International Research Journal of Environment Sciences E-ISSN 2319–1414
Vol. **5(11),** 56-64, November **(2016)** *Int. Res. J. Environment Sci.*

Review paper

Investigation of Proposed Infrastructure Developments in Beypore Port, using Rapid Impact Assessment Matrix (RIAM)

S. Praveen[1*] and J. Jegan[2]
[1]Department of Civil Engineering, Adithya Institute of Technology, Coimbatore, Tamil Nadu, India
[2]Department of Civil Engineering, University College of Engineering, Ramanathapuram, Tamil Nadu, India
praveensarvan@gmail.com

Available online at: www.isca.in, www.isca.me
Received 15th July 2016, revised 1st September 2016, accepted 6th November 2016

Abstract

This research illustrates the environmental impact assessment of Beypore port infrastructure developments in Calicut. It examines and presents a translucent atmosphere with various parameters and alternatives as a result of RIAM Analysis, which considers all major components as follows: (PC) Physiochemical, (BE) Bioecological, (SC) Sociocultural and (EO) Economical- Operational. These components are then evaluated using a collective criteria common to all direct and indirect impacts concern. The reviewed impacts will be scaled using RIAM analysis. This matrix will be applied to the environmental impact assessment for the planned infrastructure developments at Beypore Port area. It will be shown that the development of Beypore Port region will have a tremendous optimistic effect economically and socially but a modest pessimistic effect with respect to Physiochemical and Bioecological components.

Keywords: Environment, Impacts, Port, RIAM, Analysis.

Introduction

Human beings have always coexisted with water since evolution[1]. Hence, there has been a perpetual quest to develop and dominate coastal regions by humans. Environmental Impact Assessment (EIA) can be defined as the systematic identification and assessment of probable impacts of proposed projects, plans, programs or legislative actions relative to the physiochemical, bioecological, sociocultural and economical components of the total environment[2]. EIA's intended to make certain impending harms of projects reforested was addressed at premature stage in the scheduling and design process of projects[3]. In India, EIA was initiated in 1994 as a mandatory legislative requirement to protect and enhance the quality of the environment through license with setting of standards, coordination of research and dissemination of information to the public[4]. The construction of various structures for different purposes within the port limits of Beypore is not an exception and became more vital for an environmental clearance approval from the Government of India, Ministry of Forest, Environment and Climate Change.

Methodology

RIAM is a practice use to assess all kinds of environmental impacts[5]. It permits the accomplishment of skewed classifications vindicated for different analyzed items, resultant in a clear way inventory for following revaluations. As environmental impact assessments are the outcome of the effort of a interdisciplinary team[6], RIAM is the perfect method that assures the safety of a fast and obvious appraisal of main impacts. In addition all the parameters and components can simply be incorporated into solitary platform. The effects of the project activities are evaluated agreeing with the environmental components. Also for each clause a classification is determined (using the pre-defined criterion), which offers a likely impact measure for the components of the environment. The significance of the assessment criterion is classified in two groups: criteria relative to the degree of relevance of the condition and that individually can change the resultant classifications[7]. The approach adopted for this case study is based on the International Association for Impact Assessments (IAIA) guidelines.

Category A: criterion relative to the progress of the condition but is not able to alter the obtained classification individually.

Category B: The significance is assigned for each group of criteria and is found out by the use of a sequence of simple formulas.

Calculating the Environmental Score (ES): The sum of B category which values are multiplied by the product of the Category A to give a final appraisal score (ES) for the condition[4]. The process can be expressed by means of equations in (1), (2) and (3)

$$(A1) \times (A2) = AT \quad (1)$$

$$(B1) + (B2) + (B3) = BT \quad (2)$$

$$(AT) \times (BT) = ES \quad (3)$$

Where: (A1), (A2) = entity criteria scores for group (A), (B1), (B3) = entity criteria scores for group (B), AT = Result of products of all (A) scores, BT = Result of summation of all (B) scores, ES = the appraisal score for the condition.

Group (A) criteria: Significance of condition[8] (A1): It's quantifying the significance of the condition, which is measured in conjunction with the human interests or spatial boundaries. The levels are defined as given in Table-1.

Magnitude of Change (A2): It's determined the level of advantage of an impact. The levels are defined as given in Table-1.

Group (B) Criteria: Eternalness[9] (B1): This specifies whether a state is temporary or permanent as per the level given in Table-1.

Reversibility (B2): This specifies whether the result is reversible or not as per the level given in Table-1.

Cumulative (B3): It's a measure to find that whether the effect will have a express impact or whether there will be a communal effect over time along with other conditions which can be rated as given in Table-1.

Physiochemical (PC): It includes all physical and chemical aspects of the environment, comprising of non renewable natural resources (non-biological) and the physical environment degradation through pollution[10-13].

Bio-ecological (BE): It notifies all the biological aspects of the environment, counting renewable natural resources, and biodiversity conservation with species interaction and biosphere pollution.

Socio-cultural (SC): It includes all human aspects of the environment, as well as societal subjects that affect the individuals and the communities with artistic aspects. It includes the inheritance conservation and human development.

Economical/Operational (EO): An economic impact review examines how a proposed development will transform the lives of current and future populace of a community.

Table-1
Assessment criteria for RIAM analysis

Group	Category	Level	Description
A	(A1) Importance of condition	4	International Interests
		3	National Interests
		2	Out Side of Local Condition
		1	Local Interests
		0	Not Important
	(A2) Magnitude of change effect	3	Major Positive Changes
		2	Major Positive Changes
		1	Positive Changes
		0	No Changes/Status Quo
		-1	Negative Changes
		-2	Moderate Negative Changes
		-3	Major Negative Changes
B	(B1) Performance	1	No Change/Not Applicable
		2	Temporary
		3	Permanent
	(B2) Reversibility	1	No Change/Not Applicable
		2	Reversible
		3	Irreversible
	(B3) Cumulative	1	No Change/Not Applicable
		2	Non Cumulative/Single
		3	Cumulative/Synergistic

Study Area and Data Collection: The proposed development in the Beypore port is located on the south west coast of India (latitude 11° 10' 0" N and longitude 75° 47' 59" E), It is located near the Chaliyar river mouth which discharges to the Arabian Sea. Beypore was well known for its crafting of huge wooden boats called "Uru". The area was also well known for spices and was a major stop on the old "Silk Route" to Mesopotamia. Kozhikode, a busy district town in Kerala is commercially well known to be an important trade centre for textiles, steel, timber products, seafood processing and tile manufacturing. Beypore has port facilities in terms of berthing wharves where small to moderate vessels operate. The traffic from mainland operates to and from Lakshadweep Islands through Beypore port. The traffic from Lakshadweep forms approximately 50% of the total of the traffic through Beypore port. The proposed developments will be constructed as a northern extension to the existing port, east of the existing fishing harbor. The location is well connected by road, rail, air and water. It is located at a distance of 10 km by road from Calicut railway station, 20 km from Kozhikode airport. Kadalundi bird sanctuary is situated at an aerial distance of 4.2 km from the proposed project site.

A spot investigation was carried out at the planned area for the Beypore port development. Essential data requisite for assessing the environmental impacts are as obtained from the website http://environmentclearance.nic.in/. The procedure involves gathering of data and information in accordance with the guidelines from the current sources of data from the Ministry of Forest, Environment and Climate Change. Principal survey included a opinion poll survey with the people living near the port site[14], Added stakeholders were also taken into account. Based on the questionnaire survey carried out among the native people living in and around Beypore port area, various information were gathered about the air quality, health aspects, ground water and surface water. The quality control information was obtained from the resultant data. Examination of the collected water samples showed that the ground water and surface water are in the vicinity was of low quality.

Results and Discussion

Significances of RIAM: The relevant physiochemical components taken for the review were air quality, noise level, surface water quality, climate, vibration, land-use/reclamation, water quality, soil condition, sewage facility, de-silting, water logging etc., They were intended from the secondary data. Economic and social elements included employment opportunities, enhancement in socioeconomic development, ecotourism, cultural development etc. They were assessed and assigned a score centered on the questionnaire survey conducted[15]. The assessment and evaluation of impacts attributable to each of the tasks considered in the EIA study were captured under these three stages. The manner in which this was done is summarized as follows.

The RIAM process was worn to "quantify" the predictable project impacts as well as proposed mitigation measures, for the following phases: i. Existing with baseline conditions, ii. On project construction phase, iii. On project operation phase.

The results of the application of the RIAM method to the various EIA tasks are summarized in Tables-2 to 17.

Table-2
Range bands used in RIAM

ES	Range Value (RV)	Range Score(RVN)	Description of Range
108 to 72	E	5	Major positive impact
71 to 36	D	4	Significant positive impact
35 to 19	C	3	Moderate positive impact
18 to 10	B	2	Positive impact
1 to 9	A	1	Slight positive impact
0	N	0	No change
-1 to -9	-A	-1	Slight negative impact
-10 to -18	-B	-2	Negative impact
-19 to -35	-C	-3	Moderate negative impact
-36 to -71	-D	-4	Significant negative impact
-72 to -108	-E	-5	Major negative impact

Table-3
RIAM analysis of PC components in baseline conditions

Code	(PC) Components	ES	RV	A1	A2	B1	B2	B3
PC1	Ground water	-8	-A	2	-1	2	1	1
PC2	Ecology	0	N	3	0	2	1	1
PC3	Avifauna General	0	N	3	0	1	1	1
PC4	Emissions	0	N	0	-1	1	1	3
PC5	Landscape change	0	N	0	-1	1	1	3
PC6	Noise	-12	-B	2	-1	1	2	3
PC7	Water Disposal	-12	-B	2	-1	1	2	3
PC8	Air quality	-15	-B	3	-1	1	1	3
PC9	Dust	-32	-C	2	-2	3	2	3
PC10	Climate change	0	N	3	0	1	1	2
PC11	Lightning/s ky Glow	0	N	2	0	1	1	1

Table-4
RIAM analysis of BE components in baseline conditions

Code	(BE) Components	ES	RV	A1	A2	B1	B2	B3
BE 1	Effect on water table	0	N	0	-1	2	1	2
BE 2	Effect on soli	0	N	1	0	2	2	1
BE 3	Soil erosion	-6	-A	1	-1	1	2	3
BE 4	Effect on Biots	-6	-A	2	-1	1	1	1
BE 5	Damage of Habitats	0	N	2	0	1	1	3
BE 6	Effect on Ecosystem	0	N	0	-1	2	1	3
BE 7	Decomposition of waste	-18	-B	3	-1	1	2	3
BE 8	Bio accumulation	0	N	2	0	1	1	1
BE 9	Population of Species	0	N	2	0	1	1	2

Table-5
RIAM Analysis of SC components in baseline conditions

Code	(SC) Components	ES	RV	A1	A2	B1	B2	B3
SC 1	Land use	0	N	0	-1	2	2	1
SC 2	Community development	21	C	3	1	2	2	3
SC 3	Public perception	28	C	2	2	2	2	3
SC 4	Heritage/historical change	28	C	2	2	3	3	1
SC 5	Dust	0	N	0	-1	2	2	3

Table-6
RIAM Analysis of EO components in baseline conditions

Code	(EC) Components	ES	RV	A1	A2	B1	B2	B3
EO 1	Employment and Income	42	D	2	3	2	2	3
EO 2	Traffic on Land	0	N	0	2	2	2	3
EO 3	Traffic on Marine	0	N	0	1	2	2	3
EO 4	Emissions	0	N	2	0	2	2	1
EO 5	Transhipment Capacity	0	N	3	0	2	2	3
EO 6	Fishing Community	-14	-B	2	-1	3	3	1

Table-7
RIAM Analysis of PC Components during Constructions

Code	(PC) Components	ES	RV	A1	A2	B1	B2	B3
PC 1	Site preparation	0	N	0	0	1	1	1
PC 2	Demolition activities	0	N	0	0	0	0	0
PC 3	Construction	0	N	2	0	1	1	1
PC 4	Shoreline stability	-24	-C	3	-1	3	2	3
PC 5	Wave reflections	-8	-A	1	-1	3	3	2
PC 6	Current regime	0	N	0	0	1	1	1
PC 7	Dredging	0	N	2	0	1	1	1
PC 8	Heavy metals/ scrape	0	N	2	0	1	1	1
PC 9	Gaseous emission	-24	-C	2	-2	2	2	2
PC 10	Noise	-7	-A	1	-1	2	2	3
PC 11	Solid waste management	-7	-A	1	-1	2	2	3

Table-8
RIAM analysis of BE components during constructions

Code	(BE) Components	ES	RV	A1	A2	B1	B2	B3
BE 1	Impacts on biota & habitats	-8	-A	1	-1	3	2	3
BE 2	Terrestrial (Avifauna)	-4	-A	1	-1	1	1	2
BE 3	Potential for accidental releases	-28	-C	2	-2	2	2	3
BE 4	Impacts on local biodiversity	-54	-D	2	-3	3	3	3

Table-9
RIAM analysis of SC components during constructions

Code	SC) Components	ES	RV	A1	A2	B1	B2	B3
SC 1	Land use	48	D	3	2	3	3	2
SC 2	Community development	0	N	3	0	1	1	1
SC 3	Public safety	0	N	3	0	1	1	1
SC 4	Human health	0	N	3	0	1	1	1
SC 5	Public perception	-48	-D	3	-2	3	2	3

Table-10
RIAM analysis of EO components during constructions

CODE	(EC) Components	ES	RV	A1	A2	B1	B2	B3
EO 1	Employment and income	21	-C	3	1	2	2	3
EO 2	Traffic on land	-12	-B	2	-1	2	2	2
EO 3	Traffic on marine	42	D	3	2	2	2	3
EO 4	Emissions	-12	-B	2	-1	1	2	3
EO 5	Transhipment capacity	0	N	4	0	1	1	1
EO 6	Fishing community	-54	-C	2	-3	3	3	3

Table-11
RIAM analysis of PC components after constructions

Code	(PC) Components	ES	RV	A1	A2	B1	B2	B3
PC	Shoreline stability	-72	-E	3	-3	3	2	3
PC	Wave reflections	-8	-A	1	-1	3	3	2
PC	Current regime	-18	-B	2	-1	3	3	3
PC	Marine water quality impacts	-14	-B	2	-1	2	2	3
PC	Gaseous emissions	-6	-A	1	-1	2	2	2
PC	Noise	-6	-A	1	-1	2	2	2
PC	Solid waste management	-7	-A	1	-1	2	2	3

Table-12
RIAM analysis of BE components after constructions

Code	(BE) Components	ES	RV	A1	A2	B1	B2	B3
BE 1	Impacts on biota & habitats	-27	-C	1	-3	3	3	3
BE 2	Terrestrial (Avifauna)	-8	-A	1	-1	3	3	2
BE 3	Potential for accidental releases	-28	-C	2	-2	2	2	3
BE 4	Impacts on local biodiversity	-54	-D	3	-3	3	3	3

Table-13

RIAM analysis of SC components after constructions

Code	(BE) Components	ES	RV	A1	A2	B1	B2	B3
SC 1	Land use	81	E	3	3	3	3	3
SC 2	Community development	16	B	2	1	3	2	3
SC 3	Public perception	30	C	2	3	3	1	1
SC 4	Heritage/historical site	-24	-C	3	-1	3	2	3

Table-14
RIAM analysis of EO components after constructions

CODE	(EC) Components	ES	RV	A1	A2	B1	B2	B3
EO 1	Employment and income	54	D	3	2	3	3	3
EO 2	Traffic on land	12	B	2	1	3	1	2
EO 3	Traffic on marine	84	E	4	3	3	1	3
EO 4	Transhipment earnings	84	E	4	3	3	1	3
EO 5	Fishing community	-48	-D	2	-3	3	2	3

Table-15
Summary of RIAM analysis for baseline conditions

ES Range	-108	-71	-35	-18	-9	0	1	10	19	36	72
	-72	-36	-19	-10	-1	0	9	18	35	71	108
Class/RV	-E	-D	-C	-B	-A	N	A	B	C	D	E
PC	0	0	1	3	1	6	0	0	0	0	0
BE	0	0	0	1	2	6	0	0	0	0	0
SC	0	0	0	0	0	2	0	0	3	0	0
EO	0	0	0	1	0	4	0	0	0	1	0
Total	0	0	1	5	3	18	0	0	3	1	0

Table-16
Summary of RIAM analysis for construction stage

ES Range	-108	-71	-35	-18	-9	0	1	10	19	36	72
	-72	-36	-19	-10	-1	0	9	18	35	71	108
Class/RV	-E	-D	-C	-B	-A	N	A	B	C	D	E
PC	0	0	2	0	3	6	0	0	0	0	0
BE	0	1	1	0	2	0	0	0	0	0	0
SC	0	1	0	0	0	3	0	0	0	1	0
EO	0	0	2	2	0	1	0	0	0	1	0
Total	0	2	5	2	5	10	0	0	0	2	0

Table-17
Summary of RIAM analysis for operating stage

ES Range	-108	-71	-35	-18	-9	0	1	10	19	36	72
	-72	-36	-19	-10	-1	0	9	18	35	71	108
Class/RV	-E	-D	-C	-B	-A	N	A	B	C	D	E
PC	1	0	0	2	4	0	0	0	0	0	0
BE	0	1	2	0	1	0	0	0	0	0	0
SC	0	0	1	0	0	0	0	1	1	0	1
EO	0	1	0	0	0	0	0	1	0	1	2
Total	1	2	3	2	5	0	0	2	1	1	3

Summary of RIAM: The proposed project and its impact on different platforms are analysed by placing the environmental factors as a reference. For each factor, by using a predefined criteria a score is calculated. This gives an overall idea of the impact anticipated from the component. The resultant value obtained for each of the criteria and the environmental score, corresponding range values are plotted for all three phases as given in the line chart shown in the Figures-1,2,3. From the results it can be observed that physcial and chemcial components are increasing rapidly during the construction and operation stage due to the impacts of the materials usage and process adopted to the proposed devlopment. For base line conditions it results in biological components, due to the proposed infrastructure developments across the coastal riverine area. It also affects the surviving of the bilogical habitats across the chaliyar river.

Conclusion

Rapid Impact Assessment Matrix (RIAM) investigation was carried out for assessing the environmental impacts of the proposed Beypore port expansion and infrastructure development projects along the coastal area of Beypore, Chaliyar River in Calicut, India. Conclusively, the assessment shows that the development of Beypore coastal region will have an extreme optimistic effect economically and socially but a moderate pessimistic effect with respect to the Physiochemical (PC) and Bioecological (BE) components using RIAM evaluation analysis. Contrastingly, there is a majority of negative impacts due to the developments, although positive impacts will occur. Most negative impacts relate to physiochemical, biological, ecological and cultural issues but positive effects relate to the economic and social aspects. Hence it is evident that these developments will bring economic and social developments and on the other hand it leads to environmental degradation. The pessimistic impacts can be minimized by adopting an efficient environmental management plan with proper resettlement and rehabilitation scheme for the fisheries sector which includes mitigation measures for improving the socioeconomic profile of the planned site area.

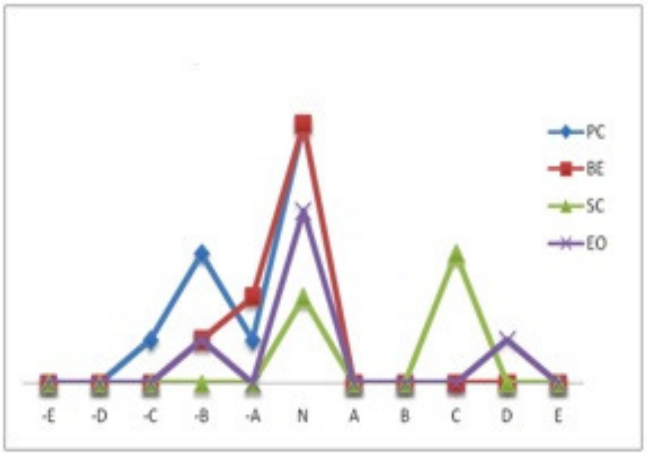

Figure-1
Summary of RIAM analysis for baseline conditions

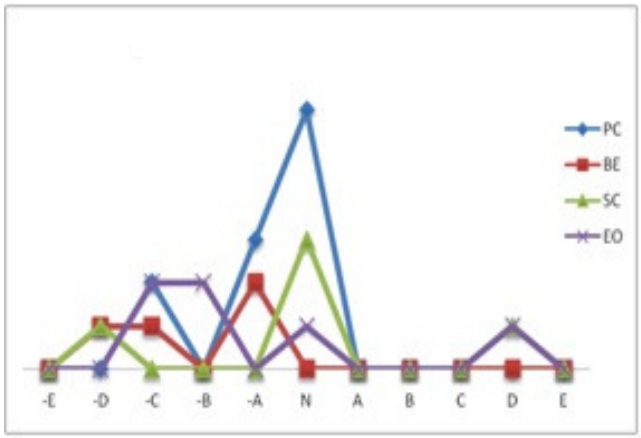

Figure-2
Summary of RIAM analysis for construction stage

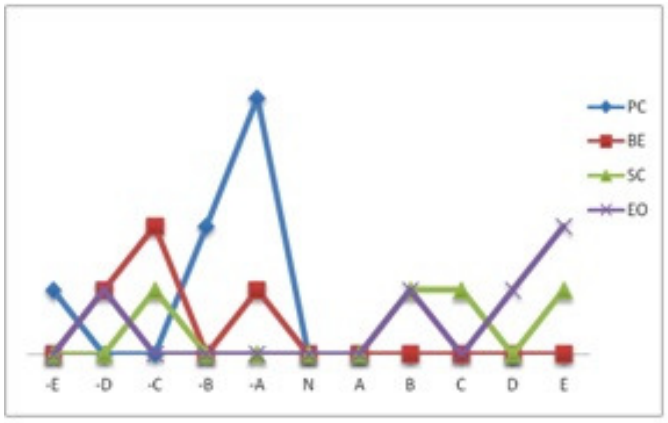

Figure-3
Summary of RIAM analysis for operation stage

References

1. Abdullahi Muhammad Abba, Aji A. Bukar and Amina Gimba (2016). Environmental Impacts on Coastal Development in Penang, Malaysia Using Rapid Impact Assessment Matrix. Proceedings of the Academic Conference of Nightingale Publications & Research International on Sustainable Development, Federal University of Technology, Minna, Education Resource Centre Conference Hall, Niger State, Nigeria. March 31, 2(1), 1-12.

2. Bindhu B.K., Mohan S. and Shibu K. (2012). RIAM – An Effective Tool for Rapid Environmental Impact Assessment - A Case Study. 2012.

3. Bisset R. (1998). Developments in EIA Methods Environmental Impact Assessment - Theory and Practice. Unwin Hyman.

4. Canter L.W. (1996). Environmental Impact Assessment. McGraw-Hill Inc, Singapore.

5. John Glasson, Riki Therivel and Andrew Chadwick (2005). Introduction to Environmental Impact Assessment. Third Edition, the Natural and Built Environment Series, Rutledge, Abingdon, 2005.

6. Guillemo Espinoza and Barabara Richards (2002). Fundamentals of Environmental Impact Assessment. Trainers' Course on Environmental Management and Assessment for Investment Projects, 2002.

7. Hacking (2008). Assessment of Environmental Impacts in Coastal Regions of Malaysia. Environmental Impact *Assessment Review*, 28(2), 73-89.

8. Lawrence D.P. (1997). The Need for EIA Theory-Building. *Environmental Impact Assessments Review*, 17, 79-107.

9. Ogunba A. Oluseguti (2004). EIA Systems in Nigeria: Evolution, Current Practice and Shortcomings. *Environmental Impact Assessment Review*, 24(6), 643- 660, http://dx.doi.org/10.1016/j.eiar.2003.10.019.

10. Pastakia C.M. (1998). The Rapid Impact Assessment Matrix (RIAM) - A New Tool for Environmental Impact Assessment. Environmental Impact Assessment Using the Rapid Impact Assessment Matrix (RIAM), Olsen & Olsen, Fredensborg, Denmark.

11. Pope Jenny, Annandale David and A. Morrison-Saunders (2004). Conceptualizing Sustainable Development Assessment. *Environmental Impact Assessment Review,* 24(6), 595-616, http://dx.doi.org/10.1016/j.eiar.2004.03.001

12. Gabriel Dan Suditu and Brindusa Mihaela Robu Sluser (2012). Digitization of the Environmental Impact Quantification Process. *Environmental Engineering and Management Journal*, 11(4), 841-848.

13. Sarvamangala Praveena, SitiShapor Siraj, Ahmad Kimon Suleiman and Ahmad Zaharin Aris (2011). A Brush up on Water Quality Studies of Port Dickson, Malaysia. *Research Journal of Environmental Sciences*, 5(12), 841-849, http://dx.doi.org/10.3923/rjes.2011.841.849

14. Verheem R. (1992). Environmental Assessment at the Strategic Level in the Netherlands. *Project Appraisal*, 7(3), 150-156.

15. Wilkins H. (2003). The Need for Subjectivity in EIA: Discourse as a Tool for Sustainable Development. *Environmental Impact Assessment Review*, 23(4) 401-414, http://dx.doi.org/10.1016/S0195-9255(03)00044-1