Environmental Monitoring at the New Industrial Area of Sta Margarida, Portugal

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Abstract: There is a growing concern on environmental impacts resulted from construction activities. Environmental assessment is a tool for reviewing, monitoring, checking and evaluating environmental performance for the construction industry, has been advocated. In this communication, we report on the results obtained in the course of an environmental impact monitoring study requested by EMPET Tavira. Although there is a plethora of environmental assessment tools, most of them are not designed for construction. This paper presents the results of a detailed study of environmental impact monitoring (EIM) in Portugal. Water quality and noise impact were monitored in a network of 5 and 6 points respectively. Ambient air quality was monitored at two locations in the northern part of Tavira using diffusive passive samplers. Landscape, heritage and biological resources were also monitored. The results were compared with relevant limits of EU Environment Protect Agency standards for the environmental indicators monitored. The comparison showed that the monitored environmental indicators had very low values compared to the existing standards and accordingly, no violation of environmental quality standards is reported.

Key-words: Environmental impact assessment, industrial park, green construction, monitoring, water, noise, air pollution, Portugal.

1 Introduction

The construction industry plays a vital role in meeting the needs of society and enhancing the quality of life. However, the responsibility for ensuring construction activities and products consistent with environmental policies needs to be defined and good environmental practices through reduction of wastes need to be promoted. Indeed, construction is one of the major contributors to environmental problems.

Most of the resources consumed in construction sites may create adverse environmental effects [1]. As a result, the government has strongly promoted the certification with ISO 14001: environmental management systems. However, such certifications can only demonstrate contractors' commitment to environmental protection without any guarantee that any genuine environmental benefits can be reaped [2].

A comprehensive environmental assessment system can facilitate tracking and benchmarking of the performance, providing a tool for measuring any continuous improvement. The present work will discuss the design of a monitoring system, technical developments and data arising from it and the use of monitoring this data in assessing the consequences at natural resources and pollution risks. It will be estimated exposure both at the individual and population levels. It will be reviewed the environmental assessment tools for construction activities and it will be developed a set of indicators for monitoring the environmental performance in construction of the industrial park of Tavira.

As part of the planning to build the new industrial park of Tavira in the Sta Catarina area in the south of Portugal the EMPET has assigned the Centre on Spatial Research and Organizations (CIEO) to conduct a baseline Environmental Impact Assessment Monitoring (EIAM). The area of concern and the monitoring locations are shown in Fig. 1. Here, we report the results obtained in the ambient air quality, water quality and noise impact parts of the EIAM.

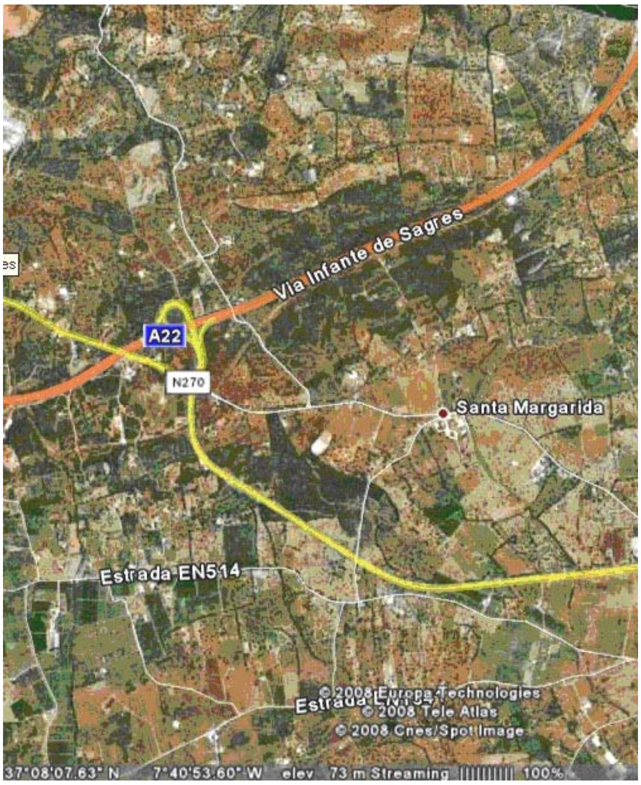

Figure 1-Location of the study area construction site of the Industrial area of Sta Margarida.

2 Review of environmental impact assessment tools

Environmental impact assessment (EIA) is a collective term for measurement and analysis of criteria, which are either having direct or indirect impacts on the environment [3]. EIA is being used globally as a planning and management tool, in order to minimise the harmful consequences of development. EIA has been broadly used in different business sectors. It can provide reliable, objective and verifiable information to the management about the achievement on the organisations' environmental objectives and targets, as well as fulfilling the legislative regulations regarding environmental protection. Its emphasis is on prevention and it is hence an example of the precautionary principle [4]. The results from EIA can also help in predicting the future trend in environmental-related development, which assist the management in designing suitable environmental strategies for the future projects [5].

Monitoring is the identification of actual impacts of the development action on the environment, is essential to verify the performance of the mitigation activities, compliance with regulatory standards, and the accurateness of the EIA predictions. The importance and benefits of monitoring the EIA process has been repeatedly highlighted in a wide range of literature [6,7,8,9,10]. According to Fairweather [11] monitoring is the "single action that could most improve impact assessment". The implementation of monitoring is the best mechanism to establish further checks on the later stages of the project cycle, otherwise money and time spent on the baseline studies and predictions are all useless unless there is some way of testing these predictions and determining whether mitigation methods will have to be applied.

Monitoring and auditing can play a vital role in making EIA an effective environmental management tool. Future development projects could be compared against similar developments carried out in the past which were subject to similar variables [12]. A resent study reported that of eight European countries studied, only Greece was found to take measures to strengthen EIA follow-up [13], and till now very few countries around the world had compulsory provisions for monitoring EIA [14]. For example the Commonwealth of Australia makes a requirement for EIA reports to contain a section on monitoring arrangements to ensure that mitigation is effective, but there are no provisions to compare monitoring results with predictions and in practice the monitoring of impacts is seldom carried out [10,15].

3 Methodology

From the many environmental descriptors monitored during the construction of the new industrial site of Sta Margarida it will be presented only three. Ambient air quality, water quality and noise impact were monitored seasonally, every three months and monthly respectively.

3.1 Monitoring Locations

The monitoring locations include the nearby highway, all major habitation groups and 5 wells The UTM coordinates and description are listed in Table 1.

3.2 Sampling Technique

Triplicate sets of outdoors diffusive passive samplers (IVL Swedish Environmental Research Institute Ltd - Gothenburg, Sweden) were used at two locations to measure concentrations of Benzene, NO, NO_2, SO_2, CO, NH_3, O_3 PM_{25} and PM_{10}. The samplers housed in PVC rain shelters were secured to existing structures or of temporary supports at 2m height. The meteorological conditions (wind velocity and direction, temperature, relative humidity and precipitation) were monitored using portable weather station.

Table 1-Locations of noise (S), water (W) and ambient air (A) quality monitoring.

Locat.	Longitude	Latitude	Description
A1	7º40´36´´	37º08´12´´	Air close to highway
A2	7º40´20´´	37º08´24´´	Air into construction
W1	7º40´23´´	37º08´02´´	Wellspring of Alamo
W2	7º40´17´´	37º08´12´´	Mine at well of Alamo
W3	7º40´48´´	37º08´07´´	Well in Sta Margarida
W4	7º40´38´´	37º08´28´´	Well in Fojo
W5	7º39´46´´	37º08´30´´	Well in Marmelos
S1	7º40´34´´	37º08´11´´	House in Southern limit
S2	7º40´32´´	37º08´10´´	Houses in Southern limit
S3	7º40´17´´	37º08´12´´	House in SE limit
S4	7º40´19´´	37º08´23´´	House in NE limit
S5	7º40´39´´	37º08´23´´	House in Northern limit
S6	7º40´45´´	37º08´14´´	Houses in Western limit

The noise equivalent level Leq was measured continuously at each of the 6 selected monitoring points using a precision integrated sound level meter RION model NA-27. The sound level meter was calibrated using calibrator Type RION model NC-74 giving a calibration level of 94 dBA with an accuracy of 0.1 dBA (fig. 2). The ‘A’ weighted network was used as it corresponds very closely to a person’s hearing sensitivity.

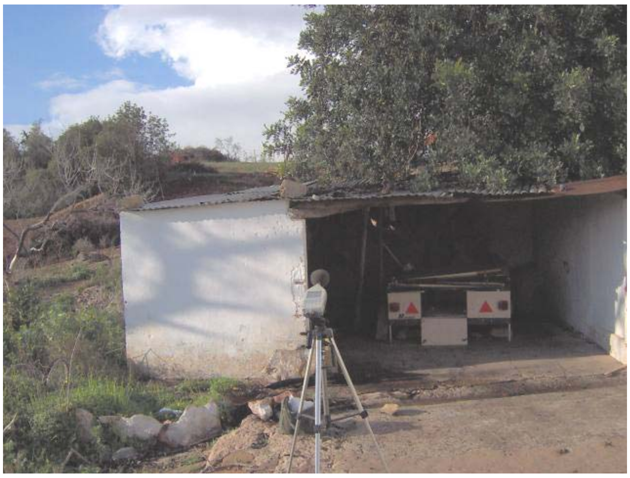

Figure 2-Measuring noise pollution at a rustic house area located close to the new industrial area of Sta Margarida construction site.

Continuous Leq measurement during day time (0700–2100 hr) was carried out close to residential areas of the new industrial site. The Leq results of each location were then used to calculate the Day noise level which is considered in this study as a descriptor of environmental noise.

Water was collected in sterilised samples and send for microbiological analyses. Hydrostatic level, pH, Electric conductivity, odour, colour, temperature and dissolved oxygen were measured in situ. Other water samples was sent for analyses of chlorites, phosphates, Sulphates, Nitrates, dissolved Iron (Fe), Copper (Cu), Manganese (Mn), Boron (B), Arsenic (As), Cadmium (Cd), Chromo (Cr), Lead (Pb), Mercury (Hg) and total pesticides.

4 Results

The results concentrations obtained for NO, NO_2, SO_2, CO, O_3 PM_{25} and PM_{10} are shown in Table 2 which lists the maximum, minimum and average concentrations detected by the passive samplers. Except for PM10 concentration at A1 and A2 locations was lower than permitted limits. PM10 concentrations are gradually reduced as we move towards the south away from the highway and transport activities.

Results for water quality show very low values compared to the existing standards (table 3). We had a problem with well 5 that dried out.

We measured noise pollution during day time only because the construction of the industrial site activity takes place exclusively at day time. The recommended limit values for noise differ from country to country [16, 17]. The World Health Organization (WHO) guideline values are arranged according to specific environments and critical health effects.

Table 2. The average, maximum and minimum concentrations measured in each location.

Parameter	Max	Loc	Min	Loc	Aver.
CO_2 (mg/m³)	725	A1	681	A2	703.00
CO(μg/m³)	380	A2	110	A1	245.00
SO_2 (μg/m³)	<100	A1	<100	A2	<100
NO_2 (μg/m³)	125	A1	102	A2	113.50
O_3 (μg/m³)	20	A2	19.6	A1	19.80
COV´s (μg/m³)	85	A1	75	A2	80.00
PM10 (mg/m³)	25.5	A2	20.6	A1	23.05
PM2.5 (mg/m³)	17	A1	14.8	A2	15.90
Temp. (ºC)	22	A1	22	A2	22.00
Rel.H. (%H)	45.1	A1	41	A2	43.05
Classification	Good		Good		

Table 3. Water measurements insitu.

Ref	Wate level	ElecCond	Temp	pH	Dis.Ox.	Dis.Ox.
Unit	m	µS/cm	ºC		mg/l	%
W1	-29.57	1141	19.8	6.86	7.37	80.8
W2	-6.10*	1669	19.5	6.84	4.45	49.2
W3	-15.58	1321	14.3	7.27	3.85	37.8
W4	-7.01	593	13.4	7.12	6.36	60.8
W5	Vazio	--	--	--	--	--

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According to the Portuguese legislation [18] the limit noise pollution for mixed zones is 65 dB during day. In Table 4 can be seen that the limit was not passed at any location at any time. A similar situation is observed at other sites [19]. In location S1 noise pollution overpass momentously the above limit due to the construction activity. The main cause of noise pollution in point S2 was excavation activities into the industrial site. In all other sites of measurements construction noise was very low and residual noise was from birds, dogs and road traffic.

Table 4. Noise measurements close to habitation areas around the industrial site.

Loc.	Time	L_{Aeq} Fast	L_{Aeq} Impl	L_{Aeq} (dB)
S1	10-10:30	63.2	67.3	63
S2	10-30-11	59.1	65.4	59.6
S3	11-11:30	48.9	53.7	50.5
S4	12:30-13	45.2	49.5	45.3
S5	12-12:30	46.5	50.2	46.5
S6	9-9:30	47.1	51.7	47.2

It has been observed that maximum percentage of areas southern part of the site fall under moderately to severe noisy conditions as compared to northern sites on the noise rating scale. Therefore, mitigation of noise pollution should be reinforced close to houses at the southern area with transplantations of large trees found at the cleared site. Noise attenuation measures should also be utilized in building design and construction [20]. This include reduction of total area of windows or other acoustically weaker building elements; sealing of 'leaks' around windows, doors and vents, improving their actual sound attenuating properties.

5 Conclusion

Regular reporting is considered to be an important aspect of environmental impact monitoring. It makes monitoring more accountable and easier to detect detrimental changes occurring because of the project and hence instigate mitigation measures. To assess the environmental performance of construction projects, it needs a systematic and objective assessment tool. However, most of the existing assessment methods are not designed for assessing construction activities.

The present environmental monitoring system has included thirteen indicators from which they were presented three. The results were compared with relevant limits of EU Environment Protect Agency standards. The comparison showed that the monitored environmental indicators had very low values compared to the existing standards and accordingly, no violation of environmental quality standards is reported for the construction of the industrial park of Sta Margarida. Another environmental monitoring indicator that is worth mentioning in the present article is landscape change (Fig. 3). The visual absorption capacity, landscape quality and sensitivity will be studied and mitigation measures of visual impact will be presented in a future article.

Figure 3-One of the most important environmental monitoring indicator at the industrial site development is landscape change of the Mediterranean policulture system.

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References

[1] Griffith A. *Environmental management in construction.* Macmillan, 1995.

[2] Tam, C.M., V.W.Y. Tam and W.S. Tsui. Green construction assessment for environmental management in the construction industry of Hong Kong. *International Journal of Project Management*, 22, 2004, pp. 563-571.

[3] Jasch C. Environmental performance evaluation and indicators. *Journal of Cleaner Product*, 8 (2000), 79–88.

[4] Glasson J. Environmental impact assessment: the next steps? *Built Environment* 20(4), 1995, pp. 277– 279.

[5] Li C.P. and I.K. Hui. Environmental impact evaluation model for industrial processes.

Environmental Management, 27, 2001, pp. 729–737.

[6] Arts J. *EIA follow-up on the role of ex post evaluation in environmental impact assessment.* Geo Press, Groningen, Netherlands, 1998.

[7] Canter L. The role of environmental management in responsible project management. *The Environmental Professional* 15, 1993, pp.76– 87.

[8] Glasson J. Life after the decision: the importance of monitoring in EIA. *Built Environment* 20(4), 1995, pp. 309– 320.

[9] Tomlinson P, Atkinson S.F. Environmental audits: a literature review. *Environmental Monitoring Assessment,* 8, 1987, pp. 187– 198.

[10] Wood G. Assessing techniques of assessment: post-development auditing of noise predictive schemes in environmental impact assessment. *Impact Assessment Project Appraisal* 17, 1999, pp. 217– 226.

[11] Fairweather P. Where is the science in EIA? *Search* 20(5), 1989, pp. 141-144.

[12] Malone N. Environmental impact monitoring. *Environ Planning Law Journal*, 14(3), 1997, pp. 222-238.

[13] Barker A, Wood CM. An evaluation of EIA system performance in eight EU countries. *Environmental Impact Assess Review*, 19, 1999, pp. 387- 404.

[14] Briffett C. Environmental impact assessment in East Asia. In: Petts J, editor. *Handbook of environmental impact assessment*, Blackwell Science, Oxford, UK, vol. 2, 1999, pp. 143-167.

[15] Wood G. Post-development auditing of EIA predictive techniques: a spatial analytical approach. *Journal of Environmental Planning* Managemend, 42(5), 1999, pp. 671–689.

[16] WHO (World Health Organization). *Guidelines for Community Noise*, WHO-expert task force meeting held in London, April, UK. 1999.

[17] Gottlob D. Regulation for community noise, *Noise/News International*, December 1995, pp. 223-236.

[18] Decreto Lei 9/2007 de 17 de Janeiro. Diario da Republica Portuguesa, Lisbon.

[19] Korfali S.I. and Massoud, M. Assessment of community noise problem in greater Beirut area, Lebanon. *Environmental Monitoring and Assessment* 84, 2003, pp. 203–218.

[20] Pandya G.H. Urban noise - A need for acoustic planning. *Environmental Monitoring and Assessment* 67, 2001, pp. 379–388.