# MANAGEMENT OF PPE DURING THE SARS-CoV-2 CRISIS. SCENARIOS AND APPLICATIONS IN VATRA DORNEI

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***Abstract***

*Mountainous environmental systems have a heightened sensibility to the effects of the SARS-CoV-2 crisis, which requires the application of recalibrated operational management in order to overcome disfunctions and prevent discordant states. This paper focuses on the recent problem of "a new category of waste", named used PPE (Personal Protection Equipment) such as masks, gloves, visors, protection goggles, disinfectant bottles etc., that lead to imbalances in natural ecosystems in general and mountain ecosystems in particular, in the context of an improper personal and institutional management. The research methodology comprised perusing scientific literature and mass-media reports regarding the topic at hand. The results confirm the main hypothesis that waste management remains a crucial issue even in crisis situations. Generally, the structure of the paper reflects the increasing incidence of a new type of waste (PPE) which might contaminate the population and the environment as well. The management scenario for PPE was applied to the city of Vatra Dornei. The current study discusses a present day theme - the management of potentially contaminated waste, probable hotspots of epidemiological recurrence and constitutes a starting point for future research into environmental protection under the the principles of the European Green Deal.*

***Key words:*** *management, PPE, SARS-CoV-2, waste, mountain, European Green Deal.*

## INTRODUCTION

The crisis generated by the SARS-CoV-2 pandemic stands as a test for the resilience of our society [1], and, in the current pandemic context, PPEs are a hot topic, intensively debated and scrutinised, of vital importance for the medical personnel treating COVID – 19 patients [2] and the rests of the population as well, in regards to the protection against certain pathogens and contaminants [3].

PPEs include face masks (single use), single use gloves, protection goggles, single use coats, visors, and disinfectant containers. Most of these are used in hospitals, but due to the current situation, they are used on a much wider scale, in every day life, from household activities to more intricate jobs, being indispensable for the protection of the human factor [3]. Thusly, due to an ever increasing demand, their production increased as well, especially those made primarily of plastic, which constitutes roughly 20-25% of its weight [3]. The global PPE market was evaluated at 40.06 billion dollars in 2016, this number estimated to increase by 2022, at approximately 58 billion [4]. Moreover, based on certain estimates, the World Health Organization (WHO) (2020) stated that the monthly need for PPE in the current SARS-CoV-2 situation is: 89 million medical single use masks, 76 million surgical gloves and 1.6 million pairs of protection goggles [5].

It is expected for the demand of PPE to continue to rise even after the pandemic, an alarming fact in terms of generated waste, as they are extensively used by the general population. Furthermore, there are no special management flows for these „new types of

waste", most being discarded alongside municipal waste or random in nature. The lack of a coherent and coordinated sustainable strategy to properly manage said waste is a real threat to the sustainable development goals (SDG-Sustainable Development Goals) set by the United Nations [3]. These objectives include: SDG 3: optimal health and wellbeing; SDG 6: clean water and sanitation; SDG12: sustainable consumption and production; SDG 13: climate action [6].

The increase in production and the ever increasing usage of these PPEs inevitably leads to the creation of large quantities of waste and their accumulation into normal waste flows and beyond, thus requiring a sustainable management to combat all negative effects of this phenomenon.

This paper brings forward the issue of PPE waste which leads to imbalances in natural ecosystems in general and mountain ecosystems in particular, waste management remaining a troublesome aspect despite the current crisis situation.

## METHODOLOGY

The research methodology involved perusing special references and mass-media reports regarding the topic at hand - the management of Personal Protection Equipment in the context of the SARS-CoV-2 pandemic crisis. The study mostly focuses on the PPE's end life cycle, specifically the waste resulting from the usage of these PPEs. This potentially contaminated waste leads to epidemiological recurrence, if proper management strategies are not set into play, which could shelter and help preserve ecosystem balance, especially in fragile systems such as mountain areas. By analysing and synthesizing the information obtained from the above mentioned sources, the current situation in regards to the management of PPE waste was laid bare alongside the implemented solutions, at international as well as national levels, with special focus on the mountain area, depending on the available information.

## RESULTS AND DISCUSSIONS

Recent research and studies on the PPE currently used during the SARS-CoV-2 pandemic mostly focus on single use maks, as these items pose the greatest challenge in terms of environmental pollution. Single use masks have become „a new social norm" [7], being one of the main profilactic methods against the spread of COVID-19 among the population and has been adopted by most countries, even though the WHO does not recommend it as a primary measure [8].

Masks must be worn responsibly, epidemiologists warning against their reckless and random disposal in nature, public places (see fig. 1), mountain footpaths, beaches, oceans (cases in Hong Kong) [3] etc., many already mentioning an „additional epidemic, one of plastic"[7].

Fig. 1. Improper disposal of protection masks in public places, Cluj-Napoca. Image source: author

The main problem of such masks is their composition, as they contain large amounts of polypropylene, besides activated carbon and unwoven fabrics. Polypropylene is a thermoplastic polymer, which degrades extremely slow and releases several toxic substances during this process, thus being extremely harmful for the environment [9]. For instance, if

every person in the United Kingdom would use a single mask per day (ideal case), this would generate 66000 tonnes of contaminated plastic waste in one year, which is ten times more damaging to the environment than using reusable protection masks [8].

PPE waste that are improperly disposed desintegrate into microplastic, which eventually reaches seas and oceans, generating ecological disasters. Reports by the WWF (World Wide Fund for Nature) estimate that for 1% of improperly discarded masks means ten millions masks/month accumulated in the environment [7].

Comparing the above mentioned aspects to the current global population (for example the resident population of Hong Kong, numbering 7 million, wears single use masks [3]), it is clear that plastic pollution created a dire situation, which requires common action to counterbalance the negative effects, some even irreversible, by adopting a PPE specific management. As previously mentioned, this type of possibly contaminated waste is not considered dangerous (as medical waste is) and consequently is not regulated and mandated to be selected, collected and incinerated [8]. Greenpeace states that masks worn by the general populace are a grey area, somewhere between „general waste" and „medical waste" [9].

In actual practice, most masks used by the population are eliminated alongside municipal waste, which might become an infection hotspot later on, the most exposed people being sanitation workers. Thusly, The Association of Cities and Regions for Sustainable Resource Management recommends storing used PPEs in a double bag for 72 hours before disposing them with other waste. This method however is not 100% effective since it requires a constant monitoring of probably contaminated PPEs. Further problems may arise regarding storage said waste (in households as well as in treatment units), as quantities continue to increase [8].

To solve the problem of eliminating single use masks, as well as other categories of PPE waste, and protect public health, as part of an integrated management system, one feasible solution is to install special devices for their disposal, on streets, in certain strategic places, thus preventing their improper discarding in open spaces. Another solution is the large scale usage of reusable masks, research demonstrating that they have the same effectiveness as single use masks, without generating new streams of waste [8] [7]. Therefore, it is imperative to educate and raise awareness about the benefits of utilizing reusable PPE and their correct usage, cleaning, and disposal, by organising public health campaigns, press conferences, information dissemination through dedicated websites and social media [8] [9].

**Situation in mountain areas. Hypothetical scenario for the City of Vatra Dornei**

The negative consequences of large scale PPE usage, especially single use, without proper management, are present even in the mountain areas of Romania. Mountain ecosystems are fragile and already affected by plastic pollution, taking into account that plastic ends up downstream all the way into seas and oceans and a further increase in plastic waste might irreversibily tip the scale towards doom.

During the SARS-CoV-2 pandemic, mountain areas have become attractors for the general population, most people choosing such areas for tourism and recreation in order to further distance themselves from others (social distancing). This evidently leads to the accumulation of several PPE from those who transit the area, rivers, camping sites, mountain trails, footpaths becoming dumping grounds for this type of waste. The situation is even more dire as this phenomenon triggers imbalances in wildlife (flora and fauna), as single use masks decay very slowly in the open (roughly 450 years) [10]. This makes PPEs „genuine eco bombs" inevitably leading to „biodiversity catastrophies" [11].

With the SARS-CoV-2 outbreak and the implementation of security and protection measures, some industries began to shift their focus on teleworking or work-from-home. Thusly, many people have purchased or rented secondary homes, especially in mountain areas.

The advantages of working in a healthy and clean environment are undeniable. However, this new social phenomenon may harm the environmental balance of the mountain system in its entirety. A negligent and improper management of PPEs and mountain areas might become dumping grounds for such waste. No matter which spatial entity we analyse, mountain area, perimountain area or hill area, the problems remain the same and derive from people's attitude and behaviour towards the environment. Maybe mountain education, systemic management measures of the mountain space and media should become deciding factors for reclaiming a „state of normality", especially now, in these times of hardship.

As official PPE data are lacking, we designed a hypothetical scenario for PPE managament in the mountain city of Vatra Dornei. According to the National Institute for Statistics, in 2019, Vatra Dornei had 16588 inhabitants with a stable residence [12], out of which 8675 female and 7913 male (see fig.2).

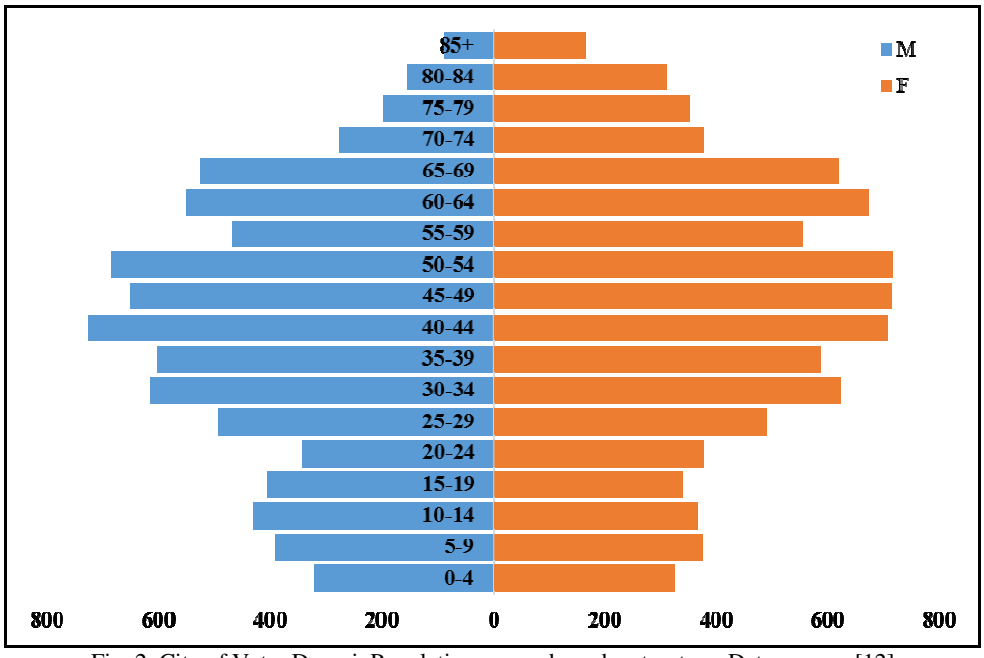


Fig. 2. City of Vatra Dornei. Population age and gender structure. Data source: [12]

Hypothetically analysing the daily behaviour of the population doning PPE, which is roughly 91.5% (population group between 10-85+years of age), in terms of generated waste, we estimate **106246** used masks per week, or **424984 monthly,** and **5099808** yearly (the scenario takes into account that each person would use one mask per day).

The numbers are alarming as the municipality does not even have a management strategy in regards to the safe disposal of this type of waste, in order to protect the environment and the population. Most PPEs are discarded alongside municipal waste, with no prior selection, and there also public places where such waste has been carelessly disposed (see fig. 3).

Fig. 3. Masks in a supermarket parking lot in Vatra Dornei. Image source: author

The scenario generated for the mountain area that includes Vatra Dornei as well as the current situation on the ground are not singular examples, and can be found in other mountain areas in Romania.

Therefore, it is imperative to take immediate action to prevent additional crisis situations generated by the contamination of mountain zones with PPE plastic by the population. Such measures could include:

- educating the general population by providing clear instructions on how to correctly and safely use and eliminate single use masks (before disposal, masks must be cut into small bits to avoid reusal by others; the elastic strips must be cut or removed to avoid harming animals - see fig.4 );


Fig. 4. Single use masks - danger for wildlife. Source: [13]

- Gradual replacement of single use masks with environmentally friendly reusable ones;
- Educating the general public by providing clear instructions on the safe use, removal and washing of reusable masks;
- Placing special devices for the proper disposal of all PPE in strategic public spaces (squares, institutions, supermarkets, parks, camping sites, mountain trails);
- Increasing the awareness level of the population and promoting a responsible behaviour in terms of PPE management.

## CONCLUSIONS

The global crisis generated by the SARS-CoV-2 pandemic confirms the importance of a sustainable and responsive waste management system as well as how easily environmental systems can be overrun by some materials and products, such as single use plastic. The current pandemic has generated a new waste category (PPE), which unfortunately becomes and integral part of the landscape. The most widely used PPEs are single use masks, which have become without a doubt an environemental as well as a social phenomenon. They pose a real threat to the environment, being considered „eco bombs", disrupting the sustainability of all ecosystems, but mountain ecosystems in particular. Environmental mountain systems have an increased sensibility to the pandemic effects of SARS-CoV-2, thus necessitating the

implementation of a recalibrated operation management that will surmount the existing disfunctions and stop discordant states. It is absolutely necessary to set norms, policies and strategies which will regulate the rational and responsible usage of PPEs by the population, being the only sustainable way to insure a balance between public and environmental health.

The general conclusion of this paper confirms the main hypothesis according to which waste management remains a problem despite the unfolding crisis situation and that, regardless of the spatial entity one analyses (mountain, perimountain or hills), issues derive from people's attitudes and behaviour.

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