

Designation and Analysis of Sustainable Development Strategies by applying SWOT model and Analytic Network Process

Shaho Karami¹⁺, Vafa Ghaemmaghami¹, Sanaz Sabeti Mohammadi¹, Ramezan Heydari¹ and Mehdi Farokhnejad¹

¹Msc of environment, university of Tehran, Iran

Abstract. In this study by making use of the analytical network method, strengths and weaknesses due to internal factors and opportunities and threats caused by external factors were identified. Based on the findings, relevant strategies for the sustainable development of the Jam Abroud village and the executive programs needed for their implementation were designed. Analytic Network Process was applied as an effective multi-criteria decision-making method to prioritize the strategies. Finally, a timetable was proposed to implement the executive plans in a ten-year time span and the authorities responsible for its implementation were determined. The results reveals that although the presented offensive patterns ranked best among strategies to create sustainable development in Jam Abroud vill, followed by conservative, competitive and defensive patterns, but it was found that the use of a combination of the above-mentioned patterns and strategies with attention to their rankings, provides the best opportunity to establish sustainable development in Jam Abroud vill.

Keywords: Sustainable development, SWOT model, environment, analytic network process, Jam abroud vill

1. Introduction

In 1987, the report of World Commission on Environment and Development was presented. “Our Common Future” is known as Brundtland Report and includes a collection of recommendations and regulation to achieve sustainable development for developing countries. The concept of sustainable development was officially adopted for the first time in this report [1] and was internationally accepted during the Earth Summit in Rio [2]. The most acceptable definition of Sustainable Development is published in Brundtland Report. Based on this report Sustainable development is the kind of development that meets the needs of the present without compromising the ability of future generations to meet their own needs [3] that means sustainable development is a long term development [4]. The Idea of sustainable development is to prevent the deterioration of natural resources, ecosystem degradation, growing social injustice, pollution, uncontrolled population growth and decline of human life quality. In fact, the condition for a sustainable society is combination of environmental sustainability with the aim of ecologic balance, economic sustainability with the aim of economic survival, social sustainability with the aim of social justice and structural sustainability with the aim of morphologic balance [5]. In other words, sustainable development connects environmental and social aspects to economic issues [6]. This development is against unsustainable economic growth and indicates the fact that maintaining the current lifestyle will cause serious challenges [7]. Sustainable development factors differ from region to region within a country [8]. Therefore to maintain sustainable development at a national level, it should be first implemented in regional scale. The aim of this research is to prioritize the strategies for sustainable development in Jam Abroud vill, since development strategies not only eliminate the existing problems but also define the development path [9].

⁺ Corresponding author. Tel.: +98 9388606291.
E-mail address: karami.sh@ut.ac.ir.

2. Material and Methods

Area of study: Jam Abroud vill and Taroud and Abarshiv vills are located in central part of Damavand County in Tehran province. The surface area of Jam Abroud vill is 41478.7 hectares. With a population of more than 17676 inhabitants [10]. It is located in the south of Damavand County and its capital is Absard city. There are different locating order of settlements is different in this county that in central part from north to the center of the vill the system is concentrated and in other parts are scattered constantly, the road and valley are the most important factors for locating the settlements and water availability and services are the most important factors for population density. Capitals of the society: a society has different types of capitals. Each part of this capital (man-made capital, social capital, natural capital) is in relation to one of the sustainable development components (economic, social and environment) [11]. Existing condition of the capitals of the society: the first phase of this study is focused on recognition of natural capitals, information gathering on human process and also man-made process. In studying of each abovementioned group, the main strategies of the 5th development plan of the country and stakeholders which affect the environmental quality in the region are considered. To maintain sustainable development new methods is required to come up with solutions and define the rules of their relations [12]. In recent years, different methods for strategies design for maintaining sustainable development is defined [13]. In this study combination of SWOT analysis and Analytic Network Process methods are applied to develop the sustainable development strategies. SWOT analysis: after studying different natural, social and manmade parameters in Jam Abroud vill, parameters which are affected by internal and external factors and cause to the opportunities or threats for the vill development or strengthen or weaken the reasons for the vill development are shown in Table 1, and afterwards developing strategies were identified.

Table 1: SWOT for Jam Abroud vill

<p style="text-align: center;">Weaknesses</p> <p>W₁ : lack of water and pollution of existing water resources W₂ :management of surface water resources out of the vill W₃ : atonal population growth and no proper distribution of general services W₄ : lack of health and educational facilities W₅ : increasing virtual jobs W₆ : low quality of roads inside the vill W₇ : lack of industrial investments in the vill W₈ : environmental degradation and increasing pollution</p>	<p style="text-align: center;">Strengths</p> <p>S₁ : Existence of holly place and historical areas and proper climate for tourism and recreational activities S₂: Young population and educated people in the vill S₃ : existence of sand and silt in the vill S₄: existence of fundamental infrastructures and easy access to Tehran S₅: Existence of arable lands for different uses (agriculture, foresting, recreation, ...) S₆ : flowing of river in the vill S₇ : presence of police and security guards in the vill</p>	<p>Internal factor</p>
<p style="text-align: center;">WO strategies (preservative pattern)</p> <p>WO₁ : Protection and development of water resources quality and exploitation of these existing resources WO₂: Provision of employment opportunity WO₃ : Development of green space, control and reduction of environmental pollutions WO₄ : Improvement of natural landscape in the vill</p>	<p style="text-align: center;">SO strategies (Offensive pattern)</p> <p>SO₁ : development and strengthening tourism industry and recreational activities in the vill SO₂ : Fundraising from private and governmental sectors to establish industries in the vill SO₃: increase and develop health, education and other services</p>	<p>External factors</p> <p style="text-align: center;">Opportunities</p> <p>O₁ :closeness to Tehran city O₂ :increasing the importance of tourism industry O₃ :development of environmental protection strategies in the country O₄ : Existence of prediction and minimization of natural disasters strategies in the country O₅: Complete the dam in the vill and renovate wells and Qanats O₆ :governmental strategies for employment</p>
<p style="text-align: center;">WT strategy (Defensive pattern)</p> <p>WT₁ : Control of population growth and prevent population concentration WT₂ : Protection of arid and agricultural lands, forest and natural and virgin areas WT₃: Sound management of soil resources to prevent of soil erosion and pollution WT₄ : Minimize damages caused by natural disasters WT₅ :Establishment of infrastructures and necessary equipments in the villages</p>	<p style="text-align: center;">ST strategies (competitive pattern)</p> <p>ST₁: Agricultural development base on reduction of water use ST₂: Use of surface water resources (river) for different uses in the vill ST₃: Power assessment for industries establishment, new settlements, ... ST₄: Use of educated local residents in directorate position in the vill ST₅ : Provision of security and peace in the vill</p>	<p style="text-align: center;">Threats</p> <p>T₁ : high rate of unemployment T₂ :weakness of risk management in the country T₃ : Lack of water and locating vase area of the country in semi arid area T₄ :vast soil erosion in Alborz area T₅ : Willingness of population to accommodate in urban areas and shaping consumption culture T₆ :increase land use change in Tehran province T₇ : immigration of Afghans and settlement in the vill</p>

Reference: authors

Table 2: final result of prioritization of strategies, executive plan and time schedule

Strategy	Final weight	Priority	Executive plan
SO ₁ :development and improvement of tourism industry in the rural district	0.164	1	Facilitating access to historical, religious and recreational areas Site selection and specifying areas for citizens and tourisms (Jam Abroud hosts citizens from Tehran in different seasons)
SO ₂ :fundraising for establishment of industries in the rural district	0.112	2	Support private investors Facilitating investments in the rural district to establish early output institutions Use of governmental budgets for governmental related industries establishment
SO ₃ :improvement of the level of hygiene, education, sport, ...	0.078	5	Establishment of health care centers, technical schools, library, sport hall, Free and Payam-e-Noor university, completion of hospitals
WO ₁ :protection and improvement of the quality of existing water resources and their exploitation	0.092	3	Completion of Nime Kaveh Vadan dam Increasing the depth of existing wells and reuse of them, maintenance of exiting Qanats
WO ₂ :providing job opportunities and improvement the level of employment	0.069	6	Establishment of small industries with early revenue Establishment of conversion industries (small packaging plants) beside the farms
WO ₃ :development of green space, control and prevention of environmental pollution	0.043	9	Establishment of green belt surrounding the industrial and mining zones and silt and sand factories Rural and urban waste management Urban and industrial waste water management
WO ₄ :improvement of natural landscape in the rural district	0.016	15	Establishment of parks and landscapes in and surrounding of the cities (Absard and Kilan) Design and management of existing natural recreational areas
ST ₁ :agricultural development based on reduction of water use	0.088	4	Establishment of green houses for vegetables, development of dry land farming Application of farming practices that rely on rain fall in rain-fed farming
ST ₂ :use of surface waters (rivers) for different application in the rural district	0.043	9	Construction of dams on the surface water flow Transmission of surface waters to arable lands
ST ₃ :feasibility study for establishment of industries, dwellings, ...	0.066	7	Site selection for new residential complexes Site selection for industrial complexes Use of arable lands for agricultural development, ...
ST ₄ :use of educated endemic human resources in managerial position in the rural district	0.032	13	Provision of intensive methods to persuade endemic professionals to come back to the rural district Improving the literacy level and training endemic human resources in the rural district
ST ₅ :provision of peace and safety in the rural district	0.022	14	Settlement of Afghan immigrants in camps and control them Provision of safety specially in tourism areas
WT ₁ :control of population growth and prevention of population concentration	0.033	12	Training of the families to prevent population growth Fair distribution of services and equipments in cities and villages to prevent immigration of rural population to urban areas
WT ₂ :protection of arid, agricultural, forests and virgin and natural lands	0.047	8	Implementation of legal forces to prevent the area destruction Prevention of changing the range lands to agricultural lands
WT ₃ :sound management of soil resources to preventing the erosion and pollution	0.015	16	Training farming by ecological methods Keeping proper drainage for gathering agricultural run off
WT ₄ :minimization of damages caused by natural disasters	0.038	11	Implementation of the regulations on earthquake resistant design of buildings Planting in the border of river, establishment of flood barriers
WT ₅ :provision of necessary infrastructures and equipments in the provinces	0.042	10	Establishment of primary schools, health care centers, mosques, provision of drinking water Completion of gas pipe installation for villages in the rural district

Resource: authors

Since the resources are always limited and because provide competitive advantages in long term and to do so, consume resources to achieve the goals, managers and planning experts intend to select the most advantageous strategies [14]. In this study in order to prioritize and select the best strategies, Analytic Network Process (ANP) which is one of the best available multi-criteria decision-making tools, was applied. To apply ANP in this study, first the problem was structured in conformity with the ANP model. This model is composed of 4 levels. The first level deals with selecting the best strategy, the second level is related to the major factors presented in the SWOT analysis, the third level to the minor factors of SWOT and the last level comprises of the strategies considered in this study. After constructing the structure of the subject, relations and dependencies between different factors were identified and paired comparisons were done by the experts. To perform the paired comparisons hour scale was applied. Initially paired comparison of the main factors was formed, and then the interdependencies between the main factors were determined by assessing the

effects of each factor on the other factors. Interdependencies between the main factors are derived from the analysis of internal and external environments were defined as shown in Figure 1.

After the relations between main factors are identified, paired comparison matrices are formed and paired comparison are conducted between minor factors and major factors and pair ed comparison of strategies and minor factors. After the completion of the matrices, Super Decision software was applied to weigh and model the issues related to Analytic Network [15]-[16]. In this study the central study problem was modeled in the software, then paired comparison was carried out. The software automatically conducts the final stages of the Analytic Network Process and generates the final results (Table 2).

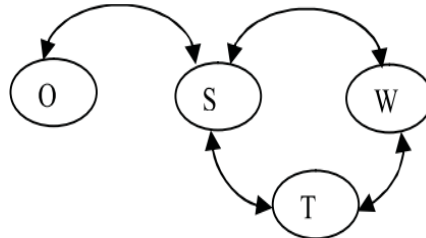


Fig. 1: interdependencies between SWOT factors

3. Results

Considering the calculated weights (Table 2), “development and strengthening of tourism industry and recreational activities in the vill” has the highest weight, and “fundraising from private and governmental sectors for industries establishment in the vill”, “protection and development of the quality of water resources and exploitation of existing resources”, “agricultural development based on water use reduction”, “increase and improvement of health, educational and sport services level” and ... are in next rates. Therefore, to achieve sustainable development in the vill by considering existing resources, executive plans which are defined for above mentioned strategies (Table 2) should be implemented.

The results reveal that offensive patterns has the highest weight and the best rank in average, after that conservative, competitive and defensive patterns are located respectively. Therefore, offensive patters for sustainable development purpose in the vill has the highest priority, conservative patters are also suitable. Indeed, use of combination of strategies in order to their rank is the best condition for sustainable development. Since these strategies show the development route and are not executive, the executive plans were presented. These plans are based on time and location and are applicable, therefore time schedule, executive agent and the responsible are mentioned in Table 2.

4. Discussion and Conclusion

In SWOT matrix, patterns and strategies are defined base on 4 criteria of strengths, Weaknesses, Opportunities and Threats. Since the importance of the main factors of SWOT is different for prioritization of strategies, therefore the main factor should be weighted. However SWOT Matrix is not able to determine the effects of the weight of these criteria on different strategies. Lots of studies and researches is done and most of them are focused on determination of the importance of the factors and weighting them by definite numbers and dependency of factors, sub factors and options are not considered. Further, some studies were done by applying AHP method which just consider hierarchy relations of factors and not same-level and reciprocal relations. In this study Analytic Network Process were applied to solve this problem. Analytic Network Process will cause that the hypothesis of dependency of factors, sub factors and options in hierarchy structure and dependency of semi level factors and mutual dependency between ... are considered. In the proposed method, the first level is selecting the best strategy and other levels are SWOT factors, SWOT sub factors, and different strategies which are considered within SWOT factors in strengths, weaknesses, opportunities and threats points. After constructing the structure, to determine the relative weight of the factors, sub factors and alternatives in decision making matrixes, pairwise comparisons and Super Decision methods were applied. The result of applying these methods reveals that the best alternative is “development and strengthening of tourism industry and recreational activities in the vill” which is selected from SO strategies (offensive pattern). The proposed method is capable for development and improvement. This is

recommended this method will be studied by considering the hypothesis of the effects of sub factor relations and interrelations in sub factors and strategies level. To eliminate the defects, use of stakeholder ideas in pairwise comparisons will be helpful. To determine the relative importance of the components of the structure Fuzzy methods could be applied.

5. References

- [1] E. Hanff, M.H. Dabat and J. Blin 2011. Are biofuels an efficient technology for generating sustainable development in oil-dependent African nations? A macroeconomic assessment of the opportunities and impacts in Burkina Faso, *Renewable and Sustainable Energy Reviews*, Vol. 15, Pp: 2199–2209.
- [2] Y. Lui, D. He, S.Buchanan, and J. Liu, 2009. Ecological Footprint Dynamic Of Yunnan China. *Journal Of Mountain Science*. Vol. 6, No. 3, Pp: 286-292.
- [3] K. Mori and A. Christodoulou, 2011. Review Of Sustainability Incidences and Indicators: Towards A New City Sustainability Index (CSI). *Journal of Environmental Impact Assessment Review*. Pp 1-13.
- [4] D. Olja, M.Ivanovic, M.T. Golusiz, S.N. Dodic, and J.M. Dodic, 2009. Perspectives sustainable development in countries of Southeastern Europe, *Renewable and Sustainable Energy Reviews*, Vol. 13, Pp: 2079–2087.
- [5] M.R. Pourjafar, z. Khodae, 2010. Geological indicators of sustainable urban development, *National Conference on Contemporary Iranian Architecture and Urbanism*, 15 pages, Beyza.
- [6] C. Karakosta, and A. Dimitris 2010. Developing countries' energy needs and priorities under a sustainable development perspective: A linguistic decision support approach, *Energy for Sustainable Development*, Vol. 14, Pp: 330–338.
- [7] S. A.Khatounabadi, 2006, Aspects of sustainable development (From thought to action), *Jahad University Unit of Technology Esfahan, Esfahan, Management*,
- [8] C. Karakosta H. Doukas and J. Psarras, 2009. Directing clean development mechanism towards developing countries' sustainable development priorities, *Energy for Sustainable Development*, Vol. 13, Pp: 77–84.
- [9] M. Rafieeyan, N. Yabrekpour, M. Roknapoor, 2007. Metropolitan areas of development strategies of Sustainable Development (Model based on SEA) Case study: Tehran Urban Complex Plan, *Journal of Urban Management*, no 19, Page7-18.
- [10] Site statistical center of Iran, Census 2011. 2012. www.amar.org.ir
- [11] M. Ziaee, R. Mohamad Alipoor, 2007. Sustainable Development Indicators, Evaluate tourism projects, Allameh Tabatabai University, www.tourismscience.ir
- [12] M. Golusin, O.M. Ivanovic. and N.Teodorovic, 2011. The review of the achieved degree of sustainable development in South Eastern Europe—the use of linear regression method, *Renewable and Sustainable Energy Reviews*, Vol. 15, Pp:766–772.
- [13] R. Mokhtarshahi Sani, and P. Mahasti, 2011. Regenerating Regional Identity for Sustainable Tourism Development Case Study: Eslami Island Iran, *Asia Pacific International Conference on Environment-Behaviour Studies*, Salamis Bay Conti Resort Hotel, Famagusta, North Cyprus, 7-9 December 2011, *Procedia - Social and Behavioral Sciences*, Vol. 35, Pp:523 – 530.
- [14] R.D. Fered, A. Parsian Translation, S.M. Arabi, 2011. *Strategic Management*, 19th Edition, Publications Office of Cultural Research, Tehran.
- [15] M. Momeni, A. Sharifi Salim., 2011, *Models and multi-criteria decision making applications*, First Printing, Publisher authors Sponsored by Elixir Pharmaceuticals Inc. Tehran, Iran.
- [16] Gh. Nabi Bidhendi, M.J. Amiri, Sh. Karami, 2013, *Application of multi-criteria decision-making methods in environment*, Kiajor publication, Tehran, Iran.