

## Waste Management in Selected National Parks – A Review

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### ABSTRACT

Natural areas have a high value associated with the existence of a variety of priceless natural resources. It is important to employ sustainable development in these areas by protecting the natural resources. Reasonable waste management is a global need that can significantly contribute to the protection of the environment and to sustainable development simply by accepting pro-environmental behaviour patterns. Waste management in national parks on four continents was restricted by law in some countries, which is also a priority for nature conservation. In North America, individual regions are subject to the regulations on waste management, which correspond to the local needs within national parks. Low environmental awareness of both residents and tourists is conducive to the degradation of the natural environment; this is particularly true in Asia. One of the most significant threats in these protected areas is inappropriate waste management, which is related with the practice of landfilling or combustion of waste. In order to decrease the amount of waste generated, the following solutions should be implemented: the development of education to increase the environmental awareness, and planning solutions in accordance with sustainable development.

**Keywords:** valuable natural areas, waste management, nature conservation, landfilling, sustainable development

### INTRODUCTION

Protected areas play a key role in maintaining the biodiversity and services provided by natural systems (Kolahi et al., 2013). Valuable natural areas (VNA) are defined as such due to the existence of a variety of specific priceless natural resources, both animate and inanimate. National parks constitute one form of nature protection, created in order to maintain biodiversity, resources, creatures and elements of inanimate nature and landscape. National parks also restore the proper state of resources and elements in nature, where distorted natural habitats exist. In the European Union, national parks were created in accordance with the provisions of Council Directive 79/409/EEC of 2 April 1979 on the conservation of wild birds (L 103 EC 25.04.1979, as amended) and Council Directive 92/43 / EEC of 21 May 1992 on the protection of wild fauna and flora (L 206 of 22.07.1992). Countries practice different approaches to the management of the protected areas (Solomon et al., 2013). It is

important to maintain sustainable development by ensuring that natural resources remain in an undamaged state, despite increasing pressure on protected areas, often caused by the anthropogenic impact on the environment. This impact is also caused by tourism (Wei et al., 2013). These activities bring many positive but also many negative effects to the country (Posch et al., 2015). The negative effects are related with the increase of waste, which contributes to the degradation of the natural environment. The tourist production of waste is perceived as one of the major threats to the environmental sustainability in remote mountainous regions and protected areas (Steg and Vlek, 2009; Clark et al., 2003). The second negative effect concerns the economic impact of the waste management hierarchy. The notion of waste hierarchy is the classification of waste management into reduction, reuse, recovery or recycling (McDougall et al., 2001). Kadafa et al. (2014) showed that the growing amount of solid waste is a global problem, and a key challenge for many developing countries. The importance

and careful understanding of sustainable resource management, as well as the increase in waste generated, are key to identifying the potential risks associated with waste management.

The aim of this work is to review the issues related to waste management in selected areas of valuable farming on four continents. The research was conducted within the context of limiting the increasing pressure on the environment, due to the increase in the waste generated.

### The importance of nature conservation

According to Butlin (1987), the main objectives of environmental protection established at the international level are focused on two main zones:

- moving away from global threats, including with the depletion of valuable natural resources
- ensuring ecological safety and awareness of the individual of a specific local community

The visitors' level of environmental protection awareness has a significant impact on the state of the environment in protected areas (Erdogan and Tosun, 2009). The anthropocentricists most aware of environmental protection were demonstrated in (Loakaewnoo et al., 2015). Łuniewski (2015) distinguished area (reserve), species and individual protection in nature conservation. In addition to natural and valuable area protection, the following should also be included:

- area protection
- object protection
- species protection

The Geographic Information System (GIS) also plays a significant role in the protected areas management, including the integration of multiple sets of data from various sources (Becco and Brown, 2013).

### The threat to valuable natural areas

VNA are subjected to pressure from many unfavourable factors of anthropogenic origin. The main threats include tourist flows, development of *leisure activities* and an increase in the number of visitors to protected areas (Balmford et al., 2009). In the areas of tourist penetration, two types of waste are clearly distinguished. The first is point waste related to the location of the accommodation and catering facilities (e.g. holiday centres, hostels, museum facilities, management

offices, viewpoints, tourist and recreational facilities). The second is linear related to communication routes (including tourist routes), pedestrian, water and motorsports, in the areas around recreation centres, on the seacoast, on the outskirts of other natural and artificial water reservoirs and along watercourses (Łuniewski, 2015). These factors adversely affect the environment and degrade vegetation. Growing pressures on the environment were demonstrated by Ringo et al. (2016), because of protected areas being visited by large numbers of tourists, which constitutes a potential threat to the environment. The negative impact of tourism on the environment is mainly noticeable for high visit rates, which exceed the capacity of an area, affect the vegetation, produce waste and noise as well as scar wildlife (Gúčik and Marciš, 2017). This is connected in particular to the degradation of fragile eco-systems (flora and fauna) (Sasidharan et al., 2002; Ragazzi et al., 2014). Other studies (Newsome et al., 2012) considered the number of visitors, the frequency and type of visited ecological farms and the spatial distribution of users to determine the size of the dispersion and the impact on valuable natural areas.

Tourism and recreation were considered as the population shifted to cognitive and recreational purposes. Cognitive purposes were treated as an active temporary rest related to a given place, while recreation was a form of passive rest, associated with a temporary stay in a given place. A special consideration for tourist penetration was within mountain protected areas (Geneletti and Dawa, 2009). One of the factors affecting the deterioration of the natural value of such a park was the waste left by people, which also had a negative impact on the quality of the surrounding environment, including the mountain streams (Manfredi et al., 2010). The environmental effect of tourism is the degradation of ecosystems (including flora and fauna) in national parks, forests and wetlands, through intensive water extraction and an increase in the amount of sewage and municipal solid waste (MSW). This can in turn cause depletion of pasture and water resources, loss of vegetation coverage, soil erosion, habitat fragmentation, degradation and destruction, introduction of exotic species and extinction of wild animal species (Sasidharan et al., 2002). Unfortunately, national parks lack funds for proper maintenance, development and management on top of the improper use by visitors, tour operators and private enterprises operating within the

park boundaries (Herremans et al., 2005). It is now widely accepted that tourism constitutes a potential threat to the environment and should be considered in accordance with sustainable development. Parks are also inhabited by the people who may have a negative impact on the local natural resources. Although Buultjens et al., (2005) confirmed that in national parks, the possibility of running a business was envisaged, the action brings negative environmental consequences. Along with the increasing of economic development and the pressure on the environment, the approach to environmental protection is changing.

### Waste management in protected areas

Waste management in VNA is subject to general jurisdiction, which remains under the rigors of application laws and regulations of a material scope. The legal mechanisms concerning environmental protection should be compatible with waste management legislation, despite the fact that the scope is different (Łuniewski, 2015). Solid waste management is a global problem and is a key challenge for many developing countries (Kadafa et al., 2014). Incorrect waste management is a serious threat to the environment. The solution is a reduction in mass, because the increased waste internationally has been significant. Manfredi et al. (2010) indicated the causes as an increase of densely populated areas, the development of urbanization, improvement of living standards, changes in consumption, and – above all – a lack of an effective waste management system. For the purpose of modelling and balancing the waste stream, it is most often separated into a series of sub-categories (Manfredi et al., 2010):

- sources of waste generation
- areas on which waste is formed or stored
- ways of living for the local society (heating methods, habits, standard of living, ecological awareness)

In order to plan a waste management system, the data collected and analysed, an understanding of ongoing processes must be achieved as well as the existing problems and possible solutions for improvement must be identified. The data analysis will include the assumed processes, functional units, finding gaps and identification of weaknesses in the system and recommending possible solutions for improvement (Pires et al., 2011). Rohracher et al. (2006) emphasized the

role of current and future waste producers as a key factor for successful innovation. Therefore, it is important to include these stakeholders in the innovation process, enabling communication and cooperation.

### North America

In North America, the analysis of waste management covered of selected parks in Canada and the United States.

#### Canada

Banff National Park is Canada's oldest national park. It is located in the Rocky Mountains, west of Calgary in the province of Alberta. On the basis of management regulations, it is possible to significantly decrease the mass of waste intended for landfilling by directing composting or reusing and recycling. In Canada, in order to reduce the mass of waste from national parks to be deposited on a landfill site, the "green public procurement practices" were introduced. Economic operators may acquire any waste suitable for composting or reuse at favourable prices. In Canada, it is prohibited to carry out landfilling of waste on a national park site or any other VNA. It is also not possible to use any other forms of waste disposal beyond recycling and composting, which are used in some national parks. There are no active landfill sites in national parks. In some cases, waste is collected in containers and then transported to municipal or regional landfill sites located outside the park. The ban of waste deposited on a landfill site is usually respected, although there have been cases of waste being deposited in the places not intended for such purposes (Biedrawa, 2010).

#### United States (US)

Waste management in each US national park is regulated by a separate state law. In the US, MSW also includes wastewater.

The Rocky Mountain National Park is located in north-central Colorado, within the Rocky Mountain Front Range. There are no landfill sites in this park, but there are facilities with containers for solid waste to be collected each year. The waste is then transferred to rural landfill sites. The law on environmental protection does not allow for the construction of landfill sites within naturally valuable areas. The waste generated within the Park is transported by lorries to organized landfill sites outside its borders.

At Yosemite National Park, which is located in east central California, any disposal of waste is illegal with the exception of the containers supplied especially for the Park. The waste from outside the Park may not be brought into the area. There is no special composting prohibition in Yosemite Park; however, compost containers attract wild animals, which is why the containers are tightly sealed (Biedrawa, 2010; Matthews et al., 2006).

### *Africa*

On the African continent, the analysis of waste management takes into account selected parks in Tanzania.

### *Tanzania*

The Mikumi National Park is located near Morogoro in eastern Tanzania. Strict enforcement of the regulations protecting the environment of the Park is important, due to the depositing of waste in its area. Within the park, waste, recycling materials and hazardous waste have been left by users near the motorway park (Ringo et al., 2016).

The Serengeti National Park is famous for the open plains (savannahs) that characterise many of the regional plateaus in East Africa (Scoon, 2018). The national park contains a wide variety of natural disturbances: animal trails, animal burrows, termite mounds, erosion; and human disturbances: paths, roads, garbage dumps, villages, and administrative centres (Belsky, 1987).

### *Asia*

In Asia, the analysis of waste management covered selected parks in five countries (China, Iran, Nepal, Mongolia and Turkey).

### *China*

There is an increased interest in national park tourism in China. Zhong et al. (2008) conducted a research in China's Zhangjiajie National Forest Park, taking into account both external and internal factors affecting the park's tourism development as well as the environmental, social, and economic changes of the area. Han and Ren (2001) noted that the Chinese protected areas were characterized by a lack of geodetic data, making it difficult to compare the results of different approaches to planning and implementation. Eco-innovative management in protected areas has not been significantly developed yet. In turn, sustainable development is seen as a source of new

opportunities and synergies to overcome the existing difficulties. In China, waste containers can be found throughout the whole park, but are not differentiated in terms of the types of waste. This hinders increasing awareness among residents.

Gaulke et al. (2010) in the Jiuzhaigou National Park in Sichuan Province, China showed an increase in the number of tourists. While assessing the sanitary conditions, the park's administration considered the solutions conducive to maintaining sustainable development. The waste in the park was collected and disposed of outside its area (Tritto, 2014).

### *Iran*

The oldest national park in Iran area is Khojir National Park. It is situated inside the Jajrud Protected Area, east of Sorkhe-hesar National Park and Tehran city. A fragment of a motorway runs through the park. In addition, environmental risks in the park include the pollution introduced as a result of generated solid waste, which reflects the low level of protection (Kolahi et al., 2013).

### *Nepal*

Sagarmatha (Mt. Everest) National Park is located in the Himalayas of eastern Nepal, where the visitor activity is concentrated. This generates significant amounts of municipal solid waste that can contaminate water and soil through improper disposal. The number of tourists has been increasing each year, similarly to the accumulation of waste (Nepal, 2003). Waste is left on the routes and camps in the mountains, including significant quantities of waste-cans, bottles, plastic bags and papers (Bishop and Naumann, 1996; Kuniyal, 2002; Kuniyal, 2005). Waste collection mechanisms have been implemented on a door-to-door basis and waste bins have been placed along routes and are regularly emptied. Municipal solid waste management is carried out by a non-profit organization that introduced waste collection. Waste management in the park, however, leaves much to be desired. It is not properly implemented, and so waste is left in the places unintended for such a purpose. Improper disposal of waste also occurs through combustion in landfill sites within the park. Another defect of the combustion method is that it results in a large number of landfill sites, which are uncontrolled and dispersed throughout the park, regardless of the geoenvironment (Manfredi et al., 2010).

### *Mongolia*

The National Park including Khovsgol Lake is located in northern Mongolia. There is no environmentally friendly waste management. In this area, waste is combusted or abandoned by individual households within its area, though there are laws and plans to regulate the amount of waste to reduce its production. The infrastructure to implement the existing legal regulations does not exist (Free et al., 2014).

### *Turkey*

Goreme Historical National Park is located at the heart of the Cappadocia region in Central Anatoli (Turkey). Hotels are built within, and there are no alternative or sustainable tourist products. Hotels produce large amounts of solid waste, including packaging, food scraps, as well as cleaning and maintenance materials, which may be toxic. Turkey requires spatial planning and environmental policy in accordance with environmental protection. In many cases, waste is collected in poorly designed landfills or simply disposed of in abandoned landfill sites. In addition, there are no modern facilities for waste management in the park area (Erdogan and Tuson, 2009).

### *Europe*

On the European continent, the analysis of waste management covered selected parks in France, Germany, Poland, Slovakia and Sweden.

### *England*

The Lake District National Park is a mountainous region in Northwest England and has no regulations beyond the national, regional and local environmental policy schemes. The Yorkshire Dales National Park is located in North Yorkshire (Northern England), and there are no waste disposal sites. However, there are landfill sites in other national parks; for example, in the North York Moors National Park (Northern England). These are mostly old municipal waste landfills, located in disused opencast mines. The environmental policy on waste management in the Yorkshire Dales National Park is characterised primarily by its opposition to the disposal of waste within the national park, beyond inert waste. In the future, it is projected to manage the inert waste generated on the park premises (Sobczyk et al., 2011).

### *France*

In France, there are no regulations to prohibit composting, incineration and recycling, but none of the parks use this omission, to the detriment of the environment (Sobczyk et al., 2011).

The disposal of waste from the Mercantour National Park (the South-Eastern French Mediterranean region) is the responsibility of the municipalities within which the park exists. Therefore, there are no regulations specifically regarding the waste generated in a park. Waste treatment takes place outside the area, and waste composting is allowed. The greatest problem in the Mercantour National Park involves the remains of picnic food left by tourists.

The Mercantour Park is located within 28 municipalities and there is no common policy for waste management. Only a few municipalities have introduced a partial selection of recycled materials, including paper, glass and metal (Sobczyk et al., 2011). According to Long et al. (2012), the lack of regulation may be derived from the deficiencies in the education on sustainable development.

### *Germany*

In the Bavarian Forest National Park, which is located in the Eastern Bavarian Forest, guests are obliged to take waste with them. Park guards collect illegally abandoned waste, and also prevent illegal unloading of waste. The waste generated in the park area is disposed of in accordance with applicable national regulations. There are no landfill sites in the park.

The Law of the Hainich National Park, Thuringia prohibits the landfilling of waste. The provision does not allow any other waste disposal. All visitors to the park are required to take packaging, bottles and any other waste with them. For this reason, there are no litter bins in the park (Sobczyk et al., 2011).

### *Poland*

In Poland, the majority of tourist traffic in national parks is seasonal, with the exception of the mountain parks – Tatra and Karkonoski in southern Poland, where winter tourism is also typical. Public holidays (the so-called long weekends) increase the attendance to national parks, which is manifested in a greater number of individual arrivals and trips to the city by car. This causes a significant concentration of vehicles in the immediate vicinity of parks. The negative effects

of tourism in national park spaces are difficult to avoid, and generally result from the need to ensure adequate conditions of stay and the safety of visitors. Studies (Patryk, 2010; Mika, 2003) showed that the largest factors contributing to poor waste management were littering on tourist routes due to the tourist traffic, the nuisance caused by an excessive number of visitors and the poor financial condition of national parks. In Poland, the regulations regarding nature protection and waste management include the legislative acts of a statutory rank and government documents that complement local law acts. A landfill site is not intended to serve the purposes of the national park, so such forms of management cannot be implemented, except for collection at designated points. Other forms of waste management (recycling and waste combustion) are not included in the investments serving the conservation purposes of the national park (Nature Conservation Act, 2004).

#### Slovakia

The Tatra National Park is situated in North Central Slovakia. The number of tourists visiting is increasing, which also has negative effects, primarily associated with solid waste management in public places. Gúčik and Marciš (2017) showed that tourists wished to have access to waste containers in the area of these mountains.

#### Sweden

In Sweden, there are no special regulations regarding the waste management in a national

park or other protected landscape area, but there is a regulation that prohibits the deposition of waste in national parks. One of the most well-known parks in southern Sweden is Norra Kvills National Park, which facilitated the 600-year history of fires study (Niklasson and Drakenberg, 2001). There are no active landfills in the parks. However, there are very old closed dumps, some of which are reclaimed (Biedrawa, 2010).

Table 1 presents synthetic waste management in the selected national parks, taking into account legal regulations as well as infrastructural objects and residential buildings. In seven countries out of the fourteen analysed, the legal regulations related to waste management exist. Some countries, including the US, Poland and Germany, show regional as well as local regulations. Waste collection was practiced in national parks in five countries. This action prevents the development of abandoned landfill sites. However, in the protected areas, waste landfilling was also practised in five countries, excluding the continent of North America. According to Gharfalkar et al. (2015) landfilling of untreated waste is not conducive to sustainable waste management. Unfavourable waste combustion in an unorganized method practiced in Mongolia and Nepal, which causes unacceptable particulate, gaseous and solute emissions (Sabbas et al., 2003). In four countries (France, Iran, Tanzania and Turkey), road infrastructure, the expansion of hotels or the occurrence of residential buildings existed within the parks, which is also not conducive to sustainable development.

**Table 1.** Aspects of waste management in selected national parks

Country	Law	Infrastructure	Household	Waste disposal			
				Collection	Recycling*	Landfilling	Combiustion
China				x			
England	x					x	
France		x			x		
Germany	x						
Iran		x					
Canada	x			x	x		
Mongolia			x			x	x
Nepal				x		x	x
Poland	x			x			
Slovakia							
Sweden	x						
Tanzania	x	x	x			x	
Turkey		x				x	
USA	x			x	x		

\*recycling = composting

## CONCLUSIONS

On the basis of the review of the issues concerning waste management solutions in selected national parks on four continents, the following conclusions can be drawn:

1. Preservation and maintenance of the landscape and biological diversity within national parks should be consistent with sustainable development, taking into account the scale of use limitation for each resource, including the natural resources.
2. The negative effects of tourism development and the exploitation of national parks' spaces are difficult to avoid, because they result from the need to ensure adequate conditions of stay and the safety of visitors.
3. In several cases, the law was uniform, but the regions (Canada), states (US) and Landes (D) introduced separate legal acts on difficult issues of waste management that arise in the parks.
4. Low levels of environmental protection awareness, and in particular natural values, were conducive to the degradation of the natural environment, which resulted from landfilling in England, Mongolia, Nepal, Tanzania and Turkey.
5. In national parks there is no sustainable method for combusting waste, even though it occurs in the parks within Mongolia and Nepal.
6. The development of tourist facilities in Turkey, the functioning of rural households in France and Tanzania, as well as the roads in Iran, were not conducive to maintaining sustainable development.
7. In the majority of the analysed national parks, there was a ban on landfilling; however, five countries actively used such a solution.
8. An extremely important and simple way to solve the waste problem is education, leading to increased environmental awareness, as well as planning solutions in accordance with sustainable development.

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