results might improve the quality of the planning process and further phases of the redevelopment of a rural brownfield.

2. Brownfield regeneration and contextualization of sustainable development

2.1. The relevance of stakeholders' participation for the sustainable redevelopment of brownfields

According to Alker et al. (2000: 64), a brownfield site is: any land or premises which has previously been used or developed and is not currently fully in use, although it may be partially occupied or utilized. It may also be vacant, derelict or contaminated. Therefore a brownfield site is not available for immediate use without intervention.

The European brownfield network, CABERNET (2005), categorizes sites in terms of their attractiveness for private investment with the A-B-C model. The model highlights the economic status (land value after rehabilitation and reclamation costs) and funding drivers for brownfield regeneration. Category A describes sites where project development is primarily driven by private funding due to expected land value after rehabilitation being higher than the reclamation costs. Category B describes projects at the borderline of profitability that tend to be funded through public-private co-operation or partnerships. Finally, Category C aggregates less economically attractive sites where regeneration projects have to be driven by public funding or specific legislative instruments (due to the value of the land after investment not being sufficient to cover the reclamation costs, or the overall perceived benefits from rehabilitation not being recognized). Therefore, it is a challenge to plan the sustainable regeneration of brownfields with low attractiveness for private investment, one which requires attention to multiple dimensions (Alker and McDonald, 2003; COBRAMAN, 2009).

Sustainable development is a guiding principle in the policy and management strategies of governments, corporations and institutions all over the world (Hediger, 1999; Parris and Kates, 2003). It has been, for example, noticeably incorporated into the discourse of European-level policy, with the Roadmap to a Resource Efficient Europe (COM(2011) 571) being one of the latest and more ambitious expressions of that incorporation yet.

In general, its "conceptual ambiguity" has significantly boosted its demand by enabling users to focus on their favorite elements (Hartmuth et al., 2008). A globally accepted definition might be with the ultimate aim of "development that lasts" (Atkinson et al., 1997: 3, in Dietz and Neumayer, 2007). At the heart of all definitions is the idea of fairness and equity and the importance of both in resource allocation across time (Hueting and Reijnders, 1998).

The goals of SD have to be defined in terms of sustainability. A choice arises when taking an economic approach, namely, whether natural capital (i.e., the range of functions the environment and natural resources provide for humans) should be fully protected or be substituted for by other forms of capital, especially produced capital, enabling constant consumption per capita over time (adapted from Dietz and Neumayer, 2007). This amount to the choice between strong sustainability (natural capital ultimately cannot be substituted by other types of capital) and weak sustainability (natural capital can be substituted by other types of capital) and the conceptual differences regarding sustainability ultimately reflect different aspirations as to what a sustainable world might be. To operationalize SD when dealing with conflict between various system goals (social, economic and ecological), a trade-off process must be extended throughout the social context system. This fits the view of Verbruggen et al. (1996), affirming that it is only on political grounds that a choice can be made from among different forms of sustainability; a decision that benefits from effective governance and public and stakeholder participation.

Hence, procedural aspects such as participatory democracy, integrated assessment and decision-making are now considered equally important within a common understanding of SD, at least in European policy (COWI et al., 2004). This is a way to comply with governance objectives and guarantee that concrete and integrated sustainability goals might be operationalized to convey political decisions. To confirm this direction, relevant policy initiatives such as Agenda 21, the Aarhus Convention and the EU Water Framework Directive institutionalized the importance of public participation in SD (Patel et al., 2007).

Public participation is pointed to as a useful process for generating contributions to the design of policies or projects that better respond to the needs of those concerned, to the decision-making process and to a greater acceptance of decisions taken (Brugha and Varvasovszky, 2000; Patel et al., 2007). Therefore, to achieve SD in a specific context it is necessary to tailor the concept to a situation and a community (Hartmuth et al., 2008). As an example, Agenda 21 makes a clear statement that many sustainability issues have their roots in local activities and agents. Healey (2000) helps us understand the need to tailor SD to a situation and a community throughout the concept of "place making" distinguishing between 'space' and 'place' in the sense that 'space' refers to the functional 'physical space' and 'place' conceptualizes 'space' in a relational manner as the localization of different stakeholders' social practices.

In addition, stakeholder participation offers conditions under which a process of integrating multiple perspectives can be developed, creating a process of social or collective learning that occurs when different individuals with common yet divergent interests negotiate to create a shared consensus on the collective action needed to solve a mutual problem. It implies the combination of multiple knowledge systems and can be facilitated by the integration of expert and non-expert perspectives (Webler et al., 1995). It includes innovation, communication and common understanding and is indicated by several authors as a process that can overcome the challenges posed in the search for SD (Garmendia and Stagl, 2010). In a more specific way, it can also promote the ability of communities "to define their own interests, to get access to new knowledge, and to mobilize the resources they need for the kind of development that is in line with their own visions and needs" (Rist et al., 2007: 25–26). This makes the integration of different knowledge systems a core issue for the promotion of SD (Strigl, 2003). However, the potential of social learning carries with it the requirement to expend considerable energy and resources to initiate and maintain the process (Rist et al., 2007), which must also overcome the idea that non-state actors cannot make a difference (Webler et al., 1995). Success also depends on the competence and availability of multiple actors (Steelman and Ascher, 1997). However, stakeholder participation has been assuming an important role in different settings, such as natural resources management (e.g., Reed et al., 2009; Tompkins et al., 2008), environmental assessment (e.g., Sheppard and Meitner, 2005) and reflections on future development (e.g., Patel et al., 2007; Kasemir et al., 2003).

With regard to stakeholder participation in the regeneration of brownfields, this concern is frequently present (Bleicher and Gross, 2010; CABERNET, 2005; COBRAMAN, 2009; EPA, 1999; Franz et al., 2006; RESCUE, 2005; Wedding and Crawford-Brown, 2007; Williams and Dair, 2007; Worrall et al., 2009; Schädler et al., 2011; SuRF, 2011). Although most SD frameworks studied do not integrate

a dimension or category for planning or assessment of brownfields redevelopment specifically for stakeholders' participation (see Table 1), all the authors referenced here indicated the importance of listening to stakeholders. This is also expressed in the tools needed to facilitate the process of integration of multiple perspectives, such as the Sustainable Assessment Tool (RESCUE, 2005; Franz et al., 2006) or the Sustainable Brownfield Revitalization Tool (Wedding and Crawford-Brown, 2007). Although some of the tools allow a partial adjustment to the particularities of each case, the universality of these type of tools can be more challenging than the authors advocate (Bleicher and Gross, 2010), especially for the regeneration of less economically attractive sites. Additionally, the required resources for their application are very demanding (Franz et al., 2006) when trying to answer to this issue.

Based on the concepts of contextualization and operationalization presented by Hartmuth et al. (2008), Bleicher and Gross (2010) developed a site-specific approach by collecting the perceptions of local actors about a site and linking them to an SD framework, highlighting the importance of stakeholder integration to define a site-specific sustainability assessment. The contextualization was made through a collection of interviews and workshop sessions with a diverse sample of stakeholders in which different local problems were identified. Stakeholders were then asked to link the local problems with the goals of the SD framework. Finally, the authors used the insights collected with the participatory process to create a computer model to assist stakeholders to evaluate different land-use scenarios locally.

2.2. Sustainability frameworks for planning and assessing the regeneration of brownfields

There are still a large number of European brownfield sites today and their regeneration needs are mostly addressed independently by EU Member States which, in the absence of agreement on a European-level Directive on the subject (COM (2006) 232), implement their own policies and incentives at national level. The COBRAMAN (2009) project has mapped 31 studies carried out with European funding focusing on the development of tools to support procedures at different stages or different scopes, while some display assessment frameworks for specific dimensions of brownfield regeneration. Other studies synthesized sets of indicators specific for land remediation development (Holland et al., 2011), criteria for prioritizing potential brownfield sites for regeneration (Cheng et al., 2011) or frameworks focusing on a systematic "process-based" approach for decision support in which sustainability principles are integrated within the remediation project life cycle (e.g., Carlon et al., 2007; EPA, 1999). In addition, there are overarching sustainability frameworks for brownfield regeneration where it is possible to distinguish main target or "goal based" dimensions. From these, our literature review leads us to highlight and discuss 9 relevant contributions in Table 1.

The authors reviewed here differ in the ways they specify the dimensions they include. Nearly all authors cited in Table 1 use environmental, economic and social dimensions when they discuss sustainability dimensions for brownfield regeneration. Several authors also include cultural dimensions (RESCUE, 2005; Williams and Dair, 2007; Worrall et al., 2009; SuRF, 2011), communitarian dimensions (EPA, 1999; Lange and McNeil, 2004; RESCUE, 2005; SuRF, 2011) and/or strategic dimensions (EPA, 1999; Nijkamp et al., 2002; Lange and McNeil, 2004; RESCUE, 2005; Schädler et al., 2011; SuRF, 2011). The distinction between social and cultural dimensions is less common in the literature, although it is present in some of the works. Such a separation allows a more specific differentiation between social issues, namely aspects related to living conditions, such as safety, public health or social services and solutions for the most vulnerable social groups, and cultural issues related to tangible and intangible cultural heritage, such as social identity. This distinction seams quite relevant in rural communities, particularly those with a mining past, where there are deep-running economic and social fragilities (Ballestros and Ramírez, 2007) and a strong social mining identity.

Built on the conceptual evolution of sustainability "goal-based" frameworks presented in Table 1, although they differ in many details, it is possible to identify six sustainability dimensions which are generally used and we designate as: environmental reconversion; cultural regeneration; social revalorization; economic revitalization; community reinforcement; and strategic reframing. These six dimensions will be applied in this paper as the conceptual basis to reach our sustainability framework for the redevelopment of rural brownfields (see Table 2).

3. A case study of SÃO DOMINGOS mine

To reach the categories that reflect the local specificities to be considered during redevelopment for each sustainability dimension, we used a post-mining area in the initial phases of its redevelopment process planning as a case study. The site does not have significant market attractiveness for private investment, so it can be considered a category C site in the A-B-C brownfield classification model (CABERNET, 2005).

The area is designated here as the São Domingos mine (SDM) and is comprised of the village of Mina de São Domingos (ca. 650 inhabitants), a large derelict copper mine (ca. 450 ha), and the smaller village of Pomarão (ca. 50 inhabitants) (Fig. 1). It is located in an economically depressed region in southeast Portugal in a rural district that is one of the largest and least populated in the country. The villages have mostly an aged and unqualified population with low purchasing power. The abandoned mine has been closed for more than 40 years and continues to be a large and unsolved environmental problem, especially due to acid mine drainage.

EDM, S.A., a Portuguese public company, is responsible for the environmental rehabilitation of the mine and this process was initiated in 2005 but is currently suspended with most of the work still to be executed, mainly due to financial limitations and underlying divergences between stakeholders on the potential uses for the post-mining landscape (Milheiras et al., 2012). This paper is part of an ongoing research REHMINE project that principally intends to identify the environmental, social and economic potential values induced by the redevelopment of the SDM when conducted in accordance with sustainability principles. Furthermore, the project aims to contribute to the improvement of the knowledge field on the decision making processes in the planning and assessment of local SD of rural brownfields.

4. Methods

The research is based on four main methodological tasks: mapping of stakeholders in the SDM redevelopment process; consultation of stakeholders through semi-structured interviews; interview content analysis; and the integration of the results with the six dimensions extracted from prior literature, which were also validated by a participative process. An inclusive view of stakeholders was used, considering a stakeholder as any group or individual who directly or indirectly influences or is influenced by the redevelopment process (Freeman, 1984; in Mitchel et al., 1997). Assuming that 'who really counts' in a participated planning or decision making process will depend on the importance attributed to each social actor (Mitchell et al., 1997) a snowball sampling procedure was used to identify relevant stakeholders for SDM redevelopment. This method is a nonprobability sampling

Table 1
Sustainability dimensions for brownfields regeneration.

Framework identification			Sustainability dimensions					
Authors	Description	Notes	Environmental	Cultural	Social	Economic	Communitarian	Strategic
EPA, 1999	Parameters, elements and characteristics associated with sustainable brownfield redevelopment	Key elements related with sustainable brownfield redevelopment (developed to account economic, social and ecological parameters) Theoretical based			Environmental justice	Site marketing and redevelopment	Community profile Organization focus and structure	Comprehensive planning Site identification, characterization and prioritarization Technological applications Risk management Legal/regulatory issues Project funding
Nijkamp et al., 2002	Sustainable urban brownfield development qualitative impact model	Determinants for success of brownfield rehabilitation. Theoretical and empirically based (1 study case)	–	–	Accountability of the current owner	Finances	–	Legal regulations
Lange and McNeil, 2004	Influential factors in successful brownfield revitalization	Determinants for brownfield rehabilitation. Theoretical and empirically based (2 national surveys)	Environmental clean up levels	–	Land use Jobs	Infrastructure Time Cost	Community support	Political support Cooperative banking Financial incentives
RESCUE, 2005, Franz et al., 2006	Sustainable brownfield regeneration objectives	Sustainable brownfield regeneration objectives assumed by RESCUE project on the Sustainable Assessment Tool. Theoretical and empirically review (8 study cases)	Management of risk from contamination	Management and reuse of existing buildings	Improvement of societal acceptance	Generate and safeguard employment and economic development	Planning processes and methods for citizens participation	Integration into regional land management and urban development
Wedding and Crawford-Brown, 2007	Sustainable brownfield revitalization success indicators	Category of indicators considered in the Sustainable Brownfield Revitalization Tool. Theoretical and empirically based (survey experts)	Environment and health indicators	–	Livability indicators	Financial, social and economic indicators	[b]	–
Williams and Dair, 2007	Sustainable brownfield development framework	Sustainable objectives to meet in brownfield developments. Theoretical and empirically based (5 study cases)	Environmental sustainability objectives[a]	Social sustainability objectives[a]	Social sustainability objectives[a]	Economic sustainability objectives[a]	[b]	–
Worrall et al., 2009	Legacy mine land sustainability principles, criteria and indicators	Sustainability principles to legacy mine land. Theoretical and empirically based (1 study case)	Environmental principles	Socio-politic principles[a]	Socio-politic principles[a]	Economic principles	[b]	–
Schädler et al., 2011	Revitalization of large contaminated brownfields integrated assessment model	First order goals. Theoretical and empirically based (1 study case)	Preservation of nature and landscape Resource-conserving and emission reducing mobility management		High quality residential environment	Strengthening of local economy	[b]	Sustainable land management

(*continued on next page*)

Table 1 (*continued*)

Framework identification			Sustainability dimensions					
Authors	Description	Notes	Environmental	Cultural	Social	Economic	Communitarian	Strategic
SuRF-UK 2011	Sustainable remediation assessment indicators	Categories of indicators for sustainable remediation (developed to account environmental, social and economic dimensions) Theoretical based	Air Soil and ground Ground water Ecology Natural resources and waste	Neighborhood and locality	Human health and safety Ethics and equality Employment and employment capital	Direct economic costs and benefits Indirect economic costs and benefits Induced economic costs and benefits	Communities and community involvement	Uncertainty and evidence Project life-spam and flexibility

[a] Some expressions are repeated in the table to account for the multiple dimensions expressed in some expressions proposed by the cited authors.
[b] Authors note the importance of a communitarian dimension in brownfield revitalization or regeneration but do not propose it as a dimension in the framework developed by them.

Table 2
Sustainability framework for planning the redevelopment of the SDM rural brownfield with specific categories and respective number of stakeholders (*N*) and percentages referring to the category issue found by content analysis.

Dimension	Categories	*N*	%
Environmental reconversion	Environmental quality	27	69.2
	Landscape as space	16	41.0
	Biodiversity	5	12.8
Cultural regeneration	Social identity	27	69.2
	Landscape as a place	26	66.7
Social revalorization	Public safety	11	28.2
	Local livability	19	48.7
Economic revitalization	Multifunctional territory	17	43.6
	Driving economic activities: tourism	36	92.3
Community reinforcement	Empowerment	11	28.2
	Institutional responsibilities	20	51.3
Strategic reframing	Integrated planning	27	69.2
	Funding strategies	9	23.1
	Territorial competitiveness	32	82.1

technique that results from asking identified stakeholders to nominate other relevant actors (Goodman, 1961). Using this technique until saturation (that is to the point that new subjects in the sample don't add new relevant suggestions), 39 relevant stakeholders were identified and mapped according to 5 groups (Williams and Dair, 2007): 8 experts with particular knowledge of the site or of sites in similar processes; 10 regulatory entities (e.g., the governmental mining department); five local/regional interest groups (e.g., the heritage protection association); two large property owners (e.g., La Sabina, S.A.); and 14 end users (e.g., the local hunters association). The interviews focused on stakeholders' opinions about the current situation in the mine and their concerns, expectations and wishes surrounding how the redevelopment should be conducted. The 39 interviews were conducted from July 2010 to October 2011. All interviews were recorded and lasted an average of one hour each.

The analysis of the interviews follows the approach proposed by Flick (1998). Using the software MAXQDA, which is specifically written for qualitative data treatment, interviews were analyzed by the thematic content analysis technique anchored on the six main sustainability dimensions found in the literature (Table 1). Every fact, statement or idea presented in an autonomous way, was considered separately as a basic unit to permit the identification of thematic sets (categories) within the original 6 dimensions, refining the initial sustainability framework. The new categories were named in a way that also encapsulates the

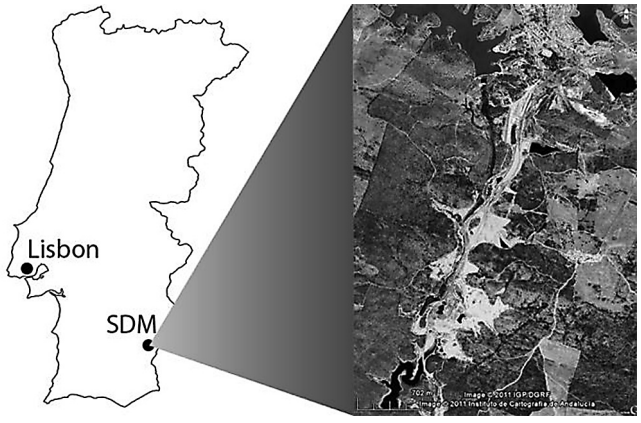

Fig. 1. São Domingos Mine (SDM), Portugal, with satellite image from Google Earth.

concepts and themes conveyed in the brownfield redevelopment or regeneration literature.

To validate the framework and ensure a balanced inclusion of the perspectives from institutional and informal stakeholders, 3 separate working sessions were organized: 2 community focus groups and an institutional stakeholder's workshop. A detailed description of that process can be found in Dias-Sardinha et al. (2011) and is beyond the scope of this paper.

5. Results

Based on the analysis of the interviews, 14 categories were identified and combined in the six dimensions previously determined, giving origin to a contextualized sustainability framework for planning the SDM rural brownfield redevelopment (Table 2).

The main statements that led to the creation of the 14 categories are presented below, as well as scientific references that support them as relevant within a sustainability framework for brownfield redevelopment.

5.1. Environmental reconversion dimension

In the *environmental reconversion dimension*, three main themes (categories) were identified in stakeholder discourses: environmental quality, landscape as space, and biodiversity. Contamination may be a defining feature of brownfields (e.g., Alker et al., 2000), making the issue of decontamination unavoidable in the regeneration of these types of sites (e.g., Castro-Gomes et al., 2012; RESCUE, 2005). In the SDM context, concerns about the environmental quality exist in parallel with a belief that the risk of contamination is currently contained within the mine "People do not have much notion, they are used to that, they were born in that, [for them] this is normal!" (interview A, end-user). Hence, respondents reported the presence of acid water as a danger leading to stream and soil contamination; soil contamination, erosion and deforestation; and diffuse pollution inherent in the use of mine tailings in road maintenance or the presence of open-air piles of ashes or slags. When rehabilitation measures were suggested, they were mainly related to water pollution control. Still, it was possible to capture some resistance to environmental measures, specifically if the mine-disrupted landscape is altered, leading to a loss of its tourism potential. As one officer put it' "The solutions found for the environmental recovery of that area must be able to promote the quality of life, and prevent the de-characterization of the industrial landscape" (interview B, regulatory entity).

This tension between remediation and a "valuable" landscape (landscape as space) was also found by Sklenička et al. (2004), for example, highlighting the need to consider the aesthetic and cultural values of the landscape.

Few participants referred to biodiversity issues. Still, some natural features of the site were mentioned:

> We have a very interesting species of flora here in São Domingos Mine which is a species of *Erica*, a species of heather *Erica Andevalensis* that is associated with areas with high concentration of heavy metals [...]. There are other values associated with the old mine structures, for example the birds: several species nest in those ruins. [Interview C, regulatory entity].

The need to protect biodiversity is also identified as an issue by Schädler et al. (2011).

5.2. Cultural regeneration dimension

The *cultural regeneration dimension* is characterized by two categories: social identity legacy and landscape as a place. The first has contradictory connotations in the SDM. A negative one is expressed when locals show a very present sense of loss in relation to what the mine was and the way the mine closure process was conducted by the owners (e.g., selling valuable assets, leaving wage debts, hampering the miners' housing situations):

> The loss of self-esteem and the degradation that has happened since the closure of the mine, everything that was important to the people came to be seen as of little importance and ... How can I explain … The detachment, the sorrow, the brutal anger of people in relation to the Mine for seeing degradation decade after decade, the lack of interests on the part of the State, on the part of the owner company, on the part of whoever. [Interview D, interest group]

A positive one is the community's strong connection to the mine, even when there is a continuous loss of mining-related memories and heritage, reinforcing the need to protect it. As a person put it "Trying to exploit the region's material heritage, but also probably there is a whole series of actions to be taken, it would be interesting to move forward with actions in the immaterial field, such as working in the memories of the community" (interview E, regulatory entity). The importance of both material and immaterial heritage was integrated in the category landscape as a place.

The cultural relevance of local industrial heritage and events are considered in RESCUE framework and in the goals proposed by Williams and Dair (2007). Additionally, the importance of heritage and the way it is perceived is combined with the concept of landscape as a place proposed by Healey (2000). Despite being conceptually distinct, one can note that the 2 cultural dimension categories are strongly connected. Ballesteros and Ramirez (2007) argue that the regeneration of industrial heritage depends greatly on how the issue is socially valued by the community, being considered a fundamental condition for the success of cultural touristic projects.

5.3. Social revalorization dimension

Concerns about public safety and local livability were associated with the *social revalorization dimension*. Despite the lack of full safety signaling in SDM, there are no records of accidents in the mining area, nor is there a demonstrated negative effect on locals' health (although this issue lacks research). Yet respondents favor better signaling and the study of the health impacts of the mine "Because you may be visiting and a wall may drop on top of you! I know the site's walls and over the years they are falling ... to rehabilitate the area or to secure [the area] is needed" (interview F, regulatory entity).

Unemployment, aging and territorial desertification are widely referred to as social challenges. In addition, poverty, drug addiction and alcoholism are sometimes pointed as consequences of the SDM's decline post-closure. This social context aids to the urban (dis)organization of the miners village, the lack of paved roads, some services, and green and public spaces hampering local livability. For many interviewees a redevelopment project should concern the social dimension "In my perspective, in addition to the environmental concerns, [there must be] a way to have an activity for people, to root younger population, or – like I already said – to give more support to the older population" (interview G, end-user).

Public safety and local livability conditions have also been considered elsewhere (e.g., RESCUE, 2005; Schädler et al., 2011; Williams and Dair, 2007) as integral parts of brownfield redevelopment. It is plausible to assume that these issues are likely to be more acute in rural settings where fewer resources are available to address them.

5.4. Economic revitalization dimension

The *economic revitalization dimension* is split in two main axes: multifunctional territory and driving economic activities. Interviewees generally mentioned tourism as relevant for local economic revitalization, assuming the SDM has a strong potential in that sector. In fact, tourism has been visibly increasing in the area, especially during the summer due to its water reservoirs, which are also a mining legacy. However, many interviewees stressed the insufficiency of tourism and the lack of private and public investment limiting tourism development. As one person expressed:

> Because all the restaurants, the food we have, the view we have, even the river beach... If we could meet all the conditions, with the trailer park, with a river beach that we already have, with the hotel and the lodges we have, or even the habitation tourism units that exist close by, it would be a good thing in terms of tourism. [Interview F, regulatory entity]

The use of existing heritage to boost tourism activity has been applied at different sites, such as Britannia in British Columbia, Canada (Meech et al., 2006) and at several sites of the RESCUE (2005) project, such as Nantes in France or Torfaen in the United Kingdom. Gómez (2010) has also made several suggestions in that direction for the Iberian Pyrite Belt region, where the SDM is located. It cannot be ignored, however, that despite the eventual role that heritage tourism can have in rural development, research shows that the results can sometimes be limited (Craveiro et al., 2013).

Many interviewees defend an economic revitalization that is not limited to tourism but also grounded in the expansion of other local and products. As a person put it':

> For example, the essential oils. Our vegetation is essentially aromatic. When I was a kid I thought that it was very cool to go the SDM and see that the cistus (wild bushes) were always trimmed like a hedge. It supported a very important local economy there. In the morning they came and cut the cistus to get the varnish, the oil, which had an important commercial value. [Interview H, end-users]

The importance of territorial multi-functionality in local development is defended by the works of Healey (2000, 2009) and addressed in several other brownfields redevelopment models (e.g., Schädler et al., 2011; Worrall et al., 2009).

5.5. Community reinforcement dimension

In the *community reinforcement dimension* two main categories were identified: empowerment and institutional responsibilities. Empowerment category gathers the ideas that concern the community's ability to self-organize and some interviewees spoke of a lack of coordination among local organizations as well as a need to boost local entrepreneurship and awareness about the mining and natural heritages. As one respondent put it':

> We had the distinct feeling that the key issue was indeed to motivate people of the Mine for their own commitment to the development of the territory. The motivation of the people for their development is halfway there. [Interview D, interest group]

It implies an increase in public participation and in this respect we can highlight proposed participative approaches such as those in Bleicher and Gross (2010) or Wedding and Crawford-Brown (2007), which also promote social cohesion, considered as fundamental to planning and achieving SD (Rydin and Holman, 2004).

The institutional responsibilities referred in the interviews are related to liability concerns and property rights, reflecting an aspect that is relevant for the SDM but can also be an issue in other rural brownfields (BC, 2008; NADO, 2001) and that is specifically problematic in abandoned mine areas (Worrall et al., 2009). At the SDM, responsibilities for the current situation are mainly attributed to the company's current owner that bought the old mining company assets (criticized for not investing enough in local development and even blocking it); the central and local administration (perceived as having acted improperly in the mine closure process, having contributed decisively to the years of institutional abandonment and being responsible for the environmental rehabilitation and administrators of the public space); the Serrão Martins Foundation (created for promoting local development in a cooperation between the municipality and the owner company, and whose actions are perceived to be insufficient); and the Guadiana Valley Natural Park, in which part of the old mine is located.

5.6. Strategic reframing dimension

Finally, three categories aggregate the issues from the *strategic reframing dimension*: integrated planning, funding strategies and territorial competitiveness. Stakeholders frequently referred to the lack of a strategy for local development and to some limitations of the current intervention from the local administration. There is interest in thinking of SDM development in an integrated way with the inclusion of all social actors in the process, giving an opportunity for fruitful synergies to be created:

> There is a need for investments so that the people who live there feel good about it and for the visitors don't only see the poor side, but also the positive side of that territory. Therefore there is a need of an action plan that aggregates investments in that direction, sustained in a real strategy not sustained by a political or a circumstantial strategy of a secretary of State or whatever. [Interview D, interest group]

This issue is related to the notion of strategic planning presented by Healey (2000, 2009) that emphasizes the need to understand the complexities and specificities of the local context to reach an effective integrated plan. In EPA (1999) framework there is a clear state for the importance of a well-structured, knowledgeable and locally grounded strategic dimension in all redevelopment phases.

Stakeholders referred to the need and the challenge of finding alternative funding sources due to the restricted investment capacity of the central and/or local administration. Funding availability is obviously one of the most important variables for achieving a successful brownfield regeneration (Lange and McNeil, 2004; RESCUE, 2005), especially in a rural brownfield with low market attractiveness (BC, 2008; NADO, 2001).

Some testimonies note privileged territorial affinities and connections based on close geographic areas like Algarve (south of Portugal), Spain, the Guadiana River, and the Iberian Pyrite Belt; on close institutions, e.g., the University of Évora or Guadiana Valley Natural Park; or on the particularities of the mining legacy, such as the miners village, the remains of industrial activity and the fluvial beach. This point to territorial competitiveness, a concept that can be related to Healey's works (2000; 2009) but is also highlighted in the approaches of Landel and Senil (2009) and Nieddu et al. (2009).

5.7. Discussing sustainable development in SDM

In sum, based on the analysis of the semi-structured interviews it was possible to identify 14 categories for action within the six sustainability dimensions, enhancing the contextualization of the SDM through a suitable "stakeholder's wish" redevelopment framework. Not all categories had the same expression among the different groups of stakeholders (see Table 2). Nevertheless, while

these variations are potentially interesting for this particular case, for the purposes of this paper all the issues mentioned were considered as equally relevant to the redevelopment of rural brownfields.

The main structure of the framework was presented first in a community focus group aimed at discussing and consolidating the diagnosis of the SDM's current state. The framework was also discussed in an institutional stakeholders' workshop aiming to promote dialog between different institutional entities and instigate shared reflections about ideas, concrete measures and projects for action. Finally, a second community focus group was scheduled, which included a reflection on the future of SDM that was structured in accordance with main framework issues and based on the results of the previous sessions. Detailed findings of that participative process are presented in Dias-Sardinha et al. (2011). It is interesting to note that the participation sessions opened public discussion about this research project on a social network (Facebook) and that the project's research team was subsequently sought for by the municipality to offer inputs for a document on territorial management and invited for 2 public events organized by stakeholders to discuss the redevelopment of SDM. With no intention to examine these actions in detail, one can associate them with the concept of social learning, introduced in the first section of this paper, and see them as modest evidence of its relevance.

6. Conclusion

The transposition of the concept of SD to concrete situations is indicated in the scientific literature as a key aspect of its potential achievement. Bleicher and Gross (2010) accounted for this situation by importing the concepts of operationalization and contextualization (Hartmuth et al., 2008) to the process of brownfield redevelopment. A modified approach from Bleicher and Gross (2010), supported by Healey's (2000) concept of "place making", was used here to develop a sustainability framework suitable to rural brownfields redevelopment. The approach consisted of a multi-stakeholder participative process, implying the combination of various knowledge systems and engendering conditions for a process of social learning able to integrate multiple place conceptions from stakeholders.

In sum, the contextualization of SD in the SDM case study allowed us to design a sustainability framework with dimensions and categories that were never presented in a common structure in spite of their presence in the extant literature. The chosen approach allowed us to validate the relevance of the 6 main dimensions, which has been shown to be suitable to comprehensively organize stakeholders' concerns. It has also permitted us to highlight challenging issues pertinent to the redevelopment of rural brownfields, namely the significant role of the community and its social identity legacy on the valorization of local cultural heritage for "place making"; the understanding that economic revitalization implies a strategy able to couple a multifunctional economy with a site's main potentialities (tourism in the SDM case); the importance of understanding territorial specificities to define a locally appropriate redevelopment strategy; and the importance of solving liability questions and institutional responsibilities when dealing with a rural brownfield. The operationalization of SD performed by linking stakeholders' perceptions to the concepts present in brownfield redevelopment and SD literature suggests that, when combined, those perceptions take into account a multitude of relevant issues consistent with sustainability principles.

Additionally, in the absence of market attractiveness, the redevelopment of a rural brownfield must be triggered by alternative aims and therefore needs to mobilize multiple agents and interests. One can suppose that conducting a participatory approach is context-dependent with specific issues. The present proposal accounts for that challenge by incorporating stakeholders' views in an early planning stage. The framework developed through this process is a first step for the combination of local and expert perspectives in the decision making process for the redevelopment of a brownfield area.

The ongoing work of REHMINE project is using the framework as the basis for reaching a participatory, locally based strategic redevelopment plan. The value of our approach is both in the method used to approach sustainability redevelopment issues and in having them all together within a framework that focuses on rural brownfields, allowing us to comprehensively address the particularities of such sites and thus enhancing the potential for sustainable (re)development locally. The participative process contributes to our understanding of existing perspectives about the value of the post-mining landscape. It also contributes to opening a dialog between entities and the inclusion of a hitherto excluded community in local development.

In the SD debate, there is a shared concern about the contribution of science to the actual building of sustainable communities. A continuous articulation of different knowledge areas and the interaction and negotiation between scientists, experts, and non-scientific actors, is indicated as being important to increase the potential achievements of local SD. We believe that the present proposal assumes this demand by tailoring the concept of SD to a particular challenging setting: the redevelopment of rural brownfields.

Acknowledgments

We thank all the 39 stakeholders that contributed with their knowledge, time and ideas to this study. We would also like to acknowledge Lucas Reijnders, Roque Amaro, Gavin Hilson, Paul Bardos and Pierre Menger for their incisive comments on the text. Finally, we are grateful to the three anonymous referees for their thoughtful observations.

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