

Effect of tourism industry on the plastic production in the southern part of the Caspian Sea

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ABSTRACT

Tourism industry growth in many regions of the world, along with the positive and negative economic and social consequences, has environmental impacts leading to irreversible damage. The present study aimed to investigate the impact of the tourism industry on municipal solid waste amounts especially plastics in Nowshahr City, Northern Iran. The physical components of solid waste were determined based on a simple random sampling method. The samples were collected during a one-year study period (from spring 2015 to winter 2016). The Kolmogorov-Smirnov test was performed to determine the normality of data distribution. Also, the One-Way ANOVA and Tukey tests were implemented to investigate significant differences between the seasons. The Delphi-AHP method was used to find the main criteria of solid waste increasing or the tourism effects reducing. The result showed that plastic (15.98%) and polyethylene terephthalate (PET) bottles (11.42%) constituted the highest physical components of solid wastes in the study period. The highest amounts of PET and plastic wastes were observed in the summer, exhibiting significant difference than in the winter ($p < 0.05$). The results showed that amount of waste in Nowshahr is completely influenced by the number of tourists, irregular presence of tourists throughout the year and season. Also, the lack of environmental awareness in the region has led to the accumulation of significant amounts of recyclable waste such as plastic. The result indicated that the importance of knowledge about the amount of produced wastes in managing and reducing environmental effects in tourism areas. Therefore, special attention should be paid to the public education and culture regarding to the separation of wastes from the source and also recycling the solid wastes as well as the public participation in study area.

Keywords: Tourism industry, Plastic generation, Waste management.

Article type: Research Article.

INTRODUCTION

In recent decades, tourism, as an economic activity, (Manzoor *et al.* 2019; Wu & Wu 2019; Rasool *et al.* 2021; Voronkova *et al.* 2021) has played an important role in sustainable development (Wakimin *et al.* 2018; Hwang & Lee 2019; Manzoor *et al.* 2019) and it has been the main force for economic growth and development worldwide (Obersteiner *et al.* 2021). Meanwhile, tourism activities provide a strategic opportunity (Bidhendi *et al.* 2021), diversify the local economy (Meyer & Meyer 2015; Manzoor *et al.* 2019), create employment (López & Arreola, 2019; Martins & Cró 2021; Rajagukguk & Kudus 2023), and generate substantial income for people (Giaoutzi & Nijkamp 2017). Sustainable development paradigm and economic considerations as well as environmental support are considered to reach local and national tourism progress. Knowledge and awareness of the environmental tourist's effects are required to achieve this goal (Vafina *et al.* 2020; Krika *et al.* 2021; Ahmad *et al.* 2021). Tourism has an environmental negative effect (Agarwal *et al.* 2019; Lee *et al.* 2021) versus economic

and social improvement (Onețiu & Predonu 2013; Talebifard *et al.* 2021). Each tourist produces 1100 g waste in average per day (Ramusch *et al.* 2016). In addition, the most municipal solid waste found in tourist activities is plastic waste (Bhat *et al.* 2014). The tourist presence in any region (higher than its carrying capacity) creates negative economic effects such as rising prices of services and land value (Talebifard *et al.* 2021) and also different environmental pollutants such as the water, soil and air pollution (Zhao & Li 2018; Mikhailenko *et al.* 2020), as well as land degradation (Shobeiri *et al.* 2013; Bakhshipour *et al.* 2021; Obersteiner *et al.* 2021). The research conducted on Langkawi Island (in Malaysia) showed that 17% of the island's dry waste was plastic. It is also stated that the global tourism industry development has recently caused an increase in waste generation and an alteration in the tourism waste composition. Ultimately waste recycling, as a basic principle, is a priority of tourism sustainability (Shamshiry *et al.* 2011). Arbulú *et al.* (2015) reported that the solid waste generation in European countries is affected by tourism activities. In these regions, using disposable and over-packaged items reduced the landfill life and displayed negative effects on the environment. Arbulú *et al.* (2013) reported that one of the main environmental challenges of tourism in Spain is the waste generation, and tourism growth is directly caused the expansion environmental problems and waste generation. After the food wastes, the plastics are the most solid wastes produced from tourism activities (Muñoz & Navia 2015; Aziz 2019; Widyarsana *et al.* 2022). Daily plastic generation has been increasing due to the benefits and practical using of this waste. Plastic wastes are resistant to degradation and exhibit long-term persistence in the environment (Kumar *et al.* 2021). The advantages of using plastic consist of flexibility, impact resistance (Awoyera & Adesina 2020), and provision of many benefits such as comfort, hygiene, and safety leading to the well-being of society. Plastic wastes are one of the main threats to the stability of the planet (Awoyera & Adesina 2020). It is estimated that about 300 million tons of plastic waste is produced annually (Singh & Sharma 2016). The plastic will become waste for its inappropriately disposal at landfills (Awoyera & Adesina 2020; Kumar *et al.* 2021). Plastic waste would increase social costs (Wandeka *et al.* 2022) leading to resource consumption and thus causing consequent public health problems (Martins & Cró 2021). In the study on the quantity and quality analysis of municipal solid wastes in Malayer City, Hamedan Province, Iran, all samples were manually separated to determine the physical components of waste, and the data were analyzed using the Tukey test (Sayahzadeh & Samadi 2009). In a similar study in Tehran City, capital of Iran, solid waste recycling potential was investigated (Dehghani *et al.* 2009). The impact of tourism on the solid waste generation and management cost showed that tourist activities are responsible for generating 41.9% to 46.6% solid waste per resident in Madeira Island, Portugal (Martins & Cró 2021). Clearly, the impact of plastics on the environment are considered as a serious crisis and can be increased due to the expansion of tourism flows, as well as the lack of efficient management and planning. Therefore, to evaluate tourist activities that generated waste and their environmental effects, the actual amount of waste should be calculated initially (Obersteiner *et al.* 2021). Meanwhile, determining the time and places of influencing tourism activities on environment can be useful in planning suitable management programs in touristic areas and reducing their effects by solutions. It is important to take a special look at the issue of environmental management during the presence of tourists in a touristic area. Therefore, knowledge and scientific attitude regarding the amount of waste generated by tourists can lead to reasonable solutions and options to achieve optimal waste management in touristic areas. The purpose of this study was to investigate the characteristics and complexities of the relationship between tourism and generated waste to achieve an appropriate response that can be provided to the flow of waste in touristic places. Actually, this research with the aforementioned goals is going to document the amount of generated waste as an environmental hazard during the presence of tourists in the region, and expressing awareness and verify the model with the data of different seasons of the year, and explain the effective economic, social and cultural criteria.

MATERIALS AND METHODS

Study area

Mazandaran Province is located in the southern part of the Caspian Sea and is known as a prominent place that has the natural and geographical area to attract tourism in Iran (Honary 2011). Over 5 million tourists entered the Mazandaran Province in 2007 (in winter) and 2008 (in spring; Razavi *et al.* 2013) which produced roughly 2,700 tons waste daily. The Nowshahr, among the western cities of the Mazandaran province, is one of the most interesting places for tourist's attraction due to its beautiful coasts and suitable climate (Hoseini 2013). The tourist's population in Nowshahr during the holiday (in summer and spring) has been more than the population capacity (Hoseini 2013).

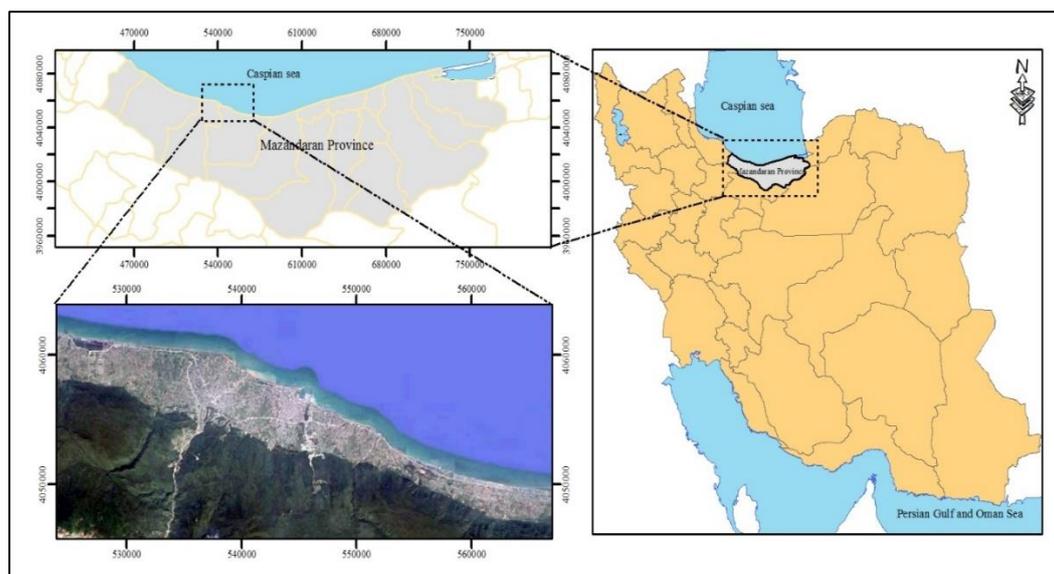


Fig. 1. Location of Nowshahr City, Northern Iran.

Data processing

In the present study, the information regarding the municipal solid waste was gathered in the one-year study period (from spring 2015 to winter 2016). Four sampling locations were selected consisting of two touristic- and two non-touristic- areas. The simple random sampling method was used to measure different kinds of solid wastes in the selected locations. The wastes were separated, and the weight of each waste component was obtained to qualitatively examine the samples and determine its weight (%). The waste components' weights were attained by placing the municipal mixed waste in a square container with the specified dimensions ($1\text{ m} \times 1\text{ m} \times 1\text{ m}$). The observed components in the waste samples consisted of perishable materials, metals, cardboard, glass, textiles, bread, rubber, wood, iron, plastic, and PET bottles, of those, the plastic and PET were measured and analyzed.

Statistical analyses

The significant difference of physical component analysis of municipal waste was examined in Nowshahr City for the one-year study period covering all four seasons using SPSS software package. The Kolmogorov-Smirnov test was used to determine the normality of data. Then, a One-Way ANOVA analysis was used to investigate the significant differences between the variables. Since there are more than two groups of samples, the Tukey test was used to compare the mean difference between the groups. In these tests, a significant level of 5% was considered. A Pearson correlation coefficient was used to determine the relationship between the number of tourists and plastic production. To improve the solution for reducing the tourism effects, the Delphi-AHP method was used to find the main criteria for generating the solid waste by tourism. In this approach, a questionnaire method was designed to collect the necessary information. To achieve this, the most important criteria and sub-criteria consisting of 32 variables were prioritized by the relevant experts in the domain. Finally, the 21 important sub-criteria served as inputs of the hierarchical analysis method.

RESULTS AND DISCUSSION

The measured solid waste in the tourist and non-tourist area of Nowshahr City showed that the plastic with 15.98% and PET bottles with 11.42% of the solid wastes components had the highest rates (%; Table 1). In study conducted in Langkawi (Malaysia), the plastic comprised 17% of wastes components (Shamshiry *et al.* 2011), which was higher than in the present study. Also Aziz (2019) reported that the plastic was 26.31% of solid waste in Pariaman tourist City, West Sumatra. In other study, the amount of PET waste and plastic were 1.05% and 2.95% in tourism areas of Hoi An in Taiwan respectively (Pham Phu *et al.* 2019). Widyarsana (2022) calculated the amount of plastic was 2.4% of the waste composition in Nusa dua tourism area, Indonesia. Also, Tran *et al.* (2021) reported that in Kata region of Vietnam, 19% of hotel wastes is related to plastic. The amounts of plastic in the tourist area of Luar Batang Village, Indonesia were 4.05%, 3.37% and 6.4% for PET, PP and LDPE respectively (Abbas *et al.* 2021). These studies showed that the plastic is one of the main waste components in

touristic area similar to Nowshahr City. The findings of the present study showed that the highest waste amount observed in the summer (with an average weight of 26.253 kg) while the lowest in the winter (with an average weight of 18.099 kg). In the study of Mateu-Sbert *et al.* (2013) in the Menorca Island (In Spain) it was found that waste generated in summer was higher than twice from winter. Actually, various factors such as the economy and seasons are the main causes of the increasing waste in summer season. Previous findings stated that an elevation in the solid waste amount exhibits a close relation with the tourist activities and holiday seasons (e.g., Shamschiry *et al.* 2011; Mateu-Sbert *et al.* 2013). In summer, there is a tourism flow to the tourist areas (Kiš *et al.* 2021) who showed that in the Ilirija region, Croatia, the amount of plastic waste increased during the tourist seasons compared to the winter. Tran *et al.* (2021) reported that the amount of produced solid waste in hotels is related to the season. Furthermore, an elevation in tourist presence in spring and summer in Nowshahr is the main cause of solid waste upraise, since the generated waste in the holiday was higher than in the other seasons. Obersteiner *et al.* (2021) argued that the tourism is the main cause of waste production. Also, Arbulu *et al.* (2017) reported that 1% elevation in tourism growth rate in Mallorca region, has caused a 1.25% upraise in waste disposal. Therefore, the amount of generated waste is highly dependent on the season (Munoz & Navia 2015).

Table 1. The weight of municipal waste for different seasons (kg)

Season	Total wastes	PET	Plastics
Spring	1459.832	148.828	162.171
Summer	1500.821	135.695	199.986
Autumn	1163.364	60.688	114.045
Winter	982.880	41.745	74.880

The Kolomogrov-Smirnov test showed that the data have a normal distribution, and the ANOVA test was performed between the values obtained from the municipal waste (Table 2).

Table 2. Results of One-Way ANOVA.

Variables		Sum of square	Df	Mean square	F	Sig.
Plastics	Between groups	4.895	3	1.632	101.504	0.000
	Within groups	3.279	204	0.016		
	All	8.175	207			
PET	Between groups	11.195	3	3.732	98.71	0.000
	Within groups	7.674	203	0.038		
	All	18.869	206			

The obtained results showed that the average total PET and plastic generated in all seasons differed significantly. The results of the produced PET and plastic in the summer exhibited a significant difference ($p < 0.05$) with the winter. Also, the average of plastic per capita in the summer was 774 g per person (Fig. 2), while was 269 g in the winter. In addition, the average produced plastic in all seasons differed from each other. Ghaffari *et al.* (2019) reported that, the most effective factors on plastic distribution in Guilan Province, Iran included urbanization and population. Each tourist in Europe produces at least 1 kg, while in America at least 2 kg per person daily (UNEP 2003). Ramusch *et al.* (2016) estimated that the amount of produced waste by tourists was 1.1 kg per day. In the present study, there was a significant difference ($p < 0.05$) between the amount of produced plastic in summer and winter. However, there was no significant difference between the average produced PET in spring and summer ($p > 0.05$). Despite, generated PET in spring and summer was different from the autumn and winter (Figs. 3-4). The study conducted by Fataei *et al.* (2004), in the Sarein Tourist City, Northwestern Iran showed that the produced plastic in the summer was higher than in the other seasons which may attributed to the high consumption of plastic in the area and high numbers of tourist. Kiš *et al.* (2021) reported that an elevation in the number of

tourists in Ilirija region, Croatia, has directly caused an upraise in the amount of waste during the tourist seasons. It can be argued that the plastic and PET amounts will be increased in the tourist areas due to high plastic production. Generally, the tourist activities have positive and significant effect on the waste production (Martins & Cró 2021).

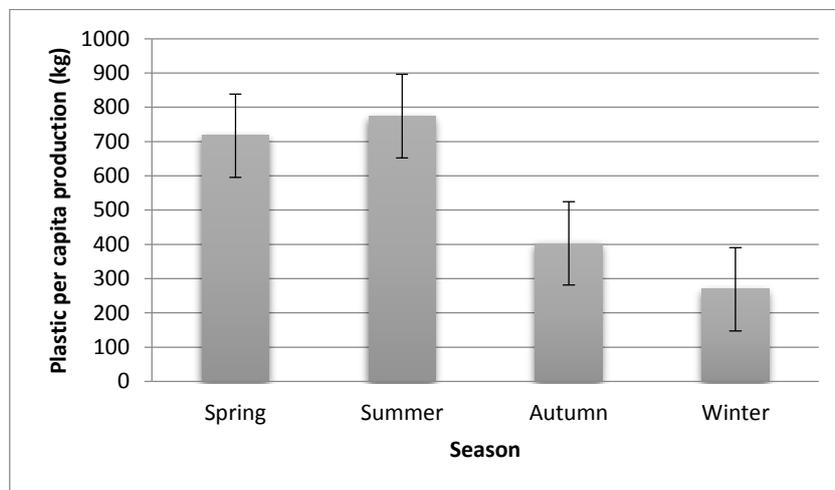


Fig. 2. Plastic per capita production in different seasons.

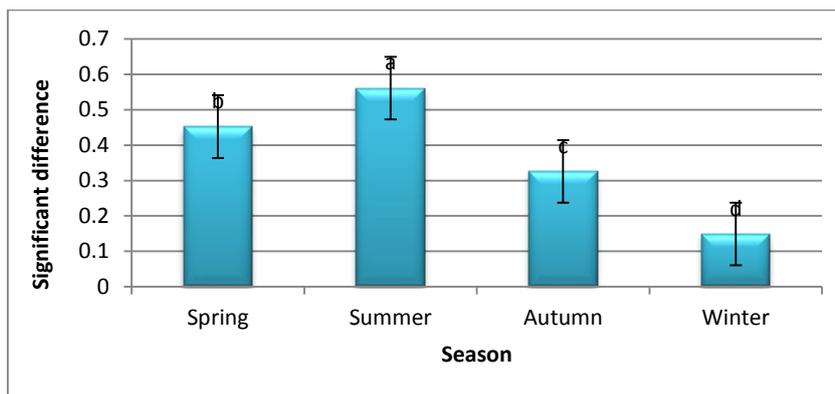


Fig. 3. Significant difference in the amount of generated plastic in the different seasons.

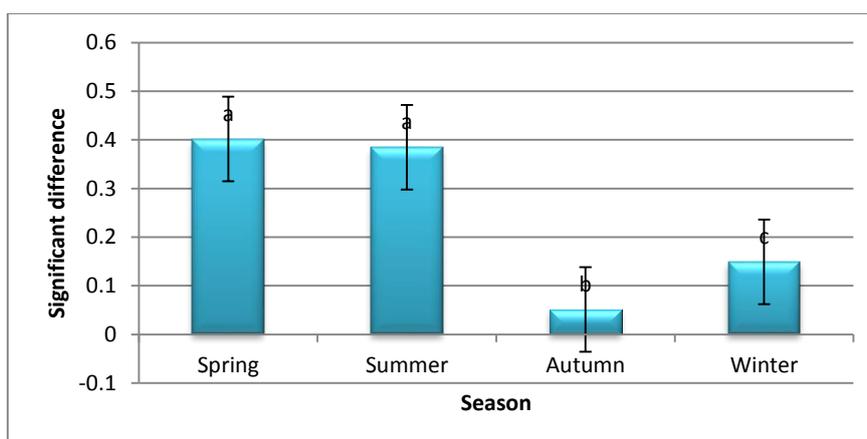
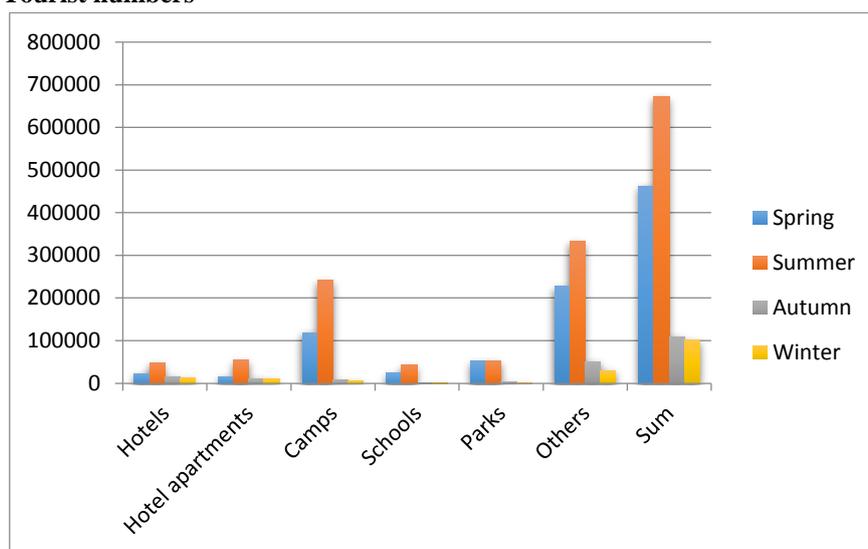


Fig. 4. Significant difference in the number of produced PETs in the seasons.

The correlation coefficient between the plastic production and the tourist population (Fig. 5) was 95.6% (Table 3) and the significant relationship between variables was 0.044 ($p < 0.05$). Zarabi & Eslami Parikhani (2011) found the similar conclusions. Therefore, further tourist's presence may lead to the production of more solid waste (Martins & Cró 2021). Studies of Arbulu *et al.* (2015), Bashir & Goswami (2016) and Mateu-Sbert (2013) reported a direct relationship between generated solid waste and tourism.

Tourist numbers**Fig. 5.** Number of tourist's presence in Nowshahr (Nowshahr Cultural Heritage, Tourism and Handicrafts Office 2015).**Table 3.** The results of Pearson correlation coefficient

	Plastic and PET	Pop	Sig.
Plastic and PET	1	0.956*	0.044
Pop	0.956*	1	

Correlation is significant at the 0.05 level (2-tailed).

The results showed that the amounts of produced solid waste by tourists cannot be compared with those reported by the previous studies, depending on the number of the tourists entered the region. Studies (Shamshiry *et al.* 2011; Kiš *et al.* 2021; Widyarsana 2022) reported that the amount of solid waste increased by the tourist activities in the holiday seasons. Therefore, the production and composition of waste would be different based on the area and also the kind of tourists activities (Hoang *et al.* 2017). The study conducted in Spain (Mateu-Sbert *et al.* 2013) indicated that 1% elevation in the number of tourists will averagely rise 0.282% waste generation, and also each tourist produced 1.3 kg waste per day. Gidarakos *et al.* (2006) estimated that the average amount of solid waste produced by tourists is about 1.2 kg/day, which is similar to that of the present study (1.24 kg day⁻¹). For every 1000 tourists, 0.245 to 0.372 kg will be added to per capita waste generation (Martins & Cró 2021). Studies (Dileo 2007; Bashir & Goswami 2016) showed that tourist activities and establishment are the main causes of produced waste. According to UNEP (2019), the companies providing services in tourist area and the number of tourists are the main factors in the generated wastes. To find main criteria of solid waste increasing or reduction of tourism affects, the Delphi-AHP method was used. Four main criteria consist of management, social and culture, economical and season and tourist area with 21 sub-criteria investigated (Table 4). The results of pairwise comparison (Table 4) showed that the season and tourist area criteria (0.366 score) are the important effective subject in solid waste production in Nowshahr City. From the sub-criteria related to the season and tourist area, the season of tourism arrival and inappropriate distribution of tourists during different seasons of the year exhibited the first priority (0.326). The waste amounts elevation displayed significant effects on the unsustainable and ineffective solid waste management system in tourist areas in Malaysia and Ukraine (Murava & Korobeinykova 2016). From the social and culture sub-criteria, the lack of information about the correct way of dealing with environment had the score of 0.249. Pohan (2013) reported that behavioral patterns and low awareness of tourists to preserve the environment and the lack of knowledge in separating and classifying waste are several problems in tourism area. Also Ranieri *et al.* (2014) argued that inefficient behavior of tourists to separate different parts of waste upraised the amount of solid waste. Taghdisi *et al.* (2012) pointed out that the development of culture can play an important role in improving the environment. Evaluating the sub-criteria of management exhibited that the weak management and lack of regular plans of related organizations to educate citizens obtained 0.235 score. The lack of planning information and regulations in tourism waste management in

Noosa region caused various problems to the environment. Also most municipalities lack financial facilities for sustainable management of solid waste in tourism areas (Chaaban *et al.* 2019). The study of Lotfi & Mirabootalebi (2012) in Ramsar City, North Iran indicated that inefficiency of tourism establishment has intensified the damage to environment. Andreck *et al.* (2005) stated that one of the best planning techniques is to charge an entry fee for tourists, which can reduce the negative effects.

Table 4. The results of main criteria of waste generation in Nowshahr tourist area

Criteria	Score	Sub-criteria	Score	Inconsistency ratio
Social and culture	0.362	People's education level	0.061	0.01
		Lack of a culture of public participation or a kind of passivity in society	0.158	
		Lack of attention and also lack of familiarity of local people in how to deal with the guidance	0.071	
		Social conditions of the host city	0.102	
		Lack of awareness of tourists about the services of various ecosystem resources and the destruction by disposal of waste	0.156	
		Type of visitors' ethnicity and cultural and linguistic differences with local people	0.055	
		Lack of awareness of waste materials and recycling conditions	0.147	
		Lack of information about the correct way of dealing with nature	0.249	
Season and tourist area	0.366	Season of tourism arrival and inappropriate distribution of tourists during different seasons of the year	0.326	0.08
		Tourist accommodation areas	0.157	
		Urban tourism arrival rate	0.321	
		Beauty and cleanliness of the host region	0.186	
Management and Institutional	0.324	Lack of skilled human resources to guide and supervise tourists	0.094	0.04
		Lack of infrastructure for waste disposal and collection in different areas	0.235	
		Inadequate and insufficient facilities and equipment for accommodation and welfare	0.192	
		NGOs active in the field in the region	0.121	
		Weak management and lack of regular plans of related organizations to educate citizens	0.358	
Economical and Demographics	0.147	Reluctance of local people to invest in the tourism sector	0.14	0.11
		Local income	0.131	
		Local People's jobs	0.096	
		Lack of ownership and free use in many natural areas	0.632	

CONCLUSION

The Knowledge about the amount of generated waste by tourists is the most important issue in evaluating tourist activities, recognizing the characteristics of the region, providing appropriate and reasonable solutions and options in order to achieve optimal land management. The results showed that the amount of generated waste in the region in the high seasons (e.g. summer and spring) is affected by the numbers of tourists, and leads to an elevation in waste significantly. Plastic (15.98%) and PET (11.42%) were the highest waste component in the area. Based on the main objectives of the study, it has been concluded that the amount of waste in Nowshahr is completely influenced by the number of tourists, and also irregular presence of tourists throughout the year and season, with a significant relationship. Therefore, it is necessary to examine the general policies of local management to reduce the environmental effects of tourism. It is suggested that a comprehensive separation plan for the solid waste components needs to be developed in Nowshahr by the Recycling Organization and finally plan implementation by the private sector. Also, the lack of environmental awareness in the region has led to the accumulation of significant amounts of recyclable waste such as plastic in Nowshahr region. Therefore, special attention should be paid to the public education and culture regarding to the separation of solid waste from the source and recycling it as well as the public participation to achieve the goals of programs. In addition to direct economic benefits, recycling programs can also indirectly be important in terms of protecting the environment and human health along with reducing the costs of environmental clean-up and training of people in the community. The ineffectiveness of optimal waste management in the region has greatly contributed to these effects, that by the proper implementation of separating solid waste from the source and recycling it by Nowshahr municipality, the amount of waste entering landfills will be certainly diminished, and the economic costs of MSW will be reduced.

These results can be an effective way in planning waste management infrastructure and waste collection services in tourist areas. The implementation of management policies such as using recycling program, especially during tourism time, could prevent the sanitary landfilling of 454.71 kg plastic and properly manage recyclable waste, e.g., plastic. The result showed the importance of knowledge about the amount of generated waste in managing and reducing environmental effects in tourism areas. This amount of knowledge makes to know, how to manage the performance of basic and practical executive and management conditions in the planning. Knowledge of the influencing criteria can be effective in choosing the optimal solution that has the most efficiency in the shortest time, which was discussed in the present study. The waste problem cannot be solved by strict rules. Therefore, a way to motivate and education should be found, and strategies should be reviewed based on sustainable development goals using compatible options.

ACKNOWLEDGMENT

The authors thank the Nowshahr Cultural Heritage, Tourism and Handicrafts Office, and the Nowshahr municipality for providing the data.

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Bibliographic information of this paper for citing:

Lohrasbi, N, Tavakoli, B, Aalipour, M 2023, Effect of tourism industry on the plastic production in the southern part of the Caspian Sea. *Caspian Journal of Environmental Sciences*, 21: 767-777.

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