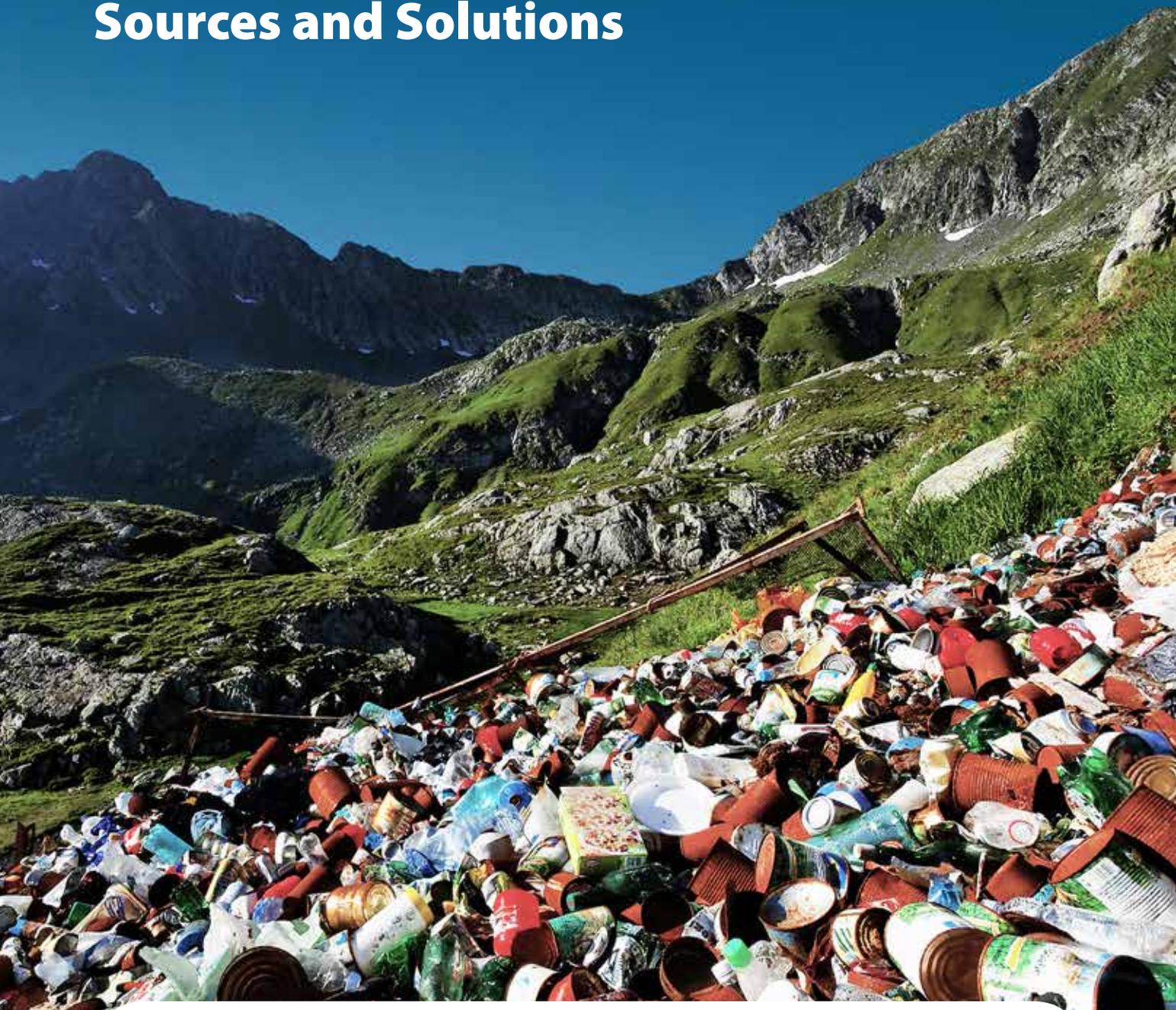


Waste Management Outlook for Mountain Regions

Sources and Solutions



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Executive Summary

Mountains play an essential role in supplying water, energy, food and other services to millions of people living in the mountains and downstream. Ensuring the continued supply of these services has never been more important. However, many mountain regions are experiencing a growing solid waste problem, from ever-expanding urban sprawls and cities, increasing consumption patterns, existing and past mining operations, tourism activities and practises of illegal dumping. Steepness, remoteness, prevailing socio-economic conditions, and vulnerability to natural hazards, makes waste management in mountains more challenging than in lowland areas. Gravity and river flow can also enlarge the footprint of mountain waste to a thousand kilometres or more downstream - and even right into the ocean.

The take-home message is that the inadequate treatment or disposal of waste in mountains not only creates risks for ecosystems and human health in mountain regions, but also for downstream areas. It is truly an issue of global concern. The good news is that there are many options available to prevent and manage waste in mountain environments, in ways that protect mountain ecosystems and people, and prevent problems from migrating downstream. This report highlights both the challenges and the solutions for good waste management in mountain regions.

The Waste Challenges

Mountain communities – challenging conditions for waste management

Many mountain communities in developing countries face significant challenges in managing growing amounts of non-organic waste. Even the more remote communities are faced with more plastics, metals and other non-biodegradable products. Many communities have not developed new practices and norms for managing waste. In many cases, formal institutional systems for waste management are non-existent, resulting in informal means of waste disposal, including open burning and dumping in ravines and rivers – polluting water supply downstream. Achieving economies of scale, for example for the recycling of materials, can be a significant challenge due to the cost and difficulties of transport, and relatively low volumes of recyclable waste. Despite these challenges, some communities have succeeded in implementing various solutions to deal with waste issues in the mountain context.

Mountain tourism – backpacking waste into remote and high places

Tourists on treks and mountaineering expeditions contribute to the increasing volumes of solid waste seen in many of the more remote and higher mountain regions. Where there are no adequate systems in place to collect and manage the waste – particularly in poorer countries and regions – waste is dumped on the side of trails, at camps, or in glacier crevasses. The growth in tourists visiting popular mountain regions, and the accompanying waste issues can be staggering. For example, the Mount Everest region in Nepal has seen an exponential increase in visitors (from 20 in 1964 to approx. 36,000 in 2012). Up to 140,000kg of solid waste is estimated to remain after 60 years of expeditions (Kelliher, 2014). Although well publicised for parts of the Himalayas and Andes, it is a problem that affects almost all mountain regions. Good, preventative measures do exist including bring-your-waste-back policies, camping and national park fees redirected to waste infrastructure, community-based waste initiatives, and successful tourism sector-initiatives. Winter tourism in the mountains, including large, international sporting events such as the winter Olympics, can also have significant waste impacts and implications.

Large mountain cities – same challenges as lowland cities, and a few more

Several large mountain cities with populations of close to a million or more inhabitants exist in Africa, Asia and Latin America. The types and characteristics of solid waste in these cities, and the way that waste is managed, is more related to the level of development of their countries, rather than their altitude. A common trait is insufficient or poor waste management: collection rates are typically low (30 – 60 percent in low income countries, and from 50 to 80 percent in middle income countries (Scheinberg, Wilson and Rodic-Wiersma, 2010), mixed waste collection occurs without separation at source. In some mountain cities, waste is disposed of in open dumpsites as opposed to sanitary landfills. While open dumping is by no means unique to mountain regions, mountain environments pose additional risks, if these sites are located near to watercourses, with the potential to pollute water that is used by large populations downstream. In spite of these challenges, many mountain cities have good experiences in managing solid waste due to the national policies and legal frameworks implemented in the countries to which these cities belong. This includes for the recycling of inorganics, composting of organics, private sector involvement, social inclusion of informal recyclers, management of E-wastes, and construction of sanitary landfills.

Globally, municipal solid waste is expected to double by 2025 (Hoorweg & Bhada-Tata, 2012), creating a huge demand for urban public services, including within mountain cities. Growth in mountain cities is also expanding to hazard-prone areas such as alongside riverbanks and steep hillsides, often resulting in the development of informal settlements that are highly vulnerable to natural hazards and disasters. Disasters themselves carry significant waste implications, generating huge amounts of waste in a short period of time.

Mining at altitude – a mountain of waste that creates risks far downstream

Mining is the most common heavy industry within mountainous regions of developing countries. Artisanal and small-scale mining are also common. Both carry with them significant waste implications. In mountains, steep slopes, terrain instability, seismic activity and adverse weather conditions add another level

of complexity and risk to mine safety and waste management. In particular, mine tailings and their long-term storage at mountain mines requires urgent attention: some of the largest mines in the world, and consequently some of the largest waste dumps, are found in mountain regions. Statistically speaking, some of these storage dams are likely to fail in the future (Morgenstern et al. 2015). Poorly managed waste in mountain regions has the potential to move downwards, expanding the waste footprint of even a small mountain mine. Contaminants can be found more than 1000 km downstream from a mountain mine, such as is the case for the large Ok Tedi mine in Papua New Guinea, which has affected the livelihoods of over 30,000 people, decreased fish stocks and caused extensive degradation of forests. More intense rainfall and flooding events have the potential to increase the risks of tailings storage failure and weaken existing waste infrastructure.

At the global level, there is very little information on the extent of waste crime in mountain regions. However, the remoteness of mountain regions is likely to make them easy targets for waste crimes, and certain cases point to this. Of particular concern in the mountain context are mining activities, which produce large amounts of waste, some of which can be hazardous with the potential to have large downstream impacts. Illegal mining activities may involve breaching environmental and safety regulations for existing activities, or neglecting risks from previous operations.

Impacts of upstream waste on freshwater ecosystems – a growing issue deserving research and attention

One of the main ways in which mountains are linked to lower-lying areas is through rivers. These rivers bring much needed water, but also carry plastic pollution downstream. There has been much attention in recent years on plastic pollution in the marine environment, but considerably fewer studies have so far studied the impact on freshwater environments. This is an area that deserves further attention.

Recommendations: *The Waste Solutions*

New knowledge for informed decision-making and implementation of solutions

Implement waste monitoring programmes. Monitoring schemes are needed to establish a baseline against which actions can be measured, and to assist in developing a systematic overview of the problems and their causes. In popular mountain tourist areas, data on visitor numbers, length of stay and activities, combined with the experience and observations of local communities, are important for managing and anticipating waste removal and disposal requirements. Risk assessments of waste management in mountain areas are also needed. This includes the potential risk for downstream areas from both large and small-scale dumping (whether legal or illegal) and industrial waste.

Fund scientific research. Research is needed to better understand the relationship between different waste streams and their biophysical impacts on sensitive mountain environments, on the health of mountain communities, and on the linkages between upstream and downstream areas. An international research agenda on mountain waste issues should be considered, taking an integrated approach involving both mountain and downstream scientific networks. The waste implications of sectors such as forestry and agriculture, which have not been addressed in this report, should also be included in future research initiatives.

Applied and participatory research is needed to better understand existing public attitudes to waste and how to best incite behavioural change and adoption of sound waste management practises in challenging environments and socio-economic conditions.

Capacity building and awareness raising

Build awareness at all levels of the large potential downstream impacts and global nature of certain waste streams in mountain environments, and the threats posed to human health. The focus should be on people living in mountain communities and those who visit mountains on a temporary basis, such as tourists. This should start with promoting sustainable consumption through the 3Rs: reduce, reuse and recycle. Awareness raising should also talk about risks to public health of inappropriate disposal and treatment of

waste and appropriate and economic alternatives. Open burning of non-biodegradable waste should be strongly discouraged or even banned. A preventative approach is needed to make sure that sustainable waste management practices are introduced before waste problems become too severe.

Prevent waste disposal in mountain areas wherever possible. A combination of both education and awareness raising to promote waste-reduction or waste-eliminating behaviour, and smart policies and instruments, are needed. This is particularly needed in mountain areas, as the costs of waste collection and removal are increased by remoteness, rugged terrain and poor infrastructure.

Build the capacity of mountain communities, and both small and large municipalities to plan for sound management of waste. Integrated management plans and approaches to waste management are needed that include avoidance/prevention (including with regards to illegal dumping), recycling, minimisation, treatment and disposal. Promoting local capacity and use of local knowledge is important to ensure measures are appropriate for local conditions.

Develop small-scale solutions that are adapted to more remote mountain settings. Options include promoting community-based, alternative options to landfills for organic wastes and waste collection centres to promote the collection and sorting of non-organic recyclables. Communities should consider working together to create shared collection centres in order to accumulate a greater volume of recyclables that can then be sold. New landfills should be sited in areas that minimise the potential for runoff that can contaminate important water sources. Existing landfills that pose risks should be relocated where possible for the same reasons. Following the waste hierarchy where waste cannot be reused or recycled due to technical, economic or environmental limitations, systems that convert municipal waste to energy (WtE) should also be explored particularly in more populated areas, as alternatives to or as means of reducing waste to landfilling. This can also lead to reduced greenhouse gas (GHG) and short lived climate pollutants (SLCPs) emissions, therefore contributing to climate change mitigation opportunities. Technological innovation research should be also be supported to explore new methods applicable to mountain settings, e.g. for waste to energy, and composting.

Ensure that the tourism industry – and tourists – are educated on waste issues, and contribute to the financing and management of waste solutions in mountains.

In line with the polluter pays principle, the mountain tourism industry and tourists themselves should bear responsibility for financing the management of the waste created in the areas they visit. Waste management practices should be integrated in the tourism industry, such as bring-back-your-waste policies and re-directing fees (e.g. entry fees, camping fees) into waste management operations. Dialogue and partnerships between tourism operators and local communities should be encouraged. Tools such as sustainable tourism eco-labels and guidelines should be considered for the mountain context, to drive innovation and best practises on reducing waste and greening the tourism sector in mountains.

Promote education on waste management within the mountaineering community.

The mountaineering community's global governing bodies, such as the International Climbing and Mountaineering Federation (UIAA) and the International Federation of Mountain Guide Associations (IFMGA), as well as national mountaineering organizations should revise current procedures, guidelines, training and certification practices to integrate and instil environmental values, including sensitization of the consequences of waste and its management. The mountaineering community should also actively engage in the broader policy and management discussions to bring the voices and experiences of mountaineers to the decision-making table.

Strengthen policies, enforcement capacities and monitoring for high-risk sectors in mountains

Promote national and global dialogues across sectors such as environment, tourism, industry, and defence, involving government, the private sector and civil society to promote understanding of challenges, risks and opportunities for waste management in mountain regions, and to reduce potential conflict across national borders. Information exchange and knowledge platforms should also be considered to share best practises.

Strengthen national legislation, enforcement capability and monitoring of the mining sector and the management of mining waste. This includes strengthening environmental standards and targets, and ensuring that the responsible

law enforcement authorities have the required skills and resources to perform their duties so that mining projects proceed in accordance with the law. Ensuring transparency and access to information is necessary for monitoring and creating incentives for all stakeholders to play by the rules, and should be part of the mining licensing permit condition. Remediation plans should also form part of any license, and a security fund should be established at each mine site large enough to cover the estimated environmental liabilities upon closure and remediation.

Ensure private sector responsibility. Private contractors and companies, whether it be in tourism, mining, construction or other sectors, should be made responsible for managing the wastes generated through their activities. Enforcement should be ensured through legal contracts. Corporate social responsibility should also be encouraged.

Strengthen and protect civil society organisations' ability to monitor compliance in mining and other sectors.

Civil society has a strong role to play in ensuring that mining companies "play by the rules" and follow adequate standards for environmental stewardship. These organisations also have an important role in fighting corruption and illegal activity, and monitoring of public procurement and service delivery (e.g. municipal waste services).

Increase the capacity of artisanal and small-scale miners to reduce their environmental and health effects.

Alternative technique to the use of mercury and cyanide exist, such as gravity methods. The awareness and capacities of artisanal miners should be increased to apply such methods.

Prepare disaster waste management plans for areas with a high exposure to natural disasters.

Mountain areas are particularly vulnerable to earthquakes, landslides and floods which can cause immense amounts of waste. Immediate waste management is needed to facilitate rescue efforts and also to reduce the spread of disease and environmental impact. Disaster waste management plans should be prepared before they are needed to facilitate effective use of scarce resources both during and after extreme events.

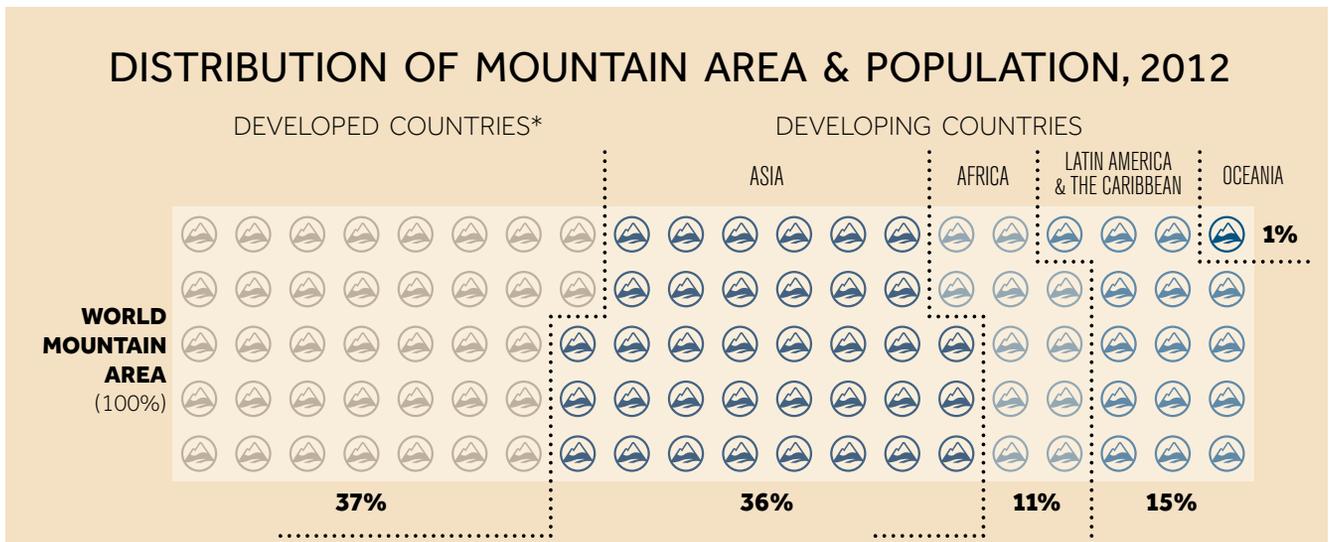
Introduction

The Waste Management Outlook for Mountain Regions provides an analysis of waste issues pertinent to the world's mountains, with an emphasis on low and middle-income countries. It complements the Global Waste Management Outlook (GWMO, 2015), which provided a comprehensive global overview of the state of waste management around the world in the 21st century.

The intention of the Waste Management Outlook for Mountain Regions is to highlight the most important waste management challenges and solutions that are specific to mountains, and their downstream implications. These are grouped according to the sources of waste: remote mountain communities, mountainous cities and larger urban areas, tourism and mining. Issues such as waste crime, plastic pollution, and the linkages between exposure to natural hazards, disasters and waste are also included. The latter three are labelled as “emerging issues” due to their increasing importance, but which happen to be relatively poorly studied and require further attention. It is important to mention that this report

does not seek to be fully comprehensive. Several waste-relevant issues, including military activities, as well as those related to forestry and agriculture in mountainous regions, are not covered in this report but certainly deserve specific attention.

This report has benefited from a wide range of input and oversight. An advisory board was established to oversee the process, which included UN Environment (UNEP) and its International Environmental Technology Centre (UNEP IETC), the International Solid Waste Association (ISWA), regional mountain organisations such as ICIMOD, national ministries, and individuals with



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