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Modelo de construcción sostenible para la recuperación y protección de zonas medioambientalmente degradadas o frágiles: el Valle de Laciana

Lucía Maestro[1], Justo García[1]

La comarca de Laciana (León, España) está sensiblemente marcada por la actividad minera, que fue motor de su economía durante las décadas de los 50 a los 80 del pasado siglo XX, y que ha dejado su huella y cicatrices en el paisaje lacianiego en forma de edificios e infraestructuras absolutamente en desuso.

En el marco de un proyecto de investigación del Plan Nacional I+D+i (2004-2007) y desde un planteamiento inspirado en los principios de la Construcción Sostenible, se ha pretendido como objetivo principal la protección, gestión y ordenación paisajística y del patrimonio edificado de la zona, así como el establecimiento de pautas para la adecuada gestión de futuras construcciones en clave de sostenibilidad, mediante intervenciones que fomenten las actividades adecuadas para el desarrollo económico y la revitalización social del territorio, al tiempo que se refuercen la identidad y la cultura propias de la comarca. Con todo ello, se ha obtenido un Modelo de Construcción Sostenible para una zona medioambientalmente deteriorada y frágil, como es el Valle de Laciana.

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Sustainable Construction Model for Rehabilitation and Protection of environmentally fragile and degraded areas: Laciana Valley

Modelo de Construcción Sostenible para la recuperación y protección de zonas medioambientalmente degradadas o frágiles: el Valle de Laciana

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ABSTRACT

Coal mining activity was the main source of income in the Laciana Valley region (León, Spain) from the 1950s to the 1980s. This mining activity has left fingerprints in the Laciana landscape, along with completely abandoned buildings and infrastructures.

Within the framework of the R&D Spanish National Plan Program (2004-2007) and the Sustainable Construction principles, a research project has been addressed, aiming protection, management, and landscape and built environment planning for this area, as main targets. At the same time, the establishment of guidelines for suitable and sustainable management of future constructions, by promoting activities adapted to the economic development and the social revitalization of the territory, is another aim.
By applying sustainable principles for regional planning to new activities, the region's identity and culture will be reinforced. In other words, a model of sustainable construction for an environmentally deteriorated and fragile area is to be pursued in Laciana Valley.

Key words: sustainable construction, mining landscape, built heritage.

RESUMEN

La comarca de Laciana (León, España) está sensiblemente marcada por la actividad minera, que fue motor de su economía durante las décadas de los 50 a los 80 del pasado siglo XX, y que ha dejado su huella y cicatrices en el paisaje lacianiego en forma de edificios e infraestructuras absolutamente en desuso.
En el marco de un proyecto de investigación del Plan Nacional I+D+i (2004-2007) y desde un planteamiento inspirado en los principios de la Construcción Sostenible, se ha pretendido como objetivo principal la protección, gestión y ordenación paisajística y del patrimonio edificado de la zona, así como el establecimiento de pautas para la adecuada gestión de futuras construcciones en clave de sostenibilidad, mediante intervenciones que fomenten las actividades adecuadas para el desarrollo económico y la revitalización social del territorio, al tiempo que se refuercen la identidad y la cultura propias de la comarca.
Con todo ello, se ha obtenido un Modelo de Construcción Sostenible para una zona medioambientalmente deteriorada y frágil, como es el Valle de Laciana.

Palabras clave: construcción sostenible, paisaje minero, patrimonio construido.

OBJECTIVES

WITHIN THE FRAMEWORK OF THE SUSTAINABLE CONSTRUCTION PRINCIPLES, A RESEARCH PROJECT HAS BEEN ADDRESSED, AIMING PROTECTION, MANAGEMENT, AND BUILT ENVIRONMENT PLANNING FOR THIS AREA..

SOCIETY

IMPLIED AGENTS
- Local/ regional public institutions
- Local associations
- Villablino inhabitants/ visitors
- Mining enterprises
- Research institutes/ Universities

ECONOMY

REVITALIZATION
- Built environment guidelines
- Building rehabilitation, reuse or disassembling
- New strategies/ Mining activity

ENVIRONMENT

LANDSCAPE MANAGEMENT
- Restoration
- Mining surroundings protection

LACIANA, A CASE STUDY

METHODOLOGY

Stage 1 Paper review
Data base elaboration

Stage 2 Data selection

Stage 3 Elaboration of the tendency indicators
Models

Stage 4 Model application/simulation

Stage 5 Building design & management. Standardization

RESULTS

➢ **Inventarization, built heritage cataloging**

E – Social housing
R – Coal waste disposal site / dumps
M – Coal mining site, facilities, mine openings/tunnels
CH – Shacks

E.G. ELEMENT M4, *Coal mining site and facilities, Bolsada*

➢ **DIMENSIONS of ANALYSIS**
- ❑ **SCOPE/ SUBJECT**
- ❑ **TYPE OF INDICATORS**
  - Action (*determinantes*)
  - Analytical (*analíticos*)

Option 1. Partial/ Whole integrated restauration, pursuing former stage
- Demolition/ Deconstruction
- Reutilization/ Material recycling/ Waste management
- Slope estabilization/ Dump treatments

Option 2. Partial/ Whole conservation of the parts of a compound element
- Reutilization/ Rehabilitation
- Development and Standard regulation: Built environment inventory for further or potential rehabilitation or reutilization

BUILDING MATERIALS AND PRODUCTS:
MATERIALS Safety, human health, durability, energy efficiency, environment protection, etc.
Material and product procedence/ Warranty a) Use 'in site' materials; b) Eco-labelling; c) Recycled and recyclable products
Equipment & machinery: Achieving Regulations
BUILDING TECHNOLOGIES, SYSTEMS OR PROCESSES:
ENVIRONMENTAL MANAGEMENT DURING THE BUILDING PROCESS
Addressing social & working affairs (hiring locals, etc.)
Health and sanitations at work
Working hours according to the surrounding environment
TECHNICAL-ECONOMIC ASPECTS
Land management
Energy: Renovable resources, efficiency, cogeneration
Rain water collection and recycling
Noises
POLLUTION (during the whole building life-cycle project)
PARTICULAR CASE: SHACKS (CHABOLOS)
DEVELOPMENT OF REFERENCE INVENTORIES
USERS' HEALTHY
ASSESSMENT AND MANAGEMENT SYSTEMS:
BUILDING CONSTRUCTION
ACHIEVING QUALITY MANAGEMENT STANDARDS
ENVIRONMENTAL CONTROL
BUILDING MAINTENANCE, ASSESMENT, REHABILITATION:
BUILDING PERFORMANCE AND MANAGEMENT
DEMOLITION / DECONSTRUCTION (BUILDING END OF USE)

CONCLUSIONS

In the case of mining valleys, the shortage of works and published papers demonstrates the difficulty in undertaking, from a scientific perspective, MULTI-CRITERIA PROJECTS aiming SUSTAINABLE MANAGEMENT of mining buildings and facilities, which remain as industrial heritage.

CATALOGING, CHARACTERIZATION AND GEOGRAPHICALLY REPRESENTATION (GIS) OF BUILDINGS, INFRASTRUCTURES AND SITE, ALONG WITH **SUSTAINABILITY INDICATOR LIST DEVELOPMENT**, ARE SHOWN AS POWERFUL TOOLS IN ORDER TO PROMOTE INTEGRATED INTERVENTIONS ON THESE NEW ELEMENTS WITHIN THE MINING VALLEY SCENARIO.

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Within the framework of the R&D Spanish National Plan Program (2004-2007) and the Sustainable Construction principles, a research project has been addressed, aiming protection, management, and landscape and built environment planning for this area, as main targets. At the same time, the establishment of guidelines for suitable and sustainable management of future constructions, by promoting activities adapted to the economic development and the social revitalization of the territory, is another aim.

By applying sustainable principles for regional planning to new activities, the region's identity and culture will be reinforced. In other words, a model of sustainable construction for an environmentally deteriorated and fragile area is to be pursued in Laciana Valley.

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1. Introduction. Laciana, a case study

Coal mining activity had been the main source of income of the region of Laciana (León, Spain) from the 1950s to the 1980s. Biosphere Reserve designation of the Valley of Laciana in 2003 has implied a step further towards the creation of a Great Cantabrian Biosphere Reserve in the north of Spain. In the reserve of the Laciana Valley, the local assemblies and associations try to combine efforts with the different administrations to promote economic reactivation of these areas, by means of incentives to projects or actions proposed by associations, companies and public or private institutions. Some of these actions include coal mining activities, since this sector has lately recovered strength in electric industry supply, as coal is being used as a source of raw materials.

The Spanish Ministry of Education and Science has subsidized a project titled "Sustainable Construction Model for Rehabilitation and Protection of environmentally fragile and degraded areas: Laciana Valley" (García Navarro et al., 2005-2007), which has developed a model following the sustainability criteria in construction, for buildings and existing infrastructures in this region.

2. Objectives

Within the framework of the R&D Spanish National Plan Program (2004-2007) and the Sustainable Construction principles, a research project has been addressed, aiming protection, management, and built environment planning for this area, as main targets. Rehabilitation, reuse or dissembling are options to be individually considered for each existing construction, and in the overall built environment. Landscape shall be considered another resource within the Laciana integrated management; therefore, restoration and mining surroundings protection must be also addressed.

At the same time, the establishment of guidelines for suitable and sustainable management of future constructions, by promoting activities adapted to the economic development and the social revitalization of the territory, is another aim.

Implied agents

Also difussion of the research and results among the implied agents was intended, in order to promote further development projects in the area:

- Villablino city council, and local and regional public institutions;
- Local associations/ Villablino inhabitants;
- Mining enterprises;
- Research institutes/ Universities.

3. Methodology

- **Stage 1**

Stage 1.1. Paper review/ Data base elaboration

A documentation compilation and bibliographical selection have been used; special attention has been placed in the study of projects, innovating techniques, reports, models, and their results on the subject.

Stage 1.2. Inventarization, built heritage cataloging

Simultaneously, a data base has been elaborated, including constructions, infrastructures and sites, which may exemplify the overall scenario in Laciana, or show solutions to be pursued in the mining valley. Interventions have been also inventoried, either if they need rehabilitation or not (Puche & Mazadiego, 1998).

Forms and reports are kept for each element. The analyzed elements were grouped into four main types:

E – Social housing

R – Coal waste disposal site / dumps

M – Coal mining site, facilities of extraction, including mine openings/tunnels

CH – Shacks

This information has been included in a data base (BdD), that allows to make specific queries on an element, while having and overall view of the remaining elements.

- **Stage 2 Supervision, data selection**

Firstly, all those elements of interest, derived from a mining operation area, were identified, characterized and implemented by GIS. This stage is a key point when addressing Territorial Integral Management Programs and Plans, as it allows visualization of a development strategy and promotion (Callegari, 2003; Sklenicka & Lhota, 2002), maximizing the territorial "carrying capacity" and minimizing impacts. Also constructive tipologies and building aspects have been analized, when dealing with buildings and facilities. The geographical representation allows complex analysis of the elements, the elaboration of reference indicators, and ultimately the decision-making (Gómez Delgado & Barredo, 2005; Márquez Domínguez, 2005).

Secondly, project proposals have been formulated, in order to incorporate those strategic guidelines, which allow the regional development, built environment reconsideration, and the landscape improvement. On the basis of environmental, social and economic criteria, regional and local municipality have been asked to highlight certain elements, to be reconsidered. These elements have been analyzed in deep, using reference indicators, and they are the basis for the models developed, in stage 3.

- **Stage 3 Elaboration of the tendency indicators/ Development and implementation of models**

A model has been developed in order to guide in the indicator selection and characterization process. Those selected indicators must evaluate state and tendency of the elements and processes found in the area, and will be another tool in the decision-making process. This proposal also intends to be applied in other areas, with similar problematics, or in fragile territories where the presence of certain economic activities and facilities may be threating.

As a result sustainable performance of the considered elements (including construction performance and management) may be periodically measured, in the valley and the surroundings.

In order to make an accurate selection of indicators, it is essential to identify all those affections, impacts or most significant weak points, taking place in the study case, as result of the economic activities. Current situation, in addition to social goals and other external aspects within the sustainability framework must be considered (Fernández Larrote, 2006; Piorr, 2003).

The proposed model considers on two main analysis dimensions (García Navarro et al., 2009):

- Scope/ Subject
- Type of indicator

  The proposal establishes two different types of indicators:

- **Action Indicators (*indicadores determinantes*)**, that recommend an energetic or transcendental performance on the territory. This action will take place to conserve or to eliminate the considered element.
- **Analytical indicators (*indicadores analíticos*),** that allow a holistic vision of the main lines to be developed in future interventions. Quantificating these indicators makes sense in those cases in which protection or rehabilitation have been stated, after applying other excluding indicators.

- **Stage 4 *Model application/simulation***

From the projects initially compiled, only the most significant ones have been selected in this stage for simulation. Villablino City council considerations have been crucial in the selection of projects. Some of the criteria include deficiencies in the local economic development and social necessities.

- **Stage 5 Design criteria formulation, standardization proposal, building management issues. Addressing demolition/deconstruction**

In this stage, constructions and sites are analyzed in depth, both in terms of performance and management, so that they may incorporate design and standardization criteria along with the sustainability aspects. Those criteria relating construction work management are highlighted.

Thus, all criteria have been classified according to the thematic lines, pointed out from the R&D Spanish National Plan Program (2004-2007), as follows:

a) Building materials and products

b) Technology, systems, construction processes

c) Evaluation Systems and Construction management

d) Maintenance, infrastructure and building assessment and rehabilitation

4. Results and Discussion

From previous analysis, the following points can be stated:

Conceptual scope of sustainable construction in mining valleys

The shortage of infrastructures in the valley becomes an opportunity to develop projects aiming potencial rehabilitation or reuse of existing constructions and mining sites.

Integrated Development Plans/ Land Planning Programs

Geographical Information Systems (GIS) have been outlined as a powerful tool, in order to implement simulations, and complete analysis of spatial attributes and scenarios with multiple variants (*see **Fig. 1***). In addition to elaborate proposals based on a detailed knowledge of a wide ranking of factors, GIS approach allows foreseeing resource sustainable management for future applications in planning processes and decision making.

Finance sources and implied agents

Lately, development programs and funds have reconsidered the main goals, as it has pointed out they should address more integrated actions, instead of exclusive concern on mining activity. Especially those actions, which make traditional uses compatible with contemporary uses (with or without tourist purposes) and new technologies, and may prevent from unemployment and population decrease in mining regions (Unzurrunzaga, 1984).

Some actions are reported in these fragile areas, when interventions in industrial sites or complexes are focused upon renovation or economic reconversion into modern enterprise centres/industrial facilities; they are called “enterprise zones” and aim to achieve economic development, so that building rehabilitation is just a consequence, not a goal to achieve (Martin Mateo, 1984). Technological institutes may offer research projects on new technologies, also using these locations.

Impulse given to a region is more effective when there is a direct involvement of local groups or associations (Colectivo Proyecto Arrayanes, 2004), since they have a true capacity to promote a more positive image of the future of the area. Local participation allows a more dynamic “impulse” and may engage the interest of research institutes and investors in order to develop proposals aiming social, economic and environmental aspects.

Environmental & mining resources. Tourism

Nowadays tourists demand activities and experiences interacting with the population and the surroundings of their destinations. Thus, cultural tourism is outlined as a more than appropriate rationale of revitalization for a territory, involving:

a. museum-oriented planning;
b. industrial routes and itineraries (Fernández y Guzmán Ramos, 2005 y 2004);
c. certain traditional activities not necessarily related to mining;
d. experiences dealing with the regional environmental resources.

Although there is a negative image of mining nowadays, there is social acceptance of mining parks, as an alternative source of employment and economic and social revitalization after mining activity closure or abandonment (GRUPO DE TRABAJO 29, 2006).

Nevertheless, tourism, when offered in many cases as a solution, does not solve all the problems of use and revaluation of built industrial heritage (Linarejos, 2002); Inadequate or poor management strategy can cause the investment to fail: final location of the thematic project and repeated topics has risen as possible causes of the lack of tourist attraction (GRUPO DE TRABAJO 29, 2006; Hughes, 2002).

Sustainability indicators setting

A guide has been developed to address selection and development of indicators; this guide may be used to analyze all the four types of elements reported in the area. It may be also used as a tool in the decision-making process of a project.

These indicators have been complemented with a series of indexes, which must be unique and specific for a territory. Nevertheless, this indicator set is a flexible list, and can be completed or modified, according to implied agents’ priorities, specific problems to be solved or models to be evaluated.

A complex nature is stated for most of the indicators used in the analysis of the indicador set proposal for the case study; which means, they rely on several variables. The relationship between each one of these variables and their influence on the global action depends on a number, called “correction technical coefficient”. The proposal includes some social-economic correction coefficients, which may vary the overall influence of an indicador. The numerical expression of these correction coefficients rely on a previous territory analysis and special circumstances, and must be stated in advance.

Model development in Laciana Valley

Finally, an element was selected for further research, one for each tipology (E, R, M, CH). Diagnosis of these elements is stated from the initial stages analysis, including units and

impact factors. These factors address all social, economic and environmental assessment.

So, the specific problems and needs for each element are pointed out. These issues have addressed the development of an intervention model.

All the model guidelines share the same structure:

A. Diagnosis methodoly and

B. Model development methodology

Although, they show singularities in the following issues:

C. Intervention models, considering the following aspects:

- Value and singularity criteria
- Conservancy criteria: current or potential threats, risks derived from human activities
- Legislation (Ley 1/2001; Ley 9/2005, etc.)

Specific interventions on parts of a compound element, or on the element as a whole, are established. As an example, type M element is shown below:

- Option 1. Partial/ Whole integrated restauration, pursuing former stage
  - Demolition/ Deconstruction
  - Reutilization/ Material recycling/ Waste management
  - Slope estabilization/ Dump treatments
- Option 2. Partial/ Whole conservation of the parts of a compound element
  - Reutilization/ Rehabilitation
  - Development and Standard regulation: Built environment inventory for further or potential rehabilitation or reutilization

Since several alternative and specific solutions may be proposed for the element, only the most appropriate ones are outlined. As for the M type, a classic solution for territory revitalization, could aim tourist adaptation of these sites, as an opportunity to emphasize mining activity importance, and to promote economic recovery (Orche, 2002; Wanhill, 2000).

Furthermore, combining certain elements, a more complex proposal may be highlighted, as follows:

- Social and cultural center – Multifunctional space used for great events;
- Industrial Site, where material reutilization and waste management may be addressed from a research perspective on applied new constructive Technologies, or coal waste disposal and reutilization.

In this sense, SIG implementation has allowed a complete analysis of spatial attributes for a practical aplication of the solutions mentioned above, so that a real project may be developed in the future in Laciana.

In addtion, a document has been developed to complement the cataloguing of type M and E elements, buildings or construction typologies. This document incorporates sustainable criteria for construction projects, and may be used for the administration or local autorities to regulate future projects in the mining region (Huete, 2001; IEA, 2001).

It emphasizes the incorporation of social criteria, specific considerations for shacks (*chabolos*), and the development of sustainable aspects in all construction life-cycle

stages, particularly demolition/ reconstruction, and building and demolition waste management (RCD), use of non hazard products or procedures, etc.

Again, administration and local autorities may incorporate these criteria on city and rural planning legal instruments, to promote sustainability aspects in future construction projects.

5. Conclusions

In the case of mining valleys, the shortage of works and published papers demonstrates the difficulty in undertaking, from a scientific perspective, and multi-criteria projects aiming sustainable management of mining buildings and facilities, which remain as industrial heritage (INCUNA, 2006).

In particular, a legal body shall be promoted by the regional administration, in order to protect mining facilities and prevent from robberies. Historical-Industrial Heritage body is currently the only organism that assumes some responsibility in order to protect and revaluate these elements (Benito del Pozo, 2002; Búrdalo, 2003).

Overall, dynamic and integrated performances should be entended, as a general goal. New elements may be included and characterize the mining landscape and the local identity. Cataloguing, characterizing and geographically representation, help to preserve all those places of interest. They highlight all the aspects and guidelines to be considered, when addressing Territorial Integral Management Programs and Plans in other related areas.

As a conclusion, we may say there are mechanisms enough to develop the mining regions, but projects are individualistic, and the management is inadequate.

For further research, a project should be addressed, in order to develop a methodology to monitor each indicador and to validate the procedure and the models set out. This recognition, in turn, allows this set of indicators to be used to assess other similar interventions or mining areas. prove serve to sustain the justification of its obtaining, recognition and effectiveness in other similar scopes of intervention (Bookstaller y Girardin, 2003).

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Figure 1. Example of inventory: Report on M4 *Coal mining site and facilities, Bolsada*, included in Access Database, linked to SIG.