**Managing uncertainties through scenario analysis in strategic environmental assessment**

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**Abstract**

Planning for the future is uncertain, and scenario analysis is a method of coping with the uncertainties of future plans. This paper addresses how to deal with future uncertainties by using scenario analysis as a possible approach for conducting a strategic environmental assessment (SEA). Though scenario-based approaches have been linked to strategic planning and SEA, this paper for the first time proposes how a combined approach may be implemented using specific tools and methodologies and further on it also implements the first three stages of the six stages proposed for the ‘scenario-based strategic planning’ approach. This work is an attempt to standardize SEA and scenario analysis as a combined approach. The three stages are tested within the Tourism Development Plan of the Iranian province of Gilan, which has been selected as a case study.

**Keywords:** tourism planning; strategic environmental assessment (SEA); scenario analysis; sustainable tourism; Iran

1. Introduction

In this paper, we explore how scenario analysis as a method can be used for strategic environmental assessment (SEA) when dealing with uncertainties. Scenario analysis can be defined as a method for developing possible futures in order to deal with uncertainty (Chermack and Lynham 2002; Tapinos 2012; Schoemaker 1995; Schwenker and Wulf 2013). Since the future is inherently uncertain (Zhu et al. 2011; Larsen et al. 2013; Cardenas and Halman 2016), all predictions into the future need to cope with uncertainties. The main task of SEA is to identify and predict significant impacts of policies, plans and programmes on the environment and on other aspects of sustainability, as well as to provide appropriate prevention and mitigation measures (Duinker and Greig 2007; Therival 2004). SEA further provides for a systematic decision support process which aims to add scientific rigour, transparency and a participative approach to decision-making (Fischer 2007). Essentially, SEA is a futuring exercise with uncertainty as an inherent component within it (Zhu et al. 2011). Besides, environmental problems themselves may be characterized by complex relationships, limited knowledge and a high level of uncertainty, offering a platform where scenario analysis may deliver useful insights (Vuuren et al. 2012). The focus of scenario analysis is not to look into the most likely development but to consider different possible developments under key assumptions (‘What if…’?) (Vuuren et al. 2012). Similarly, in dealing with uncertainties, SEA needs to analyze the impacts of different possible alternatives (Fischer 2007). By extrapolating predictions, scenario-based methods have the potential to help SEA to handle uncertainties within possible options into the future that have otherwise been overlooked (Zhu et al. 2011; Bond et al. 2015). Therefore, it makes sense to bring together these complementary decision-aiding approaches in enhancing the role of SEA in considering environmental uncertainties.

Scenario-based strategic planning is a new tool-based approach in scenario analysis (Schwenker and Wulf 2013). This paper contributes in this emerging area in two ways. First, it proposes a combined approach of how SEA can be implemented based on scenario analysis. This has been mainly inspired by Schwenker and Wulf’s work (2013) on scenario analysis for strategic planning. Secondly, it tests out the first three stages of this proposed approach. In doing so, the Tourism Development Plan within the Iranian province of Gilan has been selected as a case study. In the first stage, factors that would shape the future development of tourism in Gilan are identified. In the second stage, these factors are prioritized according to their importance and degree of uncertainty. In the light of key uncertainties, four tourism scenarios are developed in the third stage. Though the last three stages have not been implemented in this research, we provide an overview to enable understanding of what they would entail. Therefore, the fourth stage should suggest mitigation options for each of the four scenarios, while the fifth stage should assess the strategic options for all scenarios. Finally, the sixth stage should benchmark the scenarios against real-world developments through ongoing monitoring.

The paper is structured into five sections. First, the context of this research is set, followed by the methodology. The third section presents the findings of implementing the three stages of scenario-based SEA. In the fourth section, the challenges and merits of using such an approach are discussed and, finally, overall conclusions are drawn.

*1.1. Setting the context for SEA: Scenario analysis as a combined approach*

*1.1.1. SEA and tourism planning*

Environmental assessment (EA) can help in avoiding, reducing or mitigating negative impacts at all levels of decision-making. SEA is used for environmental evaluations at a strategic level, such as environmental assessment of a policy, plan or programme (Ramos et al. 2015). Environmental impact assessment (EIA), in contrast, is used for environmental evaluations at project level (Morgan 2012; Wood 2003). Within the context of tourism, SEA has the potential to make plans more environmentally sustainable. SEA exercises have been used in tourism planning since the 1990s; however, its application in tourism planning is still embryonic compared to other sectors, such as transport (Lemos et al*.* 2012). The focus on tourism as a case study can especially be justified since it is the largest and fastest growing industry in the world (Kitsiou et al. 2002; UNEP 2009). According to Du et al. (2016), tourism’s total contribution to the global economy rose to 9.5% of global gross domestic product (GDP) and, currently, it is growing more quickly than other sectors. This has led to severe environmental degradation and yet on many occasions careful planning has seen the rise of eco-tourism (Blancas et al. 2011). Hence, a combined approach within this sector is likely to yield useful insights in providing direction to gear towards a sustainable future.

*1.1.2. Scenario analysis*

The use of scenarios is not new, as it was first used as a military planning tool in World War II by US Air Force planners (Schwartz 1991; Mahmoud et al. 2009; Vuuren et al. 2012) to foresee opponents’ actions. Eventually, a USAF planner, Herman Kahn, adapted scenario analysis as a business planning tool in the 1960s (Mahmoud et al. 2009; Gates 2010). Scenario analysis entered the field of strategic planning in the 1970s when it was first introduced by Royal Dutch Shell to complement traditional forecasting tools (Zhu et al*.* 2011). With the help of this approach, the company was able to react earlier and more effectively to the 1973 oil crisis than its competitors (Wack 1985; Schwenker and Wulf 2013), becoming the most well-known success case in this field (Godet and Roubelat 2000; Van Asselt et al*.* 2010). Traditional scenario analysis approaches have a number of weaknesses. For example, they can be highly complex and slow (Millet 2003; Verity 2003; Bradfield 2008). “Scenario-based strategic planning”, developed by Schwenker and Wulf (2013), is an attempt to standardize scenario analysis implementation by developing stage-wise, tool-based approaches.

*1.1.3. SEA and scenario analysis*

Duinker and Greig (2007, 213) believe that “scenario-based approaches to forecasting environmental impacts offer a way to grapple with uncertainties inherent in predictive exercises that reach into the long-term future”. As a matter of fact, scenario analysis is commonly listed in the “SEA toolbox” (OECD 2006; Therivel 2004; Geneletti 2012), and its use is approved by a number of scientific papers (Zhu et al. 2011; Noble 2008; Geneletti 2012). Integration of scenario analysis with SEA has the potential to enhance SEA’s effectiveness. For example, one of the primary roles of SEA is to identify and assess the environmental impacts of alternatives (Therivel et al. 1992; Bina et al. 2009). Nevertheless, as exemplified by reviews of SEA reports, this has often been disregarded in practice (Fischer 2010; Zhu et al. 2011; SAIEA 2006; Geneletti 2012). By developing possible futures, scenario analysis compels the user to reflect on the implications of proposed options, thereby potentially strengthening the consideration of alternatives within SEA.

In addition, there is a general agreement that uncertainty exists in SEA, particularly in impact prediction (de Jongh 1988), but no consensus exists on how to manage it (Leung et al. 2015; Bond et al. 2015). Although scenario analysis is a suitable technique to deal with uncertainties (Bond et al. 2015), there is little evidence of the application of scenario analysis in SEA studies. One example worth noting is the use of scenario analysis in SEA in China, which was reviewed by Zhu et al. in 2011. Furthermore, Geneletti (2012) used scenario analysis to compare the environmental effects of different spatial plans in possible futures, thereby aiming to overcome two limitations encountered in SEA for spatial planning: a) poor exploration of how the future might unfold, and b) poor consideration of alternative plans. Nevertheless, Tourki et al. (2013, 16) state that “even though scenario analysis is one of the most important analytical methodologies, it is not well defined and there is no common process to apply it”. Hence, this paper’s contribution lies in applying and testing the first three stages of a combined approach of scenario analysis and SEA.

Scenario analysis is also a participative technique (Bond et al. 2015), which is complementary to existing SEA practices. In this approach, participation is initiated from Stage 1. Schwenker and Wulf (2013, 77) believe that “scenario- based strategic planning process will only be successful if external views integrate into the scenario development process”. Fischer (2007) asserts that SEA is effective when participation and involvement is enhanced, which further enables attitudes and perceptions to change. Therefore, by strengthening participation within SEA, scenario analysis is likely to enhance its effectiveness; encouragement of “learning about SEA and learning through SEA” should help in delivering all levels of learning within an appraisal (Jha-Thakur et al. 2009, 135). This is especially helpful within the Iranian context where SEA is still at an embryonic stage and lacks an established procedural framework, and public participation is not yet mandatory (Moradi 2009; Ahmadvand et al. 2009). Adopting a combined approach proposed here is likely to facilitate public participation within environmental assessment practices within the country.

*1.2 Iran’s environmental assessment (EA) context*

Article 50 of the National Constitution of Iran (1979) states that the preservation of the environment is a public duty in the Islamic Republic and all activities that involve the pollution of the environment are forbidden (UNDP 2013). However, the real movement in the field of EA in Iran started in 1994, when EIA was first put in place by Article 82 of the 2nd National Development Plan (NDP) (1994-1998). The NDP is a five-year programme and a road map for the country’s economic, political, social and cultural development. EIA was amended by Article 105 of the 3rd NDP (1999-2003). Based on the latter, Iran’s Department of the Environment (DoE) was required to provide practical and executive guidelines for EIA. At the time, the United Nations Development Programme (UNDP) was formally requested by the DoE to join forces to assist in establishing EIA guidelines and procedures (Project: Environmental Impact Assessment Enabling Activities and Capacity Building, IRA/97/017). These practical guidelines were published in 2001 and provide information and guidance for practitioners with regard to how to comply with the EIA Code of Practice of 23/12/1997. Article 71 of the 4th NDP (2005-2009) confirmed Article 105 of the 3rd NDP and further validated and extended it to the fourth planning period. The 5th NDP (2010-2015) not only emphasized performing EIA and monitoring but also mentioned SEA of plans and programmes at the national and regional level (Article 184). Figure 1 illustrates the historic evolution of EIA and SEA over different NDPs of Iran.

Figure 1: near here

The term SEA was first coined by Wood and Djeddour in the late 1980s and the instrument has been established for more than 20 years internationally (Gauthier et al. 2012; Tetlow and Hanusch 2012). In the case of Iran, the project for ‘capacity building programmes on SEA’ was the first step taken by the Iranian Government in favour of SEA. This project was undertaken by the Iranian DoE with UNDP collaboration in 2004 and 2005 ([OECD](https://www.google.co.uk/search?biw=1242&bih=585&tbm=bks&q=inauthor:%22OECD%22&sa=X&ved=0ahUKEwi_jf_p59PJAhWC0BoKHfx0AO4Q9AgIIDAA) 2006). The main outcome of the project has been the establishment of a regulatory framework for SEA, which led to the adoption of SEA in the 5th NDP in 2010. Despite this, SEAs have barely been undertaken in the country to date.

2. Research method

*2.1 Rationale for selecting the Iranian context*

The lack of maturity with SEA in Iran in spite of the establishment of the regulatory framework implies that it offers a flexible base to try out a new structured approach for SEA, such as that provided by the SEA and scenario-analysis combined approach. Within the three stages of the combined approach tried within this research, each stage was developed using specific tools (see Section 2.3 and Figure 5). This method offers a structured and well defined approach for conducting SEA, which should aid the implementation of SEA practice in Iran.

In addition to this, Iran has already laid the foundation for using scenario analysis within its planning system. Article 74 of the 4th NDP (2005-2009) compels all provincial management and planning organizations to provide long-term regional planning at provincial level, using the scenario analysis guidelines (Zali 2010). Zali and Poorsohrab (2017) have provided a detail account of regional development perspectives combining scenario analysis specifically for Gilan Province. One of the strengths of this guideline is that it encourages the participation of all sectoral and provincial organisations in decision-making. Furthermore, a lack of transparency and participation are dominant weaknesses within the Iranian planning sector as well as within its EA system (Moradi 2009). Introduction of scenario analysis-based SEA could be an effective step towards enhancing participatory decision-making.

Furthermore, as noted by Jha-Thakur and Fischer (2016), relatively less mature EA systems are more likely to be positive towards EA when compared to mature systems. In countries where SEAs have been periodically conducted and a procedure has been established, there may be reluctance to incorporate changes for initiating the use of a scenario-based approach. Therefore, proposing such a combined approach in Iran is likely to be more acceptable.

**2.2. Rationale for the case study: Gilan Province**

Gilan Province is located in northern Iran along the southern coast of the Caspian Sea and northern slope of the Alborz Mountains. It is part of the Caspian Hyrcanian mixed forest ecoregion, which is one of the Global 200 ecoregions, and has been listed by the World Wide Fund for Nature (WWF) (UNDP 2013). Figure 2 shows the location of Gilan Province in Iran. The Tourism Development Plan of Gilan Province was prepared by the Cultural Heritage and Tourism Organization of Iran. It offers a long-term plan for tourism development in Gilan for the period of 2010 until 2030 (SAP 2009). To develop this research, it was vital to choose a case study that has a tourism strategic plan. All provinces in Iran are not covered by tourism strategic planning, but Gilan is in the forefront of providing tourism strategic planning because of its diverse natural beauty owing to its geographical location. This region is listed as an Important Bird and Biodiversity Area (IBA) and it is a resting area for migratory birds (UNDP 2013). This sensitive environment annually attracts a wide range of tourists, which poses serious threats to the Hyrcanian forests, leading to loss of biodiversity and loss of habitat. It is worth mentioning that the Caspian Hyrcanian forests have been reduced from 3.4 million ha to 1.85 million ha between 1955 and 2000 (UNDP 2013).

Figure 2. near here

**2.3. The proposed scenario-based SEA approach**

The last 40 years have witnessed several approaches to scenario building (Schwartz 1996; Godet 2000; Duinker and Greig2007; Bishop et al. 2007; Mahmoud et al. 2009; Schwenker and Wulf 2013). The most influential approaches have been those of Royal Dutch Shell and the consulting firm of Global Business Network (Schwartz 1996; Schwenker and Wulf 2013). They have implemented a matrix approach for the first time, and most consultants and organisations have latched onto this approach as the default for all their scenario work (Bishop et al. 2007). In fact, Millett (2003,p.18) calls this matrix tool the “gold standard of corporate scenario generation.’’ (Bishop et al. 2007, Schwenker and Wulf 2013).

Although various scenario approaches differ in terms of detail, they share some common features; for example, they all aim to develop multiple visions and options into the future. Based on the various approaches, a total of six stages can be identified. However, none of the approaches individually contains all six stages (Phelps et al. 2001; Chermack et al. 2001; Millet 2003; Bishop et al. 2007). The six stages are as follows:

* Identification of a major issue in the organization;
* Identification of driving forces in the macro environment that influence the key factors;
* Identification of critical uncertainties relevant to the issue;
* Scenario building;
* Identification of robust strategies; and
* Selection of leading indicators or signposts.

All traditional approaches of scenario analysis require substantial time and resources, mainly owing to the lack of standardized processes and tools for implementing them (Schwenker and Wulf 2013; Bradfield 2008; Moyer 1996). The proposed approach called “scenario-based strategic planning” aims to overcome this weakness by providing for a tool-based design that makes the processes relatively simpler and less time-consuming in practice. In this paper, we have adapted the “scenario-based strategic planning” approach to the SEA process (see Figure 5). In doing so, the work mainly focusses on the first three stages. As discussed in the following paragraphs, each step combines scenario analysis and SEA. The combined approach is then tested within the Tourism Development Plan of Gilan Province in Iran. The stages have employed the tools which have been suggested by Schwenker and Wulf (2013). The following paragraphs outline the stages and the methodological approach.

*2.3.1. Identifying factors and uncertainties in the Gilan Tourism Development Plan*

The overall goal of this stage is to identify a comprehensive list of factors that would shape future development(Schwenker and Wulf 2013).The term "uncertainty" refers to the unpredictability of environmental factors that impact corporate performance. Three steps were employed to enhance the robustness of the uncertainties identified.

a) First, identification of factors and uncertainties was undertaken by the authors based on a review of the plan against the commonly found uncertainties in the relevant literature.

b) These factors were then refined through pilot interviews. In order to conduct pilot interviews, this step started with the identification of respondents who would take part in the scenario analysis process. As Luyet et al. (2012, 215) observe,

Large-scale data from citizens would make such estimation more reliable. However, this process is time consuming. This is why we propose to include, beside the project leader, several people, for example: one or two stakeholders, experts and other people who are familiar with the context of the area.

Therefore, the focus of this research was to identify experts from within the tourism sector of Gilan. A snowball sampling method was employed and a total of 20 participants were selected consisting of tourism experts working in tourism consultancy, and the Cultural Heritage and Tourism Organization of Iran. The ‘experts’ were all individuals with an in-depth level of knowledge or who have an overview of the context and understanding of the sector within which the combined approach is being implemented. During this step, participants were encouraged to incorporate any factors that may have been missed by the authors.

c) Finally, refined factors were grouped based on the broad categories of STEEP: social, technological, economic, environmental and policy governance categories (Bradfield et al. 2005; Rounsevell and Metzger 2010).

*2.3.2. Clustering factors with impact and uncertainty indexes*

Once the uncertainty factors were grouped, the second step involved clustering them. This was done on the basis of the perceptions of experts identified in Stage 1. The perceptions of experts were established with the help of a detailed questionnaire, in the manner advocated by Schwenker and Wulf (2013). This consisted of 27 uncertainty factors grouped into five categories (see Table 1). The experts were asked to rate each factor with regard to its importance on the performance of the tourism sector and its degree of uncertainty on a scale from low to high. This was followed by placing all of the factors on an impact/uncertainty matrix according to their rating, again following the method recommended by Schwenker and Wulf (2013). An impact/uncertainty matrix was used for this purpose, as it helps in positioning all of the factors based on their importance of impact and degree of uncertainty for the future (see Wulf et al. 2010a) (Figure 3).

Figure 3. near here

The factors were then clustered into a) secondary elements; b) trends; and c) critical uncertainties. ‘Secondary elements’, which are positioned at the bottom section of the impact/uncertainty matrix, have a weak impact and can demonstrate low or high uncertainty. Hence, for the purpose of scenario development, such factors can largely be ignored and therefore are not further considered (Schwenker and Wulf 2013). ‘Trends’ imply uncertainty is low; therefore, it is relatively predictable. Finally, ‘critical uncertainties’ that are positioned in the upper right hand corner denote factors that not only have a high performance impact, but are rather uncertain for future development (Wulf et al. 2010b). As a result, planners should concentrate on trends and critical uncertainties in scenario building (Schwenker and Wulf 2013).

Out of 20 questionnaires sent to the identified experts, 15 were answered in their entirety. The frequency of responses for each question was calculated by SPSS, and the uncertainty index was calculated by Excel. The priority of each factor was determined by the uncertainty and importance index. The importance index indicates the importance level of each factor that affects the tourism industry. The uncertainty index is the degree of uncertainty of each factor in the future. The major outcome of this stage was to determine two critical uncertainties (high importance of impact and degree of uncertainty factors), which form the basis of the scenario-based approach (Van der Heijden 2005).

*2.3.3. Scenario building and impact prediction based on scenarios*

The relationships between different factors and uncertainties are structured within what is commonly termed as ‘scenario logic’. A scenario matrix is the most commonly used tool for the construction of scenario logic in environmental assessment studies (Rounsevell and Metzger 2010). The concept of a scenario matrix was first introduced by van der Heijden in 2005, and it builds and visualizes four scenarios based on two key uncertainties identified (Wulf et al*.* 2010a). This research adopts the same approach. As Figure 4 illustrates, the scenario matrix consists of four quadrants created by each key future uncertainty with an extremely positive and negative outlook along the x and y axes respectively (Schwenker and Wulf 2013). Each quadrant generates a distinct future scenario (van Klooster and van Asselt 2006) and each scenario visualizes a possible future for tourism development in the region.

Figure 4. near here

*2.3.4 Recommendation options based on scenarios*

After visualizing different future development scenarios, this stage would predict the effects of implementing each scenario. Subsequently, based on the possible effects of each scenario, options are recommended to mitigate the predicted adverse impacts.

*2.3.5. Robust options test*

This stage should evaluate the strategic options to select the most appropriate one to be implemented (Tapinos 2012). A number of studies propose a strategic option evaluation based on quantifying the assessment of the impact of strategies against a hierarchy of objectives for each scenario (Driouchi et al. 2009), while others suggest making the selection based on the robustness of the strategic options for each scenario (O’Brien et al. 2007). The robustness of the strategic options is evaluated based on three criteria: feasibility, suitability, and acceptability. Feasibility focusses on whether the organization has the resources to follow the strategic choices. Suitability means strategic options are suitable within the current environment, and acceptability relates to the stakeholder’s reaction to these choices (Johnson et al. 2008). It is worth mentioning that a robustness of options can be achieved if each of the scenarios has a substantial and significant difference from the other scenarios. Managers are likely to feel more certain about the future if specific strategic actions can be developed for the most probable scenario (Wulf et al. 2010a).

*2.3.6. Monitoring*

Partidario and Arts (2005) believe that SEA monitoring is a kind of post-decision stage that leads us to think about “what comes after”. Within the context of scenario analysis, one is expected to encounter multiple futures. Hence, this stage aims at benchmarking the scenarios against real-world developments. This is expected to help organizations detect an early warning system that will enable them to analyze whether the real world is moving in the direction of a particular scenario and thus indicates which strategy option needs to be executed (Wulf et al. 2010a).

Figure 5 demonstrates all of the above stages of a scenario-based strategic planning approach and how it can be aligned with the SEA process. As can be seen, the uncertainties of the plan are identified based on analysis of the plan (Stage 1 of the SEA process), and then the uncertainties are clustered. In predicting the impacts of the Tourism Development Plan (Stage 2 of the SEA process), scenarios are built based on two important uncertainties and the impacts of each scenario are predicted. Recommendation options (Stage 3 of the SEA process) for each scenario are developed and, in the final stage, scenarios are monitored.

Figure 5. near here

**3. Implementation of the first three stages of the proposed approach**

***3.1 Stage*** *1*

Stage 1 corresponds to the scoping stage of the SEA process, as identified in Figure 5. The main purpose of this stage was to ascertain the factors that play an important role in shaping the future development of tourism in Gilan and to identify associated uncertainties. Based on an analysis of the development plan and a literature review by the authors, a list of 25 factors was identified. In order to ensure the completeness of the list and to reduce any chances of missing out uncertainties, this list was further tested amongst experts within the sector. The pilot interviews were particularly useful in adding further insight into the uncertainties. Two specific factors were added by the consultants interviewed. The first addition was a visa barrier for foreign tourists, which has been grouped under political factors, and secondly, internet capacities were identified, which have been grouped under technological factors (see Table 1). Interestingly, the Gilan Tourism Development Plan’s focus was entirely on national tourism. This can be viewed as a major drawback, as the region currently attracts a considerable proportion of international tourists (Hajilo et al. 2017). In justifying the two added factors, the interviewees opined that political alliances and motivations will continue to play a critical role in influencing international tourism within the province. Furthermore, use of technology in facilitating tourism internationally is likely to have a profound influence on the extent to which tourism will develop in the province. Based on all the responses received, Table 1 illustrates the list of factors and uncertainties within the tourism sector in Gilan. The factors were then categorized based on STEEP. Environmental uncertainties were highest in number (seven), followed by economic (six) and political (six) uncertainties. The lowest numbers of uncertainties recorded were listed under the social (four) and technology (four) categories. It should be noted that the level of public participation and interaction has been listed under social factors.

***3.2. Stage* 2**

The objective of this stage is to cluster the identified factors of the Tourism Development Plan. Factors were clustered based on the degree of uncertainty and importance as rated in a questionnaire administered to the experts identified in Stage 1, as detailed above. Based on the 15 complete responses received, Table 1 presents the result of SPSS analysis of these factors.

Table 1: near here

In the economic category (see Table 1), out of the six factors, “Strategic planning for tourism development” was rated with the highest uncertainty factor at 0.81 and an importance factor of 67.9. Tourism private investment, on the other hand, was rated with the highest importance factor of 89.3 and an uncertainty factor of 0.38. However, neither was identified as a critical uncertainty (see Figure 6). Interestingly, “Strategic planning for tourism development” is at the borderline in Figure 6. Therefore, it had a high possibility of being treated as a critical uncertainty.

As is evident from Table 1, within the social category,“Scattered future tourism development on beach” and “Social interactions” were given the highest uncertainty ratings at 1.04 and 0.57 respectively. The former also had a relatively high importance factor of 67.9. Therefore, it was located in the right hand corner of Figure 6, making it eligible to be a critical uncertainty factor.

In the environmental category, there are two notable factors that were relatively highly rated when considering both the uncertainty and importance factors. These were “Carrying capacity” and “Integrated coastal zone management”. Their location in Figure 6 shows that they are beyond the critical uncertainty zone and yet not so far from it.

Within the political category, “Capital investment platform” clearly outshone the other factors in terms of both the uncertainty and importance factors. This also found its place as a critical uncertainty in Figure 6. None of the factors under the category of technology was highly rated. As can be seen in Figure 6, these were clustered mainly around the bottom left hand corner of the matrix.

Figure 6. near here

As Figure 6 shows, the impact/uncertainty matrix was used to visualize and structure critical factors within the Gilan Tourism Development Plan. “Capital investment platform” and “Scattered future tourism development on beach” were identified as the two critical uncertainties associated with the Tourism Development Plan for Gilan Province and were positioned on the upper right corner of the matrix. Capital investment includes investment spending by all industries involved in tourism. This also includes investment spending by other industries on specific tourism assets, such as new accommodation and transport equipment, as well as restaurants and leisure facilities (WTTC, 2015). In contrast, “Scattered tourism development on beach” implies uncontrolled development and construction on the beach which attracts all tourism products to the beach. This is mainly owing to a lack of an integrated tourism development plan. Based on these two critical uncertainties, the scenarios were developed in Stage 3.

***3.3. Stage 3***

The major outcome of Stages 1 and 2 serve as the dimensions that span the scenario matrix in Stage 3 (see Figure 7).

Figure 7. near here

*3.3.1 First scenario (business-as-usual-scattered coastal development and scattered investment)*

In this scenario, there is no integrated plan for physical and non-physical development of tourism in the province and the process of environmental, economic, social, political, and cultural development is affected by the development pattern of the past. Therefore, the tourism market and products are limited to coastal sites. Tourism prosperity follows the seasonal pattern closely, which indicates a lack of diversity in the recreational services rendered throughout the year.

*3.3.2 Second scenario (homogeneous tourism development in coast and hinterland with scattered investment)*

In this scenario, the Cultural Heritage and Tourism Organization would initiate a long-term development plan for phased tourism development in Gilan over a 20-year period of time. The main emphasis of this programme is comprehensive development of the entire region so that tourism development in the highlands and hinterlands is achieved, along with development in coastal sites. However, the structure of the organization presently does not have enough power to support the issuance of permits or acquire the required finance. As a result, the progress of the plan will be slow or may cease. The private sector is therefore expected to be reluctant to cooperate and invest in the region for tourism development.

*3.3.3 Third scenario (scattered coastal development with investment opportunities)*

In this scenario, like the first scenario, coastal development continues, with the difference that development and subsequent degradation and its consequences would be accelerated due to unplanned investments.

*3.3.4 Fourth scenario (homogeneous tourism development in coast and hinterland with investment opportunities)*

According to the Tourism Development Plan for Gilan (SAP 2009), tourism will not be concentrated merely along the coastline. It will develop gradually in other areas, promoting sustainability indicators on the beach. Accordingly, development will not be limited to the coastline and, as a result, the entire region will benefit from homogeneous development. In this case, the investment opportunities will be provided by the relevant organizations and investors will be supported.

4. Discussion

This paper tests the suitability of combining scenario analysis within the context of SEA. In doing so, the application teases out several benefits of such an approach, but also brings forward the complexities of combining these methods. In terms of benefits, first, in contrast to predicting a certain future, a way of presenting future images and assessing future environmental conditions, is adopted (Zhu et al. 2011). This enhances the consideration of alternatives, which is fundamental to SEA (González et al. 2015). The European (EU) SEA directive states that SEA needs to identify, describe and evaluate reasonable alternatives (Fischer 2007). However, for various reasons, considering alternatives within SEA may result in a number of shortcomings in practice, which include: excluding them earlier on without specific reasons; stakeholder involvement in considering them is inadequate; and the selected alternative is unrealistic, but is chosen in advance based on preference (González et al. 2015). Based on the combined approach adopted here, these weaknesses can be overcome. For example, the four scenarios developed during Stage 3, based on the critical uncertainties, provide for alternatives to which the SEA can be applied. Hence, considering alternatives is embedded within this approach and cannot be avoided. The scenarios themselves are based on the identification of critical uncertainties that were approved through stakeholder involvement and prioritized based on the uncertainty and importance index. Therefore, public engagement is intrinsically interwoven. Finally, the choice of alternatives follows a systematic, scientific, and participatory approach, which helps in adding objectivity to the process.

The SEA and scenario analysis combined approach tested here enables the stakeholders to prioritize factors based on their perception of importance and degree of uncertainty (see Section 2.2.2). Within SEA, its strategic character and abstract nature make it difficult to engage stakeholders and objectively prioritize their values (Elling 2011 in Sadler et al. 2011). The combined approach enables the perceptions of stakeholders to be harnessed objectively. Within the Iranian context, where SEA is yet to make its mark, the adoption of this approach added a certain level of objectivity. Therefore, a combined approach has the potential to facilitate participation within SEA, and improve communications among SEA practitioners, decision-makers and other stakeholders (Zhu et al. 2011).

Applying scenario analysis within SEA also brings forward certain challenges during implementation. First, in order to develop future scenarios, the incorporation of trend factors is essential to enhance the accuracy of the scenario building. However, tracking and plotting such trend factors is demanding in terms of time and cost. One example of such a trend is the tourist population in Gilan Province, which tends to increase considerably in holiday seasons. An increasing tourist population trend would lead to further rises in waste generation and traffic. These trends will have substantial impacts on how a tourism organization will set their strategies. For the purpose of this research, these factors were kept constant in developing the scenarios. However, this dilutes the accuracy of the scenarios.

Figure 6 reveals that, although two critical uncertainties have been identified within the top right hand corner of the matrix, there can be other uncertainties that may narrowly miss this designation. For instance, the factor “strategic planning for tourism development” lies just at the borderline from being a critical uncertainty. Furthermore, this differentiation based on the ratings is subjective and hence a different group of experts could imply a slightly different group of critical uncertainty. In addition to this, there may be more than two factors that are critical in terms of future developments. Restricting the development of scenarios based on only two critical uncertainties may limit the potential of a future exercise such as this.

Based on the limitations on the researcher in terms of time and resources, stakeholder engagement was, to some extent, limited and this was especially so with regards to involving members of the public. Future research involving a wider group of stakeholders would lead to a better understanding of the differences and overlaps of views in scenario building. It is also recommended that the development of the scenario could be conducted in a workshop setting (Schwenker and Wulf 2013). Contributors to the workshop should include the participants identified in Stage 1 of the process. The key point of developing the scenarios in a workshop setting is that all participants are involved in the process of devising plausible scenarios.

Although large-scale data is likely to yield reliable results, it will further increase the time and resource implications of the combined approach (Luyet et al. 2012). Unfortunately, the rationale for using a combined approach stems from the fact that this should be less time consuming. However, in implementing this approach, it is evident that a thorough analysis will continue to be resource- and time-intensive. Therefore, the question remains as to what extent the combined approach will actually reduce time and resource constraints in comparison to traditional approaches.

This work elaborated mainly upon the first three stages of the six-stage proposed approach (see, for example, Wulf et al. 2010). Future research is needed to test all the six stages of scenario-based planning within the context of SEA that have been proposed in this work.

5. Conclusion

Although, there are EA-related publications that have made reference to scenario analysis (Therivel 2004; UNECE, REC CEE 2006; Duinker and Greig 2007; Zhu et al. 2011; Bond et al. 2015), the tool-based approach used in this work has never previously been tested. The lack of detail in terms of procedure and structure within scenario analysis has been highlighted as a common hindrance (Tourki et al. 2013). Reviews of state-of-the-art of scenario analysis in EA that have been undertaken by Duinker and Greig (2007), Mahmoud et al. (2009) and Tourki et al. (2013) confirm this contention, and all have concluded that a lack of guidance and analysis has been a deterrent for the use of scenario analysis in environmental studies.

Since SEA is concerned with impact prediction, managing uncertainty is unavoidable in the assessment processes (Tennøy et al. 2006; Thissen and Agusdinata 2008; Wilson 2010; Larsen et al. 2013). However, decision-makers tend to ignore uncertainty in order to deliberately create a sense of security (Lipshitz and Strauss 1997; Larsen et al*.* 2013). Moreover, a lack of resources with regard to how to deal with uncertainties in a structured method can be another reason for uncertainty avoidance. There is no defined methodology to consider uncertainties in decision-making (Leung et al. 2015; Bond et al. 2015). In this context, there is a need to develop a conceptual framework to deal with uncertainty in EA practice rather than simply criticizing practitioners for not doing so (Leung et al. 2015). This paper has attempted to bridge the gap between research and practice and to propose that scenario analysis can be a suitable tool to address uncertainties in SEA. It can help SEA practitioners to identify uncertainties in extrapolating predictions overshadowed by the complexities of decision-making and visualize all possible futures in contrast to fixed prediction (which is common in current EA practice). This approach enables decision-makers to be aware of, and be prepared to cope with, challenging uncertainties.

Tourki et al. (2013) have reviewed the application of scenario analysis conducted between 2000-2010 under three main categories, which include environmental, business, and social factors, and concluded that most of the applications were in the environmental field. This study complements this effort by evaluating the usefulness of scenario analysis as a technique to manage uncertainties within SEA. In this context, this paper delivers beyond theoretical deliberations that are typical, to date, in the EA and scenario analysis literature (Bond et al. 2015). It also offers a systematic procedural framework with tools that can translate theory into practice. In doing so, the paper has adopted a mixed approach by using qualitative and quantitative techniques. The questionnaires and discussions have helped in teasing out the real issues within the planning context while their quantitative analysis has helped in refining the results and injecting objectivity into the process.

This work is also an example of applied research that illustrates how to cope with uncertainties in a “futuring exercise” such as SEA through the use of scenario analysis. The paper provides specific phases with complementary tools to aid in the analysis and identification of uncertainties within the context of the Tourism Development Plan in Iran. The various factors were classified to decipher key uncertainties, predetermined factors (trends), and secondary elements. In the next step, we developed our scenarios based on two key uncertainties. However, it should be noted that developing four scenarios based on two key uncertainty factors does not guarantee the completeness of the scenarios. That is, other trends or secondary elements (Figure 6) may influence the scenario framework in unpredicted ways. This emphasizes the imperative role of monitoring and follow-up.

This paper contributes to existing knowledge by applying the two complementary decision-aiding tools of scenario analysis and SEA in combination to manage uncertainty in decision-making. However, the advantages of applying a combined approach extend beyond managing uncertainties. It can also help in enhancing the effectiveness of SEA, encouraging the consideration of alternatives, improving communication and participation in an objective manner, and harnessing the values of stakeholders involved within the SEA process. In delivering the six-stage approach, the paper complements the first three stages with detailed methodological tools. Though the benefits are obvious, further research is needed to elaborate the last three stages of this approach, provide evidence with regard to how this works in different sectors and contexts, and develop the possibilities that are eminent in such a combination.

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 Table 1. Factors and uncertainties in tourism development in Gilan Province

|  |  |  |  |
| --- | --- | --- | --- |
| **Category** | **Factors and uncertainties** | **Uncertainty index**  | **Importance index** |
| **Economic** **category** | 1- Tourism private investment | 0.38 | 89.3 |
| 2- Dynamics of the private sector | 0.37 | 82.1 |
| 3- Strategic planning for tourism development | 0.81 | 67.9 |
| 4- Cost of transportation and accommodation | 0.42 | 39.3 |
| 5- Unchanged communication network | 0.37 | 57.1 |
| 6- Tourism products | 0.37 | 53.6 |
| **Social****category** | 1- Tourism population | 0.38 | 71.4 |
| 2- Scattered future tourism development on beach | 1.04 | 67.9 |
| 3- Public participation | 0.28 | 50 |
| 4- Social interactions | 0.57 | 42.9 |
| **Environmental****category** | 1- Water fluctuation | 0.61 | 53.6 |
| 2- Natural disasters | 0.37 | 60.7 |
| 3- Environmental fragilities  | 0.55 | 57.1 |
| 4- Integrated coastal zone management (ICZM) | 0.57 | 89.3 |
| 5- Carrying capacity | 0.72 | 67.9 |
| 6- Waste management | 0.65 | 75.0 |
| 7- Water consumption pattern | 0.5 | 85.7 |
| **Political** **category** | 1- Commercial barriers | 0.58 | 78.6 |
| 2- Cultural Heritage and Tourism Organization  | 0.38 | 53.6 |
| 3- Capital investment platform | 1.31 | 82.1 |
| 4- Cost of travelling fuel | 0.37 | 28.6 |
| 5- Current energy sources | 0.62 | 46.4 |
| 6- Visa barriers for foreign tourists | 0.55 | 71.4 |
| **Technological****category** | 1- Transportation expansion | 0.55 | 57.1 |
| 2- Use of fossil fuels | 0.29 | 50 |
| 3- Internet capacities | 0.34 | 46.4 |
| 4- Tourism advertising | 0.38 | 57.1 |

Figure 1. Historic key of EIA and SEA in different National Development Plans of Iran (MPO 1994; MPO 1999; MPO 2005; MPO 2010; UNDP 2003)

Figure 2. Location of Gilan Province in Iran

Figure 3. Impact/uncertainty matrix adapted from Schwenker and Wulf (2013)

Figure 4. Scenario matrix adapted from Van der Heijden )2005)

Figure 5. Scenario analysis process in SEA for Tourism Development Plan adapted from Zhu et al (2010) and Schwenker and Wulf (2013)

Figure 6. Impact/uncertainty matrix for Gilan tourism development

Figure 7. Future possible scenarios for Gilan tourism development