Food and Agriculture Organization of the United Nations

THE GLOBAL MECHANISM
United Nations Convention to Combat Desertification

Vulnerability of mountain peoples to food insecurity: updated data and analysis of drivers

Mountain Partnership

Vulnerability of mountain peoples to food insecurity: updated data and analysis of drivers

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS and
UNITED NATIONS CONVENTION TO COMBAT DESERTIFICATION
Rome, 2020

Required citation:
Romeo, R., Grita, F., Parisi, F. and Russo, L. 2020. *Vulnerability of mountain peoples to food insecurity: updated data and analysis of drivers*. Rome, FAO and UNCCD. https://doi.org/10.4060/cb2409en

ISBN 978-92-5-133716-5 (FAO)
ISBN 978-92-95118-26-3 (UNCCD) (hard copy)
ISBN 978-92-95118-27-0 (UNCCD) (e-copy)

Electronic version can be downloaded from: FAO: doi.org/10.4060/cb2409en, www.mountainpartnership.org and www.unccd.int/publications

Cover photo: Drying tomatoes in Kyrgyzstan (©Alma Karsymbek); all maps: Mountain Partnership, 2020, adapted by authors

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Foreword

This study, conducted by the Food and Agriculture Organization of the United Nations (FAO), the Mountain Partnership Secretariat and the Global Mechanism of the United Nations Convention to Combat Desertification UNCCD), clearly indicates that the number of mountain people who are vulnerable to food insecurity is still increasing.

At the same time, mountains have a high potential to support greener development building on their sustainable food systems and rich biodiversity. We need to unlock this potential for the benefit of all humanity.

A total of 346 million people in rural mountain areas in developing countries were estimated to be vulnerable to food insecurity in 2017. The number increased by 39 million people between 2012 and 2017. These findings confirm those presented by the study "Mapping the vulnerability of mountain people to food insecurity", published by FAO in 2015 and of which this study is an update.

Vulnerability to food insecurity is related to a complex system of environmental, social and economic factors, which include, among others, land degradation, climate change, natural hazards, and insufficient access to infrastructure and services. These factors add to the already high exposure of mountain people to multiple risks and reduce their ability to cope with food shortages and other shocks.

The COVID-19 pandemic and the restrictions adopted by countries to respond to it have amplified the existing vulnerabilities of mountain communities. Mountain livelihoods – which rely mostly on agriculture, tourism and remittances – have been particularly affected by the global lockdowns. The prolonged recession that is unfolding will require special attention to ensure that the most vulnerable among mountain people, particularly women and youth, are not pushed into poverty and further deprivation.

This publication is an example of how data collection that makes use of new technologies and methodologies can generate information to support policies and decision-making aimed at combating poverty and eradicating hunger.

Ensuring food security, promoting the sustainable use of natural resources, reducing land degradation and protecting mountain ecosystems are global priorities and shared goals of FAO and UNCCD. The Mountain Partnership, a UN alliance with over 400 members, advocates for the sustainable development of mountain areas, by drawing attention to the plight of mountain people and supporting local and global action among its members and outside, beyond the mountain constituency circle.

The information produced in this study is a call to national authorities and the international community to give urgent attention to the threats affecting mountain people, their livelihoods and ecosystems in the spirit of the UN 2030 Agenda of leaving no one behind.

We trust that this publication will contribute to this noble goal.

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Acknowledgements

The authors have benefitted from the technical advice and guidance of FAO experts in food security and experts from the Global Mechanism of the United Nations Convention to Combat Desertification.

Special thanks go to Nathalie Troubat, Carlo Cafiero, Giulia Conchedda, Giuseppina Cinardi and Ilaria Rosati (FAO) for their contribution to the methodology used in this study.

We also extend our gratitude to the following individuals for their technical advice, assistance in improving the document or providing data and information: Paola Codipietro (independent consultant); Danilo Godone (CNR Italy), Samantha Abear, Valeria Barchiesi, Yuka Makino, Sara Manuelli, Giacomo Pontara, Ewald Rametsteiner, Ashley Steel, Yasmeen Telwala and Sven Walter (FAO); Sandrine Jauffret, Pedro Lara Almuedo and Andjela Vragovic (Global Mechanism of the UNCCD), Rodica Nitu and Robert Stefanski (WMO).

Technical editor:
Fabio Grita (GIS Expert, FAO Consultant)
Editors:
Rosalaura Romeo (MPS/FAO), Fabio Parisi (MPS/FAO) and Laura Russo (MPS/FAO)
Concept: FAO Mountain Partnership Secretariat
Layout: Roberto Cenciarelli
Editing: Jeannie Marshall and James Varah

Acronyms

CCI	Climate Change Initiative
CIESIN	Center for International Earth Science Information Network, Columbia University
DEM	Digital Elevation Model
ESA	European Space Agency
FAO	Food and Agriculture Organization of the United Nations
FAOSTAT	Food and Agriculture Organization Corporate Statistical Database
GAUL	Global Administrative Unit Layers
GIS	Geographic Information System
GPW	Gridded Population of the World
GRUMP	Global Rural–Urban Mapping Project
HKH	Hindu Kush Himalaya
ICIMOD	International Centre for Integrated Mountain Development
IFAD	International Fund for Agricultural Development
IFPRI	International Food Policy Research Institute
IPCC	Intergovernmental Panel on Climate Change
LDN	Land Degradation Neutrality
LDN–TSP	Land Degradation Neutrality – Target Setting Programme
MDER	Minimum Dietary Energy Requirement
MP	Mountain Partnership
MPS	Mountain Partnership Secretariat
NASA	National Aeronautics and Space Administration
PRIO	Peace Research Institute Oslo
SDG	Sustainable Development Goal
SEDAC	Socioeconomic Data and Applications Center
SOFI	State of Food Security and Nutrition in the World
SPAM	Spatial Production Allocation Model
UCDP	Uppsala Conflict Data Program
UNCCD	United Nations Convention to Combat Desertification
UNDESA	United Nations Department of Economic and Social Affairs
UNDRR	United Nations Office for Disaster Risk Reduction
UNEP–WCMC	UN Environment Programme–World Conservation Monitoring Centre
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNU	United Nations University
WHO	World Health Organization

Executive summary

In mountain regions of developing countries, food insecurity, social isolation, environmental degradation, exposure to the risk of disasters and the impacts of climate change, and limited access to basic services are still prevalent. This is especially true in rural areas. This study, the third of its kind published by the Food and Agriculture Organization of the United Nations (FAO), adds further evidence of these occurrences and shows that under some circumstances, these occurrences are increasing.

Mountains cover 39 million km^2, or 27 percent, of the world's land surface. In 2017, the global mountain population reached nearly 1.1 billion – accounting for 15 percent of the world's population – having increased by 89 million people since 2012. The increase added almost entirely (86 million people) to the mountain population in developing countries, which reached one billion people in 2017.

Population has increased in all the regions of the developing world. Only the areas at the highest mountain altitudes (above 3 500 m) continued to experience a depopulation trend in the last 17 years, while at all other elevations population increased. In all African subregions, in South America and in Central and Western Asia, the population density is higher in the mountains than in the lowlands.

In the developing countries, 648 million people (65 percent of the total mountain population) live in rural areas. Half of them – 346 million – were estimated to be vulnerable to food insecurity in 2017. In other words, one in two rural mountain dwellers in developing countries live in areas where the daily availability of calories and protein was estimated to be below the minimum threshold needed for a healthy life.

In the five years from 2012 to 2017 the number of vulnerable people increased in the mountains of developing countries, approximately at the same pace as the total mountain population. Although the proportion of vulnerable people to the total mountain population did not change, the absolute number of vulnerable people increased globally by 40 million, representing an increment of 12.5 percent from 2012 to 2017.

Quinoa in Peru (©FAO/Heinz Plenge)

The number of vulnerable people has increased in all regions of the developing world. More than half the increase in absolute numbers was observed in Africa (25 million more vulnerable people from 2012 to 2017 bringing the sum to 132 million people, and their share to 67 percent of the total rural population), and particularly in Eastern Africa.

The vulnerability to food insecurity of the mountain people in the developing world is compounded by the presence and occurrence of natural hazards and armed conflicts that disrupt livelihoods or put strain on the natural resources on which mountain people depend.

Approximately 516 million rural people were estimated to live in mountain areas affected by past natural hazards with medium to high exposure (of which 241 million, or 47 percent, were those with high exposure). The estimated numbers of people vulnerable to food insecurity was 275 million with medium to high level of exposure (122 million or 44 percent with high exposure).

An estimated 212 million rural people in the mountains lived in areas identified as having medium and high intensity of conflicts between 2000 and 2018, and 50 million were in areas of frequent and/or intense conflict. The numbers of vulnerable people living in areas where conflicts of medium or high intensity occurred were estimated at 128 million people.

Isolation and distance from food markets and limited access to services and facilities undermine mountain peoples' capacity to cope with the lack of local food production. In 2017, 85 million rural mountain people lived more than one-hour's travel distance from the closest market. Out of those, 34.5 million people (41 percent of the considered population) were vulnerable to food insecurity.

Only 29 percent of the rural mountain population lived in areas with high service and facilities availability such as education, health care, amenities, food services, non-food shops, access to water and sanitation, technology and communication, electricity and hotels. The majority of the rural mountain population, approximately 442 million people, live in areas with limited service availability and 17 million people (almost 3 percent of the rural mountain population), were estimated to have no or very low access to basic town facilities and services.

Land degradation is seriously impacting agriculture, endangering the sustainability of crop production and animal husbandry and water security, especially in areas where land degradation is rapidly progressing. In most developing countries, the impact of unsustainable agriculture practices on land degradation is very high. Other factors include climate-related extreme weather events, especially drought, which also threatens livelihoods of people, land use changes from natural land cover into farmlands, grazing lands, human settlements and urban centres, intensive use of technology, intensive exploitation of groundwater resources, and others. There is a strong dependency of rural mountain people on land resources and a lack of sustainable land management practices able to stem land degradation. The vulnerability trends observed at regional level show differences among continents and subregions. For example, in Africa, from 2012 to 2017, out of the 132 million mountain people vulnerable to food insecurity, 86 million lived in areas characterized by limited to very extensive land degradation changes, and 27 million of those lived in areas where the rate of land degradation was moderate to very high.

As reported by the Intergovernmental Panel on Climate Change (IPCC), climatic variability is seriously threatening mountain environments and communities, and its negative impacts are forecasted to worsen in the coming century. Glaciers are melting especially at lower elevations and this is decreasing the stability of mountain slopes while increasing the extent of the areas affected by natural hazards, which are in turn severely affecting mountain communities' livelihoods. Climate extremes are threatening to erode and reverse the gains made in ending hunger and malnutrition, a negative effect particularly relevant for mountain communities, which are already vulnerable to food insecurity. Mountain agriculture is being negatively affected by the decrease in water resources available in the river basins fed by snow and glaciers.

Estimating the number of mountain people vulnerable to food insecurity and analysing the potential drivers of vulnerability pose methodological challenges. All methodological choices were made following consultations with experts within and outside FAO. Considerations are provided to help understand the limits of the study and should be taken into account for the correct interpretation of the results.

It is hoped that the results of this study may induce governments and other stakeholders to conduct more in-depth investigations on mountain stressors and on better identification of the most vulnerable groups, which might remain hidden in global studies. In particular, the implications of the COVID-19 pandemic on the livelihoods of mountain people will be important to consider both in rural and urban areas. To remove food insecurity and malnutrition in mountain areas, countries should promote the conservation and sustainable use of mountain biodiversity. They can support sustainable food systems, including those associated with traditional crops and diets, by recognizing the economic and environmental role of family farming and by creating the enabling environment to make it a driver of progress and inclusive growth in mountains.

Countries, where possible, should create the enabling environment for the integrated landscape approach. This could not only provide benefits to the land, but also offer solutions for multiple climate change and biodiversity issues. Land governance accompanied by security of tenure is becoming more important with growing populations and accompanying competition for increasingly limited resources. *The Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests in the Context of National Food Security* (FAO, 2012) serve as a reference and set out principles and internationally accepted standards for practices for the responsible governance of tenure. They provide a framework that States can use when developing their own strategies, policies, legislation, programmes and activities.

A lack of secure tenure can lead to degradation of land resources, as users lack incentives or the capacity to manage them with long-term productivity in mind. Securing land tenure, which is an important factor for implementing sustainable land management practices and achieving land degradation neutrality, will increase the coping capacity of mountain people and will reduce inequalities and social and political instability.

Access to productive resources and secure land tenure should be available to all, aiming at diversifying livelihoods and implementing practical actions to safeguard decent work opportunities, particularly for youth in rural areas. Additional efforts

should be made to mainstream gender in the development of mountain-related policies and plans aimed at reducing pressures on natural resources and the environment, including land degradation and water shortage, and increasing economic sustainability of local livelihoods. The UN Decade of Action 2020–2030 calls for accelerating sustainable solutions to the world's challenges, such as reducing poverty and inequalities. The UN Decade on Ecosystem Restoration (2021–2030) presents opportunities for improving degraded ecosystems in mountain regions. Strong, effective and coordinated action in favour of sustainable mountain development is one solution to end hunger and protect mountain ecosystems.

In line with the recommendations of *Vulnerability to food insecurity in mountain regions: land degradation and other stressors* (FAO and UNCCD, 2019), the present study provides additional recommendations for concrete actions needed in mountain regions. These recommendations include combating land degradation, adapting to climate change, strengthening agricultural value chains and promoting economic development, and seeking financial support for such actions that are fundamental to reducing vulnerability to food insecurity. The study also provides recommendations to improve the availability and quality of data for future estimates of vulnerability to food insecurity. This information is meant to advise elevant stakeholders' on how to strengthen support to vulnerable mountain populations, also in order to preserve, and possibly increase, ecosystem services and biodiversity.

Key recommendations:

- Encourage Mountain Partnership member countries and UNCCD country Parties to integrate the processes for estimating vulnerability to food insecurity in mountain regions within the UNCCD national action programmes and the Voluntary National Reviews, for the implementation of the 2030 Agenda for Sustainable Development.
- Include gender issues in vulnerability assessment frameworks. Efforts should be made to mainstream gender in the development of mountain-related policies and plans aimed at reducing biological and environmental pressures and increasing economic sustainability of local populations. Despite progress and the commitment of countries to achieving the Sustainable Development Goals (SDGs), the persistence of gender data gaps and the lack of quality, updated, reliable and comparable data are still serious constraints.
- Seek financial support and international expertise and opportunities offered by financial resources mobilized within the framework of the SDG implementation process in order to address mountain vulnerability to food insecurity.
- Invest in building national data capacities, train mountain experts, improve national capacities in remote sensing and Geographic Information System (GIS) data analysis, provide access to national georeferenced data through public portals and websites, and use common data standards to ensure data compatibility and integration. Web portals would be an excellent tool to enable on-the-fly data analyses and queries to help inform the general public and to provide a roadmap of ongoing initiatives on relevant vulnerabilities in order to improve knowledge and/or enable access to data on vulnerability.
- Engage governments, the UNCCD, the Mountain Partnership and other relevant international organizations and non-governmental organizations in an international forum to continue and improve the work done so far,

and foster national partnerships. In this context, the Mountain Partnership and Land Degradation Neutrality national working groups and stakeholders' networks would be a valuable addition in gathering expert advice on how to improve future assessments.

1 Introduction

Family in Tajikistan (©Bakhriddin Isamutdinov)

1. Introduction

Farmers in Uttarakhand, India (©Amit Sah)

Mountains cover 27 percent of the earth's surface. They provide humanity with essential goods and services such as water, food, biodiversity and energy.

Mountain ecosystems are vulnerable to natural hazards, climate-related extreme events and the unsustainable use of resources. Rural mountain people living in developing countries are among the world's poorest and most vulnerable to food insecurity. Mountain communities face hunger and malnutrition and are often marginalized and have poor access to infrastructure and services. Access to food is often a problem, in terms of quantity (seasonal food shortages, as well as recurrent crises) and quality (unbalanced diets).

Within the mountain communities, there are some groups that are more vulnerable than others. Women often have more nutritional problems due to their lower economic and social status. In some mountain societies, women and girls may be more vulnerable due to prevailing gender biases. Many mountains are home to ethnic minorities that may be at further risk of malnutrition because of lack of recognition in national policies.

Since 2003, FAO has published two reports that estimated mountain peoples' vulnerability to food insecurity: "Towards a GIS-based analysis of mountain environments and populations" (FAO, 2003) and "Mapping the vulnerability of mountain peoples to food insecurity" (FAO, 2015a), both of which pointed to widespread and increasing vulnerability to food insecurity among mountain peoples from 2000 to 2012.

The present study builds on those and provides updated information to cover the period 2012–2017. It also looks at some of the stress factors that can lead to food shortages.

FAO defines food security as: "a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life." (FAO, 1996). People become vulnerable to food insecurity when these conditions are not met.

FAO (2015a) found that 39 percent of mountain people (urban and rural) in developing countries were considered vulnerable to food insecurity in 2012. That was a 30 percent increase in vulnerability to food insecurity from 2000, while the mountain population itself had increased by only 16 percent over the same period. The figures for rural areas were even more alarming: almost 50 percent of the rural mountain population in developing countries was considered vulnerable to food insecurity. These figures illustrate the precarious state of many mountain people, who are in danger of falling or remaining below a safe minimum threshold of food security because of low agricultural productivity, a harsh climate, isolation and marginalization.

Several environmental and socio-economic factors are known to cause acute declines in the access to food or in consumption levels below the minimum amount for survival, and lead to food insecurity. Recent editions of the *State of Food Security and Nutrition in the World (SOFI)* (FAO *et al.*, 2017, 2018 and 2019) have highlighted conflicts, climatic variability and extremes, and economic slowdowns and downturns as the key drivers of the recent increases in food insecurity in the world. In mountain regions, poverty, conflicts, climatic variability, land degradation, and natural hazards are among the most disruptive stressors affecting people's livelihoods. The *Special Report on the Ocean and Cryosphere in a Changing Climate* (IPCC, 2019a) noted that climate-related changes in snow and glaciers have altered the seasonality and amount of water, with an impact on livelihoods and socio-economic sectors including agriculture.

Although global mountain specific data on the implications of COVID-19 are not available, there is no doubt that the pandemic has disrupted life in the mountains

Potatoes in Peru (©Alma Karsymbek)

and compounded the vulnerabilities of mountain communities. Mountain agriculture and tourism have been affected by the lockdowns, as well.

The population of mountain regions, especially in developing countries, is increasing. Settlements and urban areas are growing and, in some regions, improved infrastructure, including roads, electricity and telecommunication networks, has boosted development. At the same time, increasing population puts more pressure on mountain ecosystems and often leads to the misuse of natural resources while also increasing the number of people vulnerable to food insecurity. As noted by IPCC (2019a), the people and infrastructure in mountain areas are increasingly exposed to natural hazards because of a growth in population, tourism and development. In other mountain areas, people abandon their homes and lands in search for better opportunities. In isolated, rural mountain areas, where people depend on locally produced food as their main source of sustenance, there is a strong link between vulnerability to food insecurity and insufficient access to basic services (transport, markets, education and health care), which affects people's capacity to cope when there is less food available.

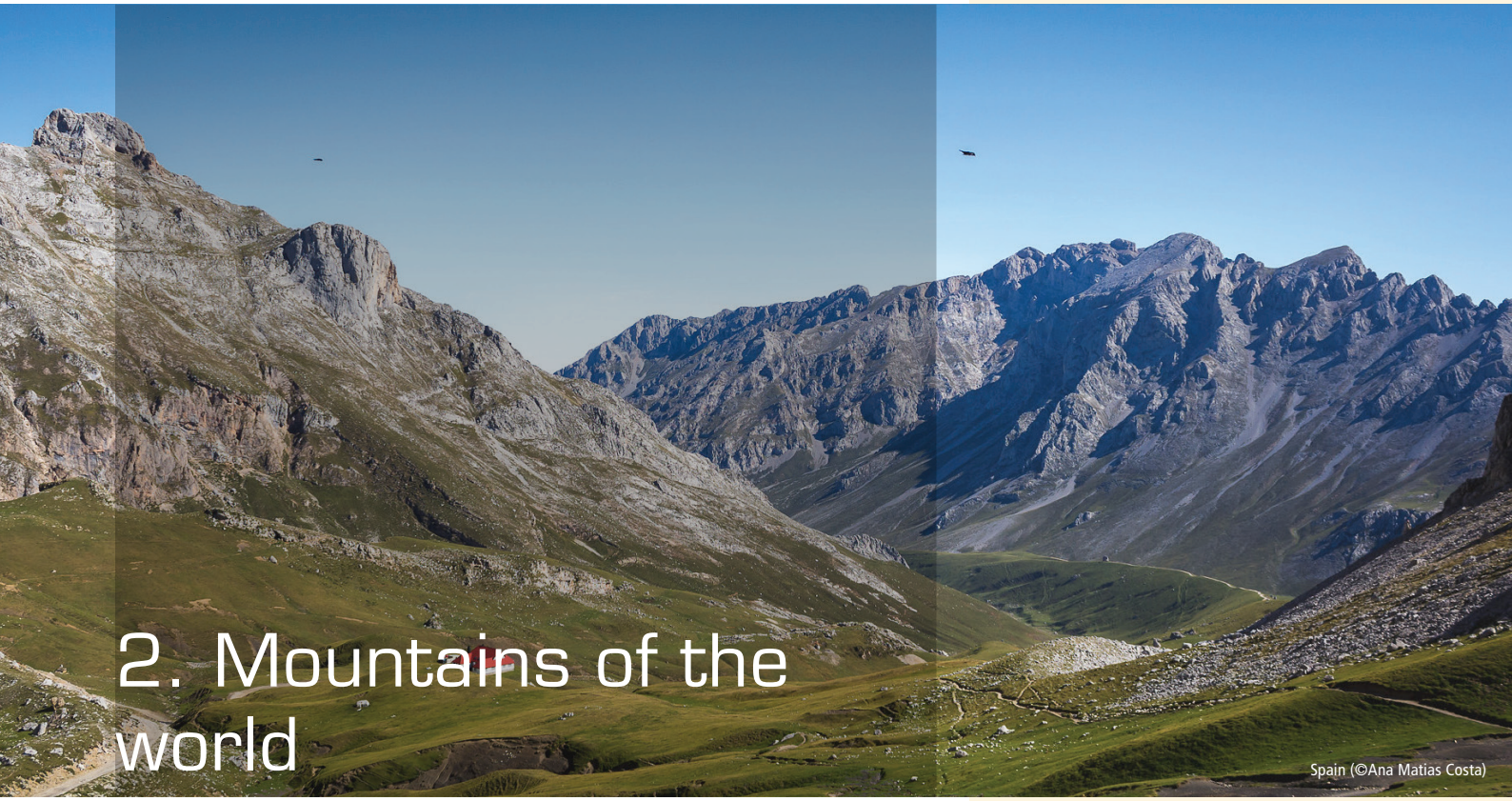
This study has examined natural hazards, conflicts, poor access to services and infrastructures, land degradation and climatic variability, as stressors in mountain areas. In particular it assumes that the occurrence of the above-mentioned stressors potentially affects vulnerability of rural mountain people to food insecurity. It has not been possible, with the available data, to determine cause-effect relationships between the occurrence of the stressor and the number of people vulnerable to food insecurity in a given area. However, the data presented in the study provide a geographical visualization of the occurrence of stressors and the estimated number of vulnerable mountain people in the same mountain areas and aim to contribute to a better understanding of the vulnerability of rural mountain people in developing countries.

Grain threshing (©Global Himalayan Expedition)

Mountain community in Nepal (©Pradeep Mehta)

2 Mountains of the world

Landscape in Afghanistan (©Jawid Rezaie)



2. Mountains of the world

Spain (©Ana Matias Costa)

Mountains cover 39 million km², or 27 percent, of the world's land surface. The distribution of mountains is uneven, with 54 percent of the global mountain area in developing countries (Map 1).

Definition of mountains

This study uses the latest United Nations Environment Programme–World Conservation Monitoring Centre (UNEP–WCMC) definition of mountains, which identifies seven classes:

Class 1. elevation > 4 500 m

Class 2. elevation 3 500 – 4 500 m

Class 3. elevation 2 500 – 3 500 m

Class 4. elevation 1 500 – 2 500 m and slope ≥ 2°

Class 5. elevation 1 000 – 1 500 m and slope ≥ 5° or local elevation range [7 km radius] > 300 m

Class 6. elevation 300 – 1 000 m and local elevation range [7 km radius] > 300 m

Class 7. isolated inner basins and plateaus less than 25 km² in extent that are surrounded by mountains but do not themselves meet criteria of classes 1–6 (this seventh class was introduced in the 2002 revision of the original 2000 system).

Compared with the data presented in FAO, 2015a, which reported 32 million km² of mountain cover, the increase in the area classified as mountains is the result of several factors:

- the use of a different Digital Elevation Model (DEM) (For this study, the layer developed in 2002 by UNEP–WCMC was used);
- the inclusion of class 7 of the UNEP–WCMC classification; and
- the inclusion of Antarctica.

By excluding class 7, areas that are found in the middle of mountainous regions and that possess mountain cultural and climatic characteristics were considered as lowlands by the previous mountain classification.

Regions and subregions

Countries have been grouped according to the United Nations Statistics Division "M.49" standard (presented in Annex I). The M.49 country grouping identifies five regions: Africa, Americas, Asia, Europe and Oceania. This framework has also been used as the basis to allocate regions to the categories of "developing" and "developed" countries. While there is no established convention for the designation "developed" and "developing" in the United Nations system, in common practice Japan, Israel and Cyprus in Asia, Canada and the United States of America in the Americas, Australia and New Zealand in Oceania, and Europe are considered as developed, and all other countries and areas are considered developing. This is the classification used in this report.

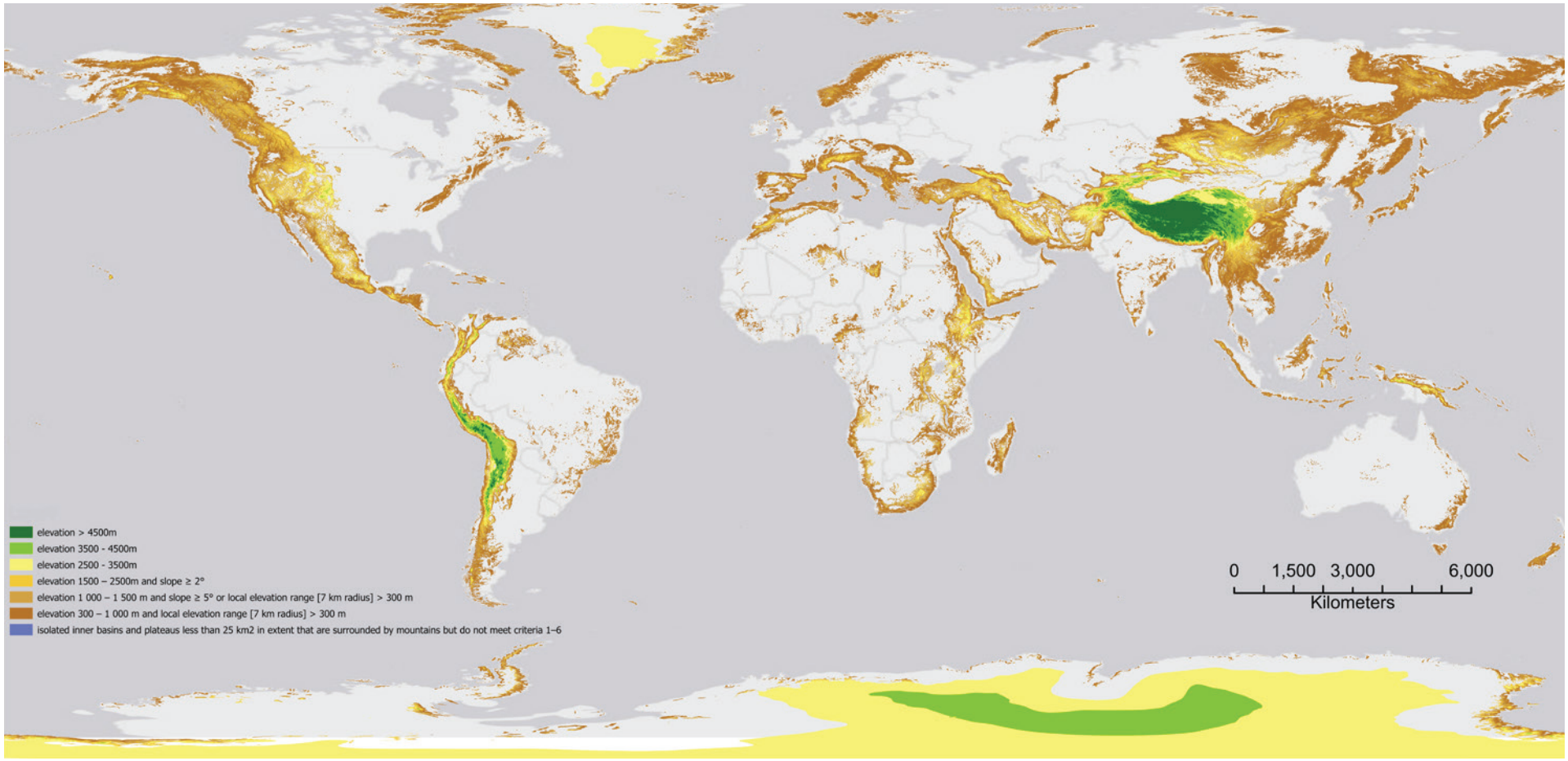
For the developing world, the following four regions and 16 subregions are identified:

Region	Subregion
Africa	Eastern Africa
	Middle Africa
	Northern Africa
	Southern Africa
	Western Africa
Latin America & the Caribbean	Caribbean
	Central America
	South America
Asia	Central Asia
	Eastern Asia
	South-Eastern Asia
	Southern Asia
	Western Asia
Oceania	Melanesia
	Micronesia
	Polynesia

No further subdivision in regions and subregions was considered for the developed world, as the presentation of results and analysis focuses on developing countries.

The details of the country grouping schemes and the composition of the regions and subregions are presented in Annex 1.


Argentina (©Colin Bell)



Map 1: Global mountain areas as per the UNEP–WCMC classification

Region	Mountain area (000 km²)										
	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	Class 7	Lowlands	Total Mountain area	Mountains over land area (%)	Global distribution of mountains (%)
Africa	**0.1**	**5.1**	**101**	**610**	**1 301**	**2 096**	**96**	**25 797**	**4 210**	**14**	**11**
Eastern Africa	0.1	4.9	77	346	597	799	40	5 118	1 863	27	4.7
Middle Africa	0.0	0.1	6.3	84	210	356	13	5 932	670	10	1.7
Northern Africa		0.1	6.8	61	209	493	17	6 871	787	10	2.0
Southern Africa			10	117	265	274	25	1 989	692	26	1.8
Western Africa			0.0	1.9	20	174	1.5	5 887	198	3.2	0.5
Latin America & the Caribbean	**157**	**584**	**437**	**800**	**816**	**1 816**	**77**	**15 859**	**4 687**	**23**	**12**
Caribbean			0.0	2.8	5.5	39	0.5	190	48	20	0.1
Central America	0.0	1.1	67	365	296	448	42.8	1 263	1 221	49	3.1
South America	157	583	370	433	514	1 329	33.7	14 405	3 419	19	8.7
Asia	**1 626**	**982**	**1 081**	**2 044**	**2 112**	**3 820**	**249.3**	**19 045**	**11 914**	**38**	**30**
Central Asia	28	92	110	118	94	167	6.3	3 375	615	15	1.6
Eastern Asia	1 449	745	628	900	821	1 360	120	5 219	6 024	54	15
South-Eastern Asia	0.8	6.2	24	114	302	1 100	19	2 960	1 566	35	4.0
Southern Asia	148	138	277	624	507	704	65	4 236	2 464	37	6.3
Western Asia	0.0	0.6	42	288	388	488	39	3 255	1 245	28	3.2
Oceania & Pacific	**-**	**0.7**	**18**	**47**	**31**	**129**	**4.4**	**342**	**231**	**40**	**0.6**
Melanesia		0.7	18	47	31	127	4.4	328	228	41	0.6
Micronesia						0.1	0.0	5.5	0.1	2.1	0.0
Polynesia				0.0	0.2	2.1	0.0	8.5	2.4	22	0.0
Developing world	**1 783**	**1 572**	**1 637**	**3 500**	**4 260**	**7 863**	**427**	**61 042**	**21 042**	**26**	**54**
Developed world	**0.2**	**13**	**729**	**1 588**	**2 526**	**6 929**	**209**	**34 421**	**11 996**	**26**	**31**
Antarctica	**0.0**	**1 108**	**4 480**	**120**	**141**	**417**	**9.6**	**12 465**	**6 275**	**34**	**16**
World	**1 783**	**2 693**	**6 847**	**5 208**	**6 928**	**15 209**	**646**	**107 929**	**39 314**	**27**	**100**

Table 1: Mountain areas in thousands of km2 by region and mountain elevation class

The developed world as a whole hosts 31 percent of mountain areas. Asia hosts 30 percent of the mountains of the world, followed by Latin America and the Caribbean (12 percent) and Africa (11 percent). The highest mountains are found in Asia: 91 percent of mountains above 4 500 m (class 1) are in this continent (Table 1).

Overall, class 7 represents less than 2 percent of the total mountain area, the smallest share of all mountain classes.

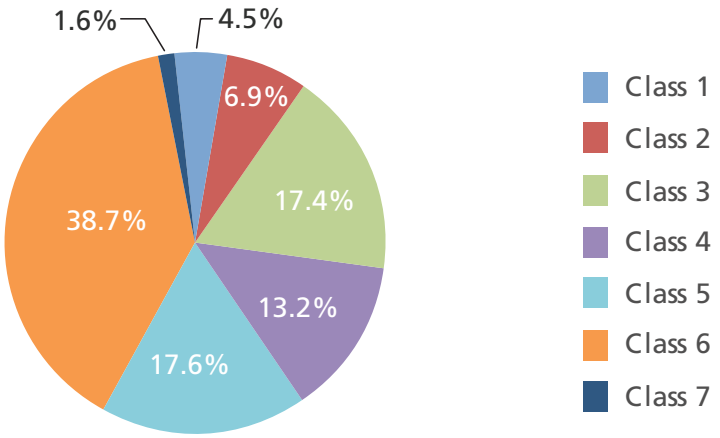


Figure 1. Share of mountain areas in the different classes (total mountains = 100%)

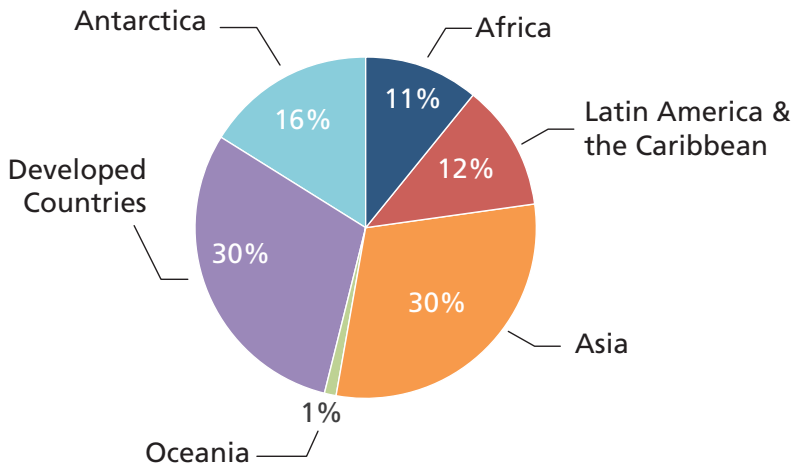


Figure 2. Distribution of mountains among regions

Landscape in India (©Vikram Negi)

3 Mountain population

Village of Cha, India, welcomes GHE team (©Global Himalayan Expedition)

3. Mountain population

Empowering youth in the Andes (©Juan Angulo Delgado)

As of 2017, there were 1.1 billion people living in mountain areas worldwide, representing 15 percent of the global population. Most of the mountain population, 1 billion people (91 percent), lived in developing countries. Only 96 million lived in developed countries (Table 2).

Distribution by regions

Region	Number of mountain people ('000)	Percentage to total mountain population
Africa	252 430	23
Latin America & the Caribbean	167 502	15
Asia	580 284	53
Oceania	3 472	0.3
Developing countries	1 003 687	91
Developed countries	96 228	8.8
World	1 099 915	100

Table 2: Mountain population by region in 2017

The mountains of Asia host more than half (53 percent) of the total mountain population, or 580 million people. African mountains are the second most populated, with 252 million people or 23 percent of the total mountain population.

Out of the ten countries with the highest mountain populations, six are in Asia (China, India, Indonesia, Iran, Turkey, Pakistan), two are in Africa (Ethiopia, South Africa) and two are in the Americas (Mexico, Colombia).

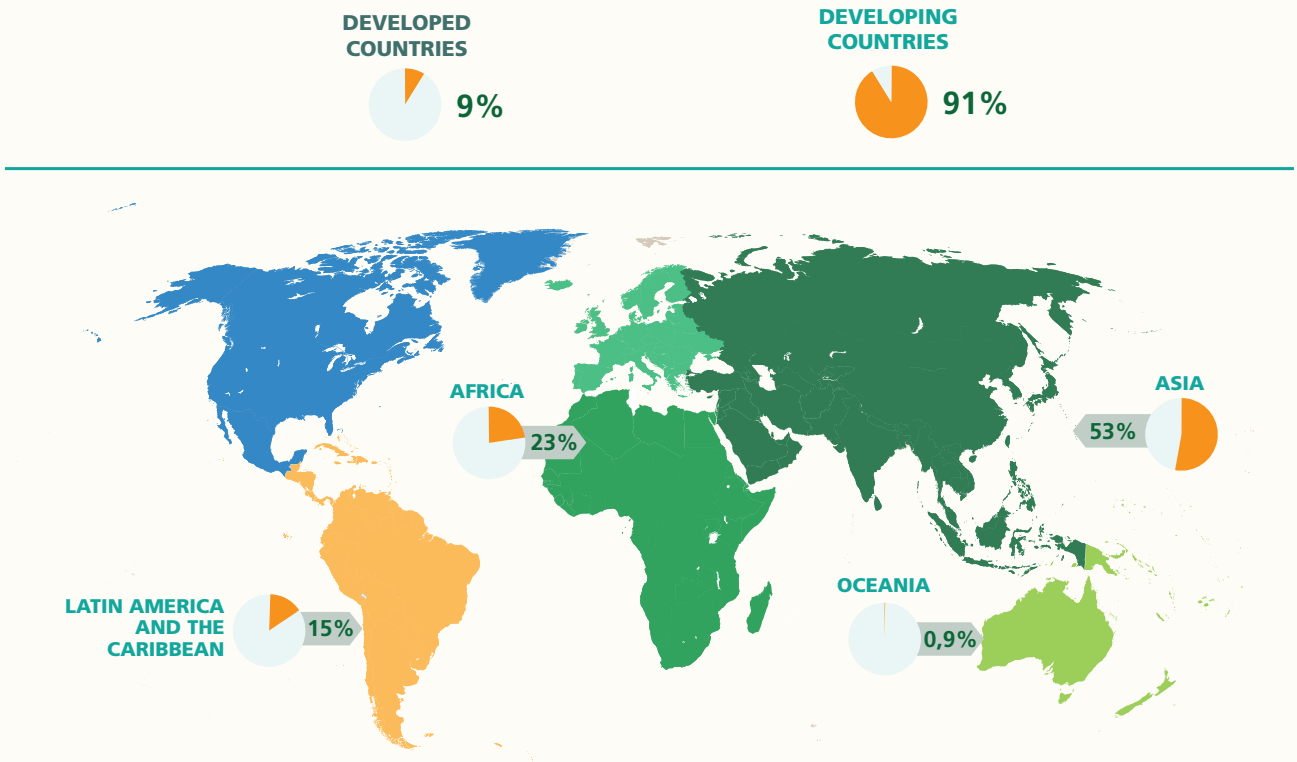


Figure 3: Share of mountain people in the regions of the developing world in 2017

Distribution by elevation classes

The vast majority of mountain people, 989 million people (or 90 percent of the total mountain population), live in areas below 2 500 m (class 4, class 5 and class 6). Latin America and the Caribbean is the region with the greatest share of people living above 2 500 m (34 million people or 20 percent of the mountain population of the region in 2017) followed by Asia (22 million people). In Africa, of the 18 million people living above 2 500 m, 17 million are found in the highlands of Eastern Africa (Table 3).


Uttarakhand, India (©Amit Sah)

Region	2017 Mountain population ('000 people)											Global distribution of mountain population (%)
	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	Class 7	Lowlands	Total Mountains	Total Population	Mountain dwellers to total population	
Africa	0.1	206	17 731	71 146	68 210	85 177	9 960	998 780	252 430	1 251 210	20	23
Eastern Africa	0.1	206	17 342	59 698	44 099	27 093	7 162	264 462	155 599	420 060	37	14
Middle Africa	0.0	0.7	274	5 866	9 927	13 632	959	131 968	30 659	162 626	19	2.8
Northern Africa		0.0	23	1 153	5 513	23 175	709	202 286	30 573	232 859	13	2.8
Southern Africa			91	4 365	7 537	10 182	1 066	41 671	23 240	64 911	36	2.1
Western Africa			0.4	65	1 134	11 095	65	358 394	12 359	370 753	3.3	1.1
Latin America & the Caribbean	811	8 971	24 560	29 710	28 490	70 992	3 968	473 281	167 502	640 783	26	15
Caribbean			0.0	80	370	4 152	50	38 798	4 652	43 450	11	0.4
Central America	0.06	12	6 988	18 853	16 823	25 158	2 407	105 810	70 241	176 052	40	6.4
South America	811	8 959	17 572	10 776	11 297	41 682	1 511	328 673	92 608	421 281	22	8.4
Asia	1 600	4 572	15 954	82 993	133 891	321 499	19 774	3 768 572	580 284	4 348 856	13	53
Central Asia	0.3	22	200	1 493	3 684	12 160	182	52 666	17 742	70 408	25	1.6
Eastern Asia	1 517	3 795	7 312	34 740	51 785	141 044	12 529	1 264 282	252 722	1 517 004	17	23
South-Eastern Asia	0.7	200	357	2 045	10 573	52 387	919	579 007	66 482	645 489	10	6.0
Southern Asia	83	555	5 828	31 523	47 016	71 457	3 636	1 704 609	160 097	1 864 706	8.6	15
Western Asia	-	0.25	2 257	13 192	20 834	44 450	2 509	168 008	83 242	251 250	33	7.6
Oceania & Pacific	-	0.0	321	1 727	414	786	225	8 014	3 472	11 486	30	0.3
Melanesia		0.0	321	1 727	414	773	225	6 817	3 459	10 276	34	0.3
Micronesia						0.4	-	525	0.4	526	0.1	0.0
Polynesia				-	0.0	13	-	672	13	685	1.9	0.0
Developing world	2 411	13 750	58 566	185 576	231 005	478 453	33 927	5 248 647	1 003 687	6 252 335	16	91
Developed world	-	1.1	185	2 325	8 119	83 916	1 682	1 166 480	96 228	1 262 708	7.6	9
World	2 411	13 751	58 750	187 901	239 124	562 369	35 609	6 415 127	1 099 915	7 515 042	15	100

Table 3. Mountain population (thousands) by regions and elevation classes in 2017

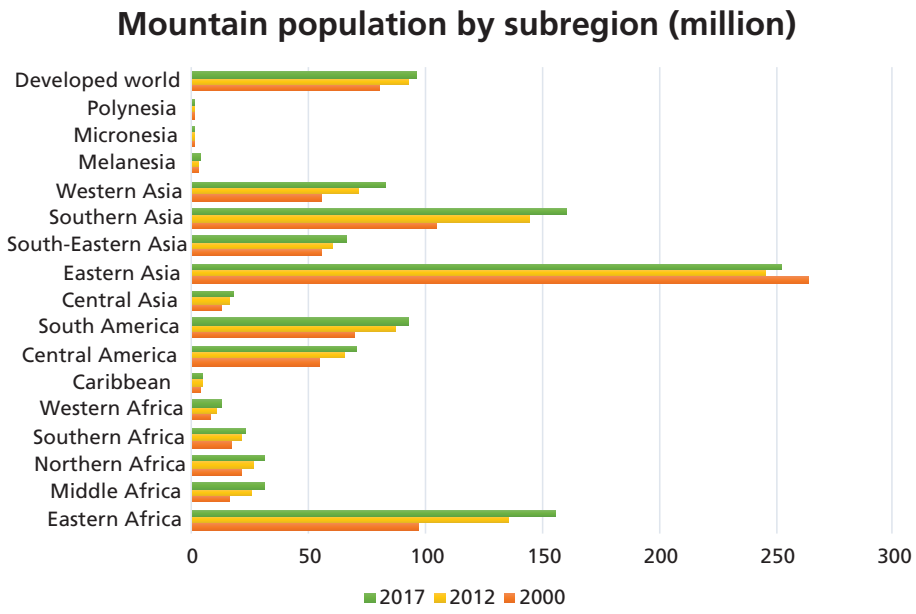


Figure 4: : Changes in mountain population by subregions of the developing world in 2000, 2012 and 2017

Population data were derived from the LandScan Global Population Database for the years 2000, 2012 and 2017. These data sets use the best available census counts to estimate population, and apply a spatial distribution model that includes road proximity, slope, land cover and night-time lights.

LandScan data were adjusted to match national-level Food and Agriculture Organization Corporate Statistical Database (FAOSTAT) population figures, which conform to United Nations (UN) official data. The political boundaries used to assign pixels to countries or territories were those of the Global Administrative Unit Layers (GAUL).

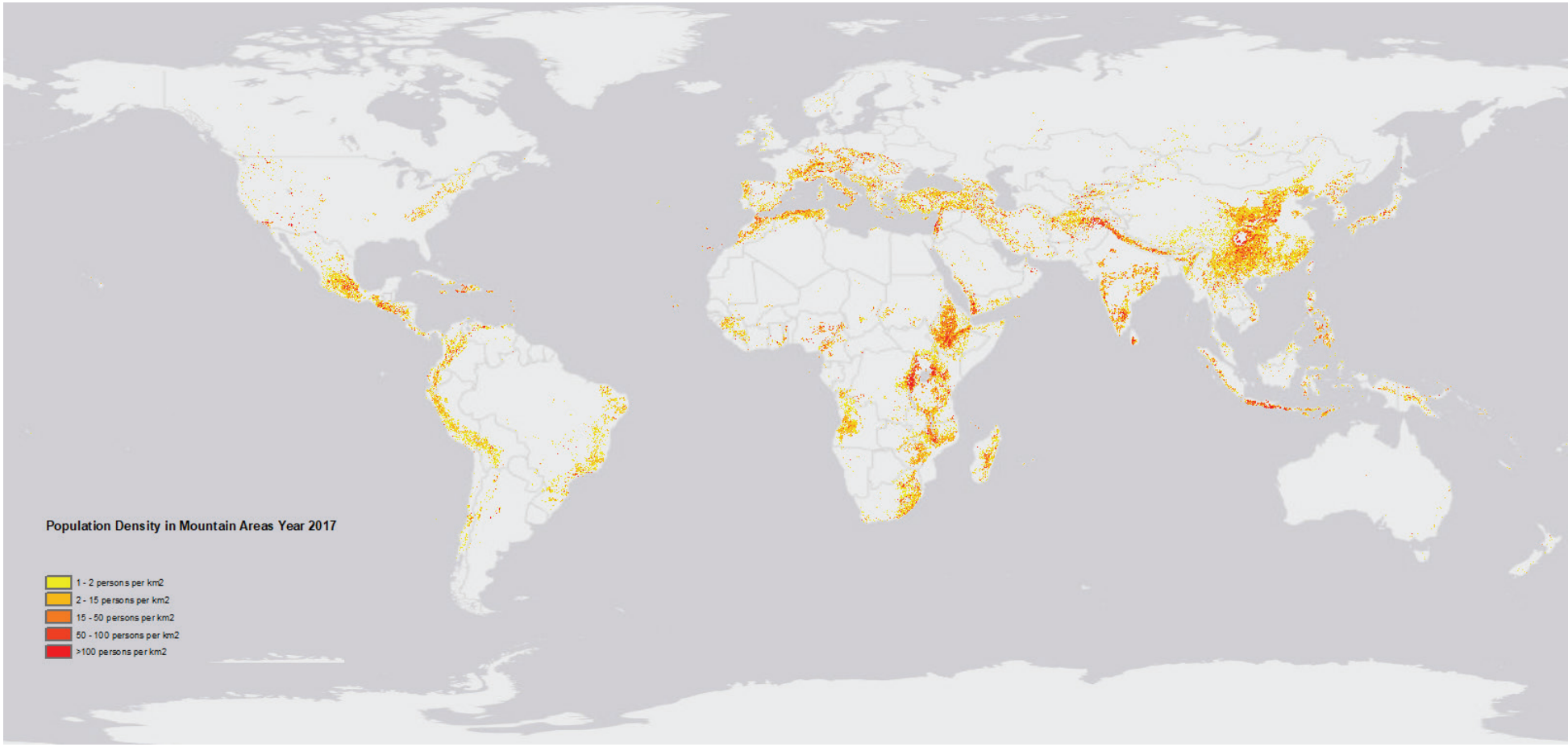
Mountain population density

Mountain population density varies considerably among regions and elevation classes (Table 4). In the developed world, population density ranges from 0.1 persons per km^2 at the highest elevation (class 2) to 12 persons per km^2 at the lowest (class 6). In the developing world, mountain population density ranges from 1.4 in class 1 to 79 persons per km^2 in class 7 and is highest in the Caribbean (97 persons per km^2) followed by Eastern Africa (84 persons per km^2). In several areas, population density in the mountains is higher than that of the lowlands. This is the case in all African subregions, in South America, and in Central and Western Asia. In Africa the highest population density is found between 2 500 and 3 500 m, with 176 persons per km^2, which is more than 4 times the density in the lowlands (39 people per km^2). At that altitude, in Eastern Africa the number of people reaches 225 per km^2, the highest human density of all mountain areas in the developing countries.

Mexico City (Photo by Jorge Gardner on Unsplash)

People per km²									
Region / subregion	**Class 1**	**Class 2**	**Class 3**	**Class 4**	**Class 5**	**Class 6**	**Class 7**	**Lowlands**	**All mountains**
Africa	**1.4**	**41**	**176**	**117**	**52**	**41**	**103**	**39**	**60**
Eastern Africa	1.2	42	225	173	74	34	178	52	84
Middle Africa	4.8	6.0	44	70	47	38	75	22	46
Northern Africa		0.1	3.3	19	26	47	42	29	39
Southern Africa			8.7	37	28	37	42	21	34
Western Africa			21	35	57	64	43	61	63
Latin America & the Caribbean	**5.2**	**15**	**56**	**37**	**35**	**39**	**52**	**30**	**36**
Caribbean			0.7	29	67	107	110	204	97
Central America	1.3	11	104	52	57	56	56	84	58
South America	5.2	15	48	25	22	31	45	23	27
Asia	**1.0**	**4.7**	**15**	**41**	**63**	**84**	**79**	**198**	**49**
Central Asia	0.0	0.2	1.8	13	39	73	29	16	29
Eastern Asia	1.0	5.1	12	39	63	104	104	242	42
South-Eastern Asia	0.9	32	15	18	35	48	49	196	42
Southern Asia	0.6	4.0	21	51	93	101	56	402	65
Western Asia	-	0.4	54	46	54	91	64	52	67
Oceania		**0.0**	**18**	**37**	**13**	**6.1**	**51**	**23**	**15**
Melanesia		0.0	18	37	13	6.1	51	21	15
Micronesia						3.4	-	96	3.4
Polynesia				-	0.1	6.1	-	79	5.3
Developing world	**1.4**	**8.7**	**36**	**53**	**54**	**61**	**79**	**86**	**48**
Developed world	**-**	**0.1**	**0.3**	**1.5**	**3.2**	**12**	**8.0**	**34**	**8.0**
World	**1.4**	**5.1**	**8.6**	**36**	**35**	**37**	**55**	**59**	**28**

Table 4: Mountain population density by regions and elevation classes in 2017



Map 2: Mountain population density and distribution in developing countries in 2017

Mountain population trends in developing countries (2000–2012–2017)

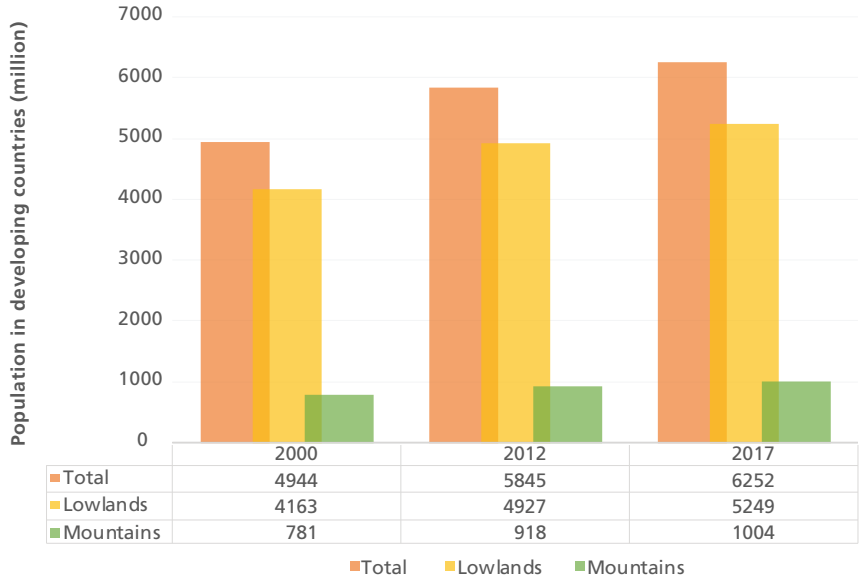
From 2000 to 2017, the total mountain population of the developing countries increased from 780 million to 1 billion people (918 million in 2012) (Table 5). The share of the mountain population remained stable both at the global level (around 15 percent of the world population) and in developing countries (16 percent of the total population of developing countries).

From 2000 to 2017, the mountain population increased in all regions of the developing world. There were differences among regions (Table 5). Africa had the greatest change in both absolute and percentage values, with an increase of 94 million mountain people (59 percent). In Asia, the mountain population increased by 88 million people (18 percent increase), Latin America and the Caribbean by 40 million (31 percent increase), and Oceania by 0.9 million people (35 percent). These increases were in line with the overall population growth in the regions.

At the world level, the distribution of mountain people living in each elevation class did not change much from 2000 to 2017. At the highest altitudes, above 3 500 m (mountain classes 1 and 2), the population has decreased, probably in the most isolated and inhospitable areas. These two classes were the only ones to experience a decrease in the total mountain population between 2012 and 2017.

Region	Number of mountain people ('000)			Percentage change 2000–2012	Percentage change 2012–2017	Percentage change 2000–2017
	2000	2012	2017			
Africa	158 855	220 711	252 430	39	14	59
Latin America & the Caribbean	127 709	157 780	167 502	24	6.2	31
Asia	491 570	536 354	580 284	9.1	8.2	18
Oceania & Pacific	2 580	3 164	3 472	23	9.7	35
Developing world	780 714	918 009	1 003 687	18	9.3	29
Developed world	80 232	92 862	96 228	16	3.6	20
World	860 945	1 010 871	1 099 915	17	8.8	**28**

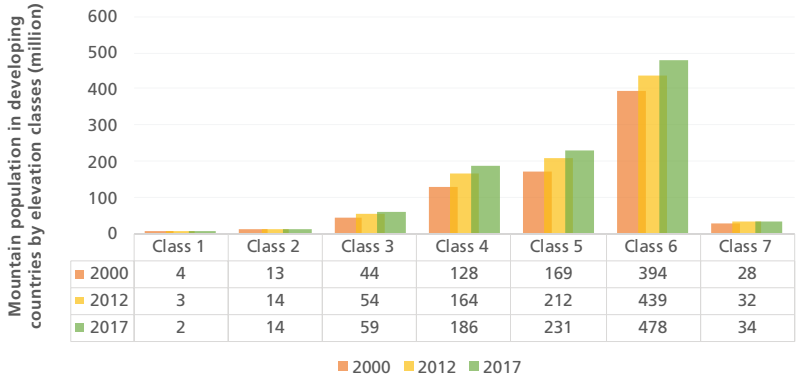
Table 5: Mountain population by region in 2000, 2012 and 2017



	2000	2012	2017
Total	4944	5845	6252
Lowlands	4163	4927	5249
Mountains	781	918	1004

Figure 5: Population changes in developing countries in 2000, 2012 and 2017

At lower altitudes (class 3, class 4, class 5 and class 6) a constant population increase occurred throughout the period 2000–2017 in line with the overall population change (Figure 6).



	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	Class 7
2000	4	13	44	128	169	394	28
2012	3	14	54	164	212	439	32
2017	2	14	59	186	231	478	34

Figure 6: Changes in mountain population in developing countries by elevation classes in 2000, 2012 and 2017

Women in Kyrgyzstan (©Alma Karsymbek)

Rural and urban population in developing countries

Defining rural and urban areas and populations

Urban areas were derived from the Global Rural–Urban Mapping Project, Version 1 (GRUMP v.1) based on the Socioeconomic Data and Applications Center's (SEDAC) Gridded Population of the World (GPW), Version 3 data set (GPW v.3). The GRUMP v.1 uses a combination of population counts, settlement points and the presence of night-time lights to identify urban areas. Also, the areas defined as "settlements" in the European Space Agency Climate Change Initiative (ESA-CCI) land cover classification, when found outside the urban areas defined by the GRUMP, were considered as urban areas for the purpose of this study. All the remaining land was defined as rural.

Based on the areas defined as urban, and the UNEP–WCMC mountains classification, the entire world population was divided into mountain population and lowland population, and then the mountain population was divided into rural and urban.

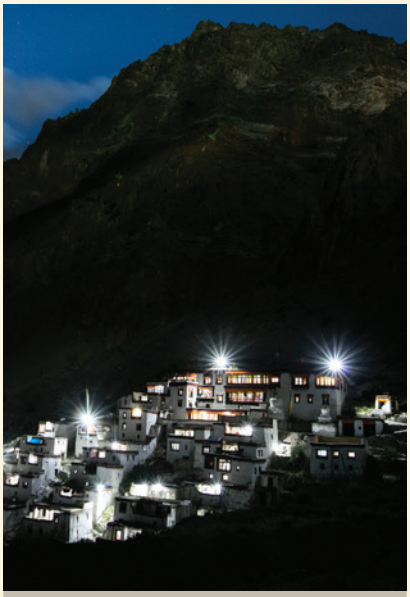
The focus of this study is on the rural mountain people in developing countries, and only some basic information at the aggregate level on urban people is presented.

In the developing countries, the number of rural mountain people in 2017 was 648 million, or 65 percent of the mountain population. There were 356 million urban people (35 percent of the mountain population) (Table 6).

Asia has the largest number of rural mountain people (394 million) followed by Africa (196 million). Latin America and the Caribbean has the highest proportion of urban mountain people (112 million), twice the rural population (55 million) of the region. Central Asia is also a subregion where the share of urban people is higher than that of the rural population.

Region/subregion	Mountain population ('000 people)			
	Rural	Urban	Rural population to total mountain population %	Urban population to total mountain population %
Africa	**196 031**	**56 399**	**78**	**22**
Eastern Africa	135 446	20 152	87	13
Middle Africa	21 818	8 840	71	29
Northern Africa	16 892	13 680	55	45
Southern Africa	12 206	11 034	53	47
Western Africa	9 668	2 691	78	22
Latin America & the Caribbean	**55 236**	**112 266**	**33**	**67**
Caribbean	3 615	1 037	78	22
Central America	25 692	44 550	37	63
South America	25 929	66 679	28	72
Asia	**393 673**	**186 611**	**68**	**32**
Central Asia	7 083	10 659	40	60
Eastern Asia	185 000	67 722	73	27
South-Eastern Asia	51 648	14 833	78	22
Southern Asia	107 886	52 211	67	33
Western Asia	42 056	41 185	51	49
Oceania	**3 194**	**278**	**92**	**8.0**
Melanesia	3 186	273	92	7.9
Micronesia	0.1	0.3	32	68
Polynesia	7.3	5.4	58	42
Developing world	**648 134**	**355 553**	**65**	**35**

Table 6: Rural and urban population in developing countries in 2017



Lingshed Monastery after electrification, India (©Global Himalayan Expedition)

Rural mountain populations increased from 547 million in 2000 to 590 million in 2012 and to 648 million in 2017 (Figure 7).

The great majority of rural mountain people live at the lower elevation classes (Figure 8).

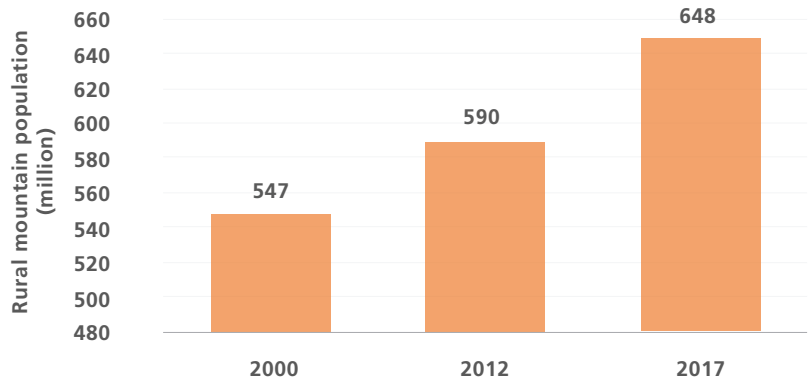


Figure 7: Rural mountain population changes in developing countries

Figure 8: Rural mountain population changes in developing countries by mountain classes in 2000, 2012 and 2017

Urban mountain population increased from 237 million in 2000 to 328 million in 2012 and to 356 million in 2017 (Figure 9).

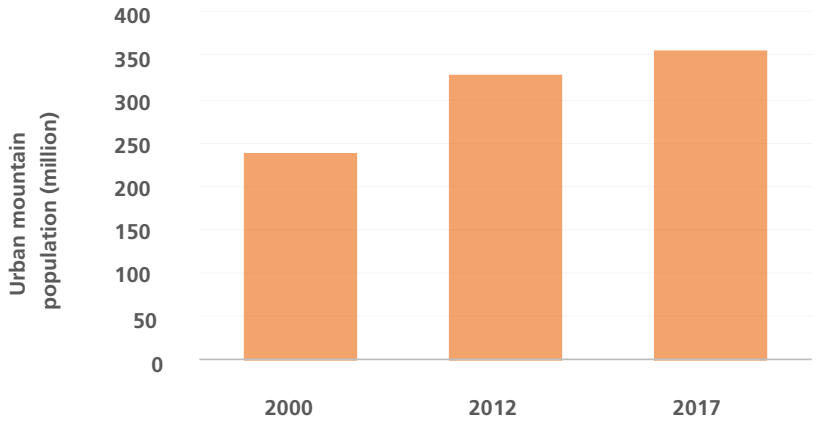


Figure 9: Urban mountain population changes in developing countries in 2000, 2012 and 2017

The share of the urban mountain population compared to the rural population increased from 2000 to 2012 and then remained stable from 2012 to 2017 (Table 7). This trend was more marked at the lower altitudes (Class 5 and 6).

Mountain class	2000		2012		2017	
	Rural %	**Urban %**	**Rural %**	**Urban %**	**Rural %**	**Urban %**
Class 1	100	0.3	99	1.0	99	1.2
Class 2	745	25	69	30	68	32
Class 3	71	29	66	34	66	34
Class 4	75	25	72	28	73	27
Class 5	65	35	61	39	62	38
Class 6	69	31	62	38	62	38
Class 7	73	27	68	32	69	31
Total	**70**	**30**	**64**	**36**	**65**	**35**

Table 7: Share of rural and urban mountain population by elevation classes in 2000, 2012 and 2017 (%)

4

Estimating the number of rural people vulnerable to food insecurity in the mountain areas of developing countries

Afghan farmers collecting wheat (©Maryam Farzami)

4. Estimating the number of rural people vulnerable to food insecurity in the mountain areas of developing countries

Shepherd in Nepal (©Bijay Gurung)

The study published by FAO (2015a) developed an approach for estimating the number of vulnerable mountain people in developing countries based on the definition of food insecurity as "the probability of a person or household falling or staying below a minimum food security threshold within a certain timeframe." The minimum food security threshold is expressed in calories and grammes of protein per person per day. The study adopted the model to estimate the availability of calories and grammes of protein from the production of the six most important crops (beans, cassava, maize, potato, rice, wheat) and the five main livestock commodities (cattle, chickens, goats, pigs, sheep) in mountain areas (FAO, 2015a). The model was applied to the whole rural mountain population of developing countries, and estimates of the number of vulnerable people in the years 2000 and 2012 were established. The present study builds on the above approach.

In an effort to refine the model used in 2015 and make more realistic approximations of the vulnerability to food insecurity among mountain people, the present study has applied the model only to the people living in the rural areas of developing countries where agriculture and pastoralism are the prominent economic activities, defined as the "agro-pastoral zone." The agro-pastoral zone in this study therefore is a subset of the rural areas and includes all areas where it is expected that agricultural and pastoral activities do take place (such as croplands, grasslands, shrublands, open forests). The results obtained on this reference population are presented as estimated numbers of "vulnerable" and "non-vulnerable" people.

The rural people living outside the agro-pastoral zone as defined by the model are considered as "not assessed." While this approach leaves out approximately 100 million people globally (20 percent of the total rural mountain population of developing countries), it presents a situation that is more in line with the nature and limitations of the model.

The 2015 study (FAO, 2015a) also estimated the number of vulnerable mountain people in the urban areas of developing countries by using the "poverty headcount ratio at urban poverty line (percentage of urban population)" developed by the World Bank. Since such an estimate would not have added significant scientific knowledge to this report, it was decided not to include it and instead to focus further on the rural mountain population.

The methodology used in this study for the estimation of the number of vulnerable people is described in detail at the end of this chapter.


Agriculture in India (©Céline Abadia)

Global situation

In 2017, 346 million people living in the rural mountain areas of developing countries were estimated vulnerable to food insecurity, representing 34 percent of the total mountain population and 53 percent of the rural mountain population. The estimated number of vulnerable rural mountain people increased by 38 million people, or 12.5 percent from 2012 to 2017 (Table 8).

Rural mountain population					
	Number of people ('000)			Population change (%)	
Condition	2000	2012	2017	2000–2012	2012–2017
Vulnerable	242 638	307 110	345 612	27	13
Non-vulnerable	195 699	192 239	199 053	-1.8	3.5

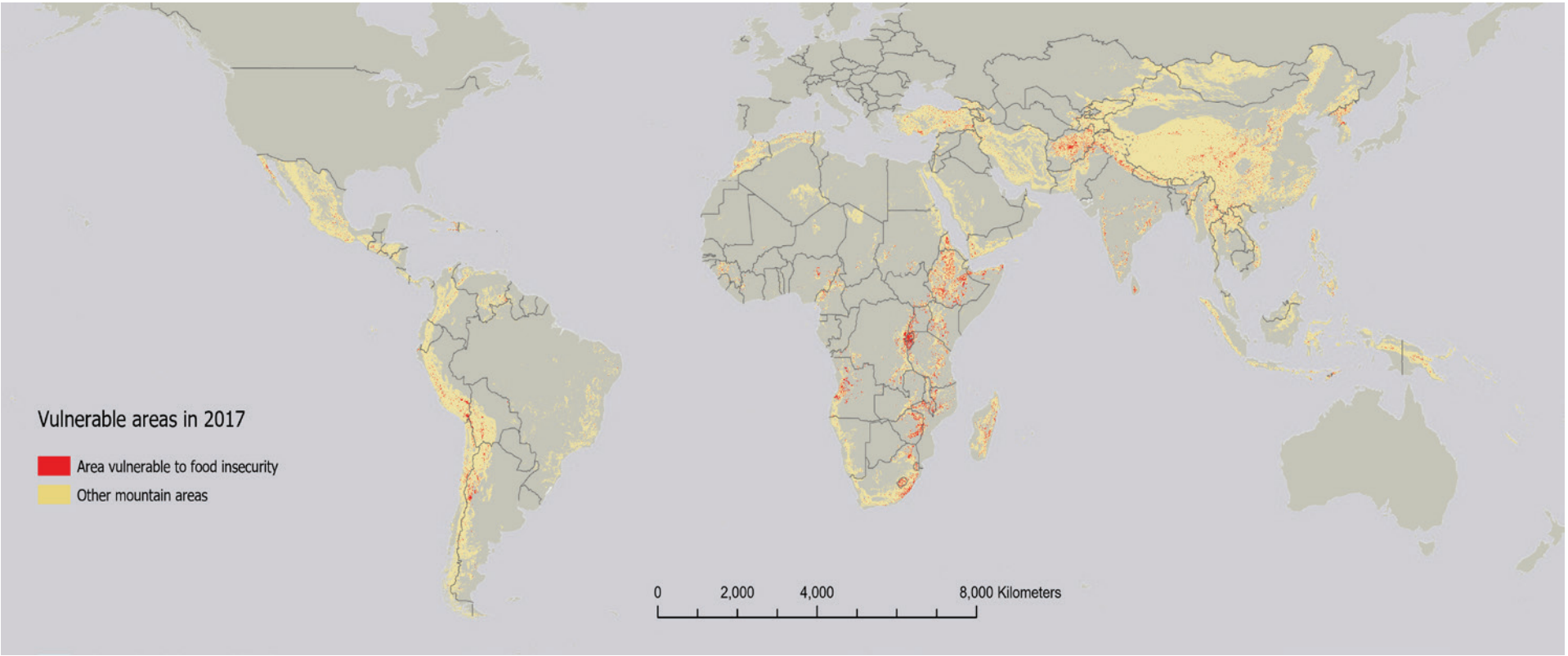
Table 8. Vulnerable rural mountain people in developing countries (2000, 2012 and 2017)

During the same period (2012–2017), the rural mountain population increased by 10 percent (from 590 million to 648 million). The proportion of vulnerable people to the total rural mountain population therefore remained practically constant from 2012 to 2017 (52 percent in 2012 and 53 percent in 2017) (Table 9). Compared to 2000, however, this proportion increased, as the vulnerable people in the year 2000 were 44 percent of the rural population.

Developing World		2000	2012	2017
Number of people ('000)	Total mountain population	780 714	918 008	1 003 687
	Rural mountain population	544 743	589 558	648 134
	Vulnerable population	242 607	307 083	345 571
Population share (%)	Vulnerable population to total mountain population	31	33	34
	Vulnerable population to rural mountain population	44	52	53

Table 9: Total, rural and vulnerable mountain population in the developing world (2000, 2012 and 2017)

People vulnerable to food insecurity are present in all the rural mountain areas, with an uneven geographical distribution (Map 3).



Map 3. Mountain areas in developing countries considered vulnerable to food insecurity in 2017

In 2017, more than half of the total vulnerable mountain people (56 percent) were found in Asia (195 million people), followed by Africa (132 million), Latin America and the Caribbean (17 million) and Oceania (1.4 million) (Table 10). The results for Oceania are a particular case as population in this region is very small (total mountain population is 3.5 million people) and 100 percent of Micronesia's and 52 percent of Melanesia's populations were found outside of the agro-pastoral area. Because a large share of Oceania's rural population was not assessed by this study, and the mountain population is small, there are considerable uncertainties related to the estimates for this region.

	Number of vulnerable people ('000)			Share of total vulnerable population (%)		
Region	2000	2012	2017	2000	2012	2017
Africa	82 082	107 472	131 967	34	35	38
Latin America & the Caribbean	15 179	16 832	17 160	6.3	5.5	5.0
Asia	144 523	181 342	195 006	60	59	56
Oceania	823	1 437	1 439	0.3	0.5	0.4
Developing world	**242 607**	**307 083**	**345 571**	**100**	**100**	**100**

Table 10: Distribution of estimated vulnerable people by region in 2000, 2012 and 2017

Over the years, Africa has increased its share of the global vulnerable population, from 34 percent in 2000 to 38 percent in 2017, the largest increase in the world, while in Asia this share has decreased (from 60 percent in 2000 to 56 percent in 2017 of the world vulnerable population).

Globally, the number of vulnerable people increased in the periods 2000–2012 and 2012–2017 in all mountain classes except at the highest elevations (Figure 10).

Class 1 (above 4 500 m), is the only area where there was a decrease in the estimated number of people vulnerable to food insecurity in all regions. This result is linked to the depopulation experienced throughout the 2000–2017 period.

In the areas between 3 500 and 4 500 m (class 2) the study found very small upward variations in the number of vulnerable people in the period 2000–2012 (390 000 people) and even fewer (110 000) in the period 2012 to 2017. In these areas also, the (downward) changes in the total mountain population were very small.
Globally, the highest increase in the number of vulnerable people, in absolute terms, was in class 6, with 24 million more vulnerable people from 2000 to 2012 (22 percent increase), and 14 million more vulnerable people (10 percent increase) from 2012 to 2017 (Table 11, Table 12 and Table 13).

Figure 10: Vulnerable rural people by mountain classes in developing countries in 2000, 2012 and 2017

Region/ subregion	2017 Vulnerable rural mountain people ('000)								Vulnerable people to total mountain population (%)
	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	Class 7	Total	
Africa	**-**	**101**	**9 421**	**41 916**	**36 606**	**37 859**	**6 063**	**131 967**	**52**
Eastern Africa	-	101	9 125	35 994	27 343	16 238	4 966	93 767	60
Middle Africa	-	0.0	219	3 858	4 354	5 798	514	14 743	48
Northern Africa	-	-	6.5	526	1 476	4 794	186	6 989	23
Southern Africa	-	-	70	1 497	2 761	4 877	356	9 561	41
Western Africa	-	-	-	41	672	6 153	41	6 906	56
Latin America & the Caribbean	**356**	**1 623**	**2 277**	**2 821**	**2 216**	**7 376**	**490**	**17 160**	**10**
Caribbean	-	-	0.0	41	103	1 373	10	1 527	33
Central America	-	6.2	1 206	2 181	1 488	3 623	392	8 896	13
South America	356	1 617	1 071	599	625	2 380	88	6 736	7.3
Asia	**361**	**1 946**	**7 442**	**31 543**	**41 359**	**104 641**	**7 713**	**195 006**	**34**
Central Asia	0.0	10	119	850	1 445	2 034	91	4 549	26
Eastern Asia	326	1 562	2 828	12 547	18 237	48 722	5 066	89 289	35
South-Eastern Asia	0.2	70	62	847	4 194	14 807	436	20 415	31
Southern Asia	35	304	3 528	12 935	12 605	33 063	1 540	64 010	40
Western Asia	-	0.0	905	4 364	4 879	6 016	579	16 742	20
Oceania & Pacific	**-**	**-**	**68**	**906**	**204**	**147**	**113**	**1 439**	**41**
Melanesia	-	-	68	906	204	143	113	1 434	41
Micronesia	-	-	-	-	-	-	-	-	-
Polynesia	-	-	-	-	0.0	4.3	-	4.3	34
Developing world	**717**	**3 670**	**19 208**	**77 186**	**80 385**	**150 024**	**14 379**	**345 571**	**34**

Table 11: Estimated number of vulnerable people by subregions and elevation classes (2017)

Region/ subregion	2012 Vulnerable rural mountain people ('000)								Vulnerable people to total mountain population (%)
	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	Class 7	Total	
Africa	**-**	**169**	**8 405**	**32 511**	**30 305**	**30 663**	**5 419**	**107 472**	**49**
Eastern Africa	-	169	8 095	27 681	23 096	13 980	4 430	77 451	57
Middle Africa	-	0.0	229	3 343	3 297	4 206	465	11 540	44
Northern Africa	-	-	5.2	351	976	3 450	154	4 936	19
Southern Africa	-	-	76	1 118	2 484	4 008	332	8 018	38
Western Africa	-	-	-	19	452	5 019	38	5 528	50
Latin America & the Caribbean	**411**	**1 427**	**2 128**	**2 754**	**2 202**	**7 415**	**496**	**16 832**	**11**
Caribbean	-	-	0.0	36	146	1 408	12	1 602	35
Central America	-	11	1 184	2 119	1 419	3 649	395	8 777	13
South America	411	1 416	945	599	636	2 358	88	6 454	7.4
Asia	**404**	**1 964**	**7 013**	**27 975**	**37 898**	**98 803**	**7 286**	**181 342**	**34**
Central Asia	1.1	12	97	661	1 145	1 745	69	3 729	24
Eastern Asia	343	1 439	2 683	12 669	18 008	48 173	5 026	88 341	36
South-Eastern Asia	1.0	76	53	738	3 604	14 641	413	19 526	33
Southern Asia	59	436	3 608	10 130	10 629	29 387	1 328	55 577	39
Western Asia	-	0.0	572	3 777	4 512	4 858	450	14 169	20
Oceania & Pacific	**-**	**-**	**95**	**880**	**189**	**160**	**114**	**1 437**	**45**
Melanesia	-	-	95	880	189	156	114	1 433	45
Micronesia	-	-	-	-	-	-	-	-	-
Polynesia	-	-	-	-	0.0	4.4	-	4.4	34
Developing world	**815**	**3 559**	**17 642**	**64 119**	**70 594**	**137 040**	**13 314**	**307 083**	**33**

Table 12: Estimated number of vulnerable people by subregions and elevation classes (2012)

Region/ subregion	2000 Vulnerable rural mountain people ('000)								Vulnerable people to total mountain population (%)
	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	Class 7	Total	
Africa	**-**	**165**	**7 519**	**25 896**	**22 048**	**21 883**	**4 571**	**82 082**	**52**
Eastern Africa	-	165	7 084	22 379	16 335	9 828	3 801	59 592	62
Middle Africa	-	0.0	320	2 295	2 468	2 886	358	8 327	51
Northern Africa	-	-	9.3	280	624	2 119	113	3 146	15
Southern Africa	-	-	106	935	2 285	2 654	265	6 244	38
Western Africa	-	-	-	6.7	336	4 397	34	4 774	59
Latin America & the Caribbean	**624**	**1 595**	**2 104**	**2 369**	**1 782**	**6 213**	**491**	**15 179**	**12**
Caribbean	-	-	0.0	16	74	1 313	8.6	1 411	40
Central America	-	18	1 313	1 899	1 239	2 942	389	7 799	14
South America	624	1 578	791	453	469	1 958	94	5 968	8.5
Asia	**970**	**1 406**	**5 171**	**18 919**	**27 096**	**84 481**	**6 481**	**144 523**	**29**
Central Asia	5.9	74	91	348	681	1 128	49	2 377	19
Eastern Asia	358	649	2 037	11 420	17 049	47 782	4 890	84 184	32
South-Eastern Asia	1.6	6.8	3.8	260	2 300	12 554	322	15 449	28
Southern Asia	604	676	2 469	5 087	5 110	21 064	942	35 953	34
Western Asia	-	0.1	570	1 804	1 955	1 952	277	6 559	12
Oceania & Pacific	**-**	**-**	**63**	**501**	**99**	**101**	**59**	**823**	**32**
Melanesia	-	-	63	501	99	95	59	817	32
Micronesia	-	-	-	-	-	-	-	-	-
Polynesia	-	-	-	-	0.0	5.7	-	5.8	31
Developing world	**1 594**	**3 166**	**14 857**	**47 685**	**51 026**	**112 678**	**11 601**	**242 607**	**31**

Table 13: Estimated number of vulnerable people by subregions and elevation classes (2000)

Potato crop in Ethiopia (©FAO/Giulio Napolitano)

Regional situation

The following paragraphs present the situation of the estimated number of vulnerable people in the mountain areas of the developing countries by regions and subregions.[1]

Africa

In Africa, 132 million rural mountain people were estimated to be vulnerable to food insecurity in 2017, representing 67 percent of the total rural population. In other words, in the mountain areas of Africa, two rural people out of three were estimated vulnerable to food insecurity in 2017, the highest share in all continents. There was an increase of 25.4 million vulnerable people from 2000 to 2012 and of 24.5 million from 2012 to 2017 (Table 14). The share of vulnerable people to the total African mountain population remained stable from 2000 to 2017 (around 52 percent), while the share to the rural population increased (5 percent).

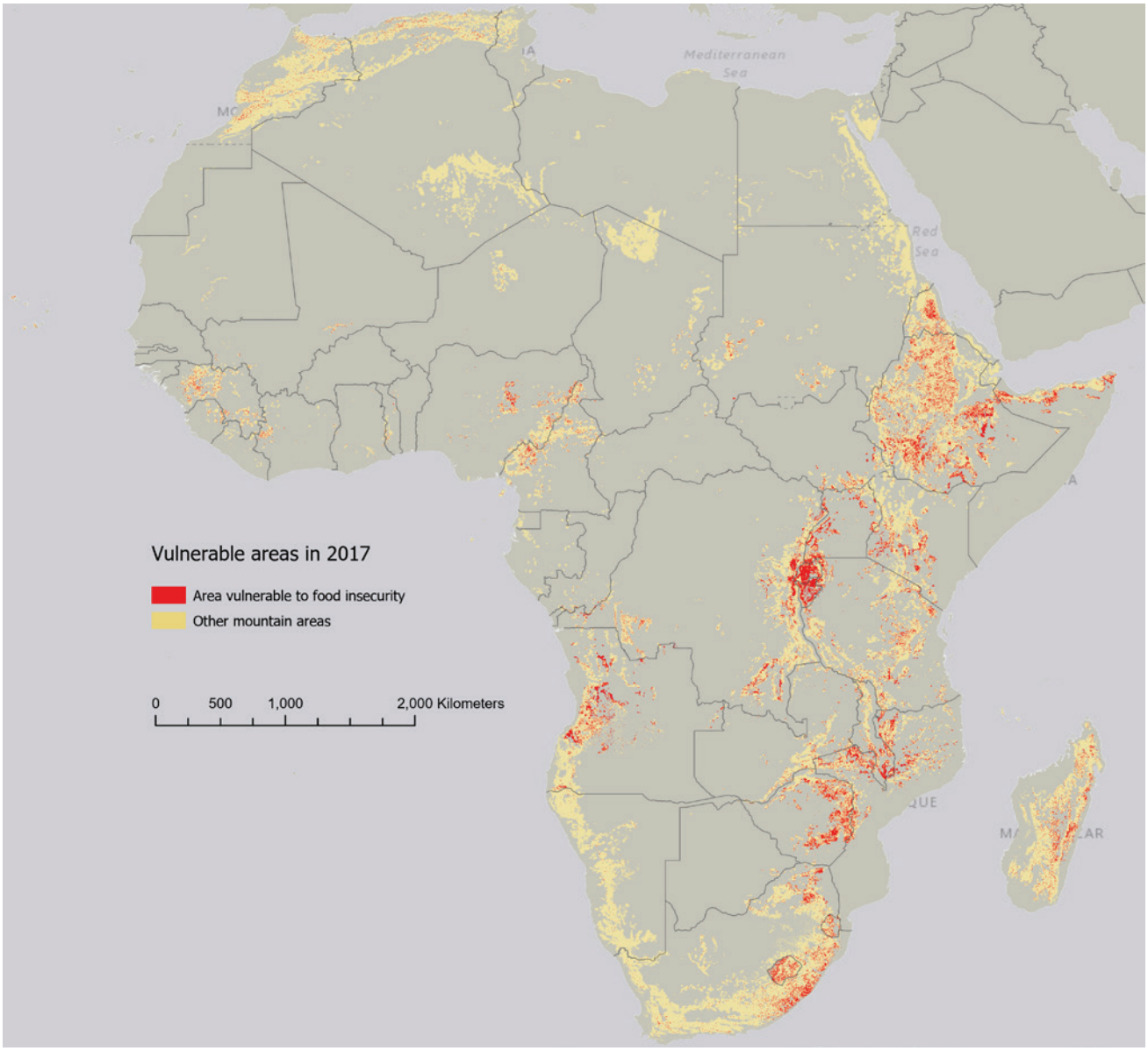
The number of vulnerable people increased in all African subregions from 2000 to 2017 and their distribution in the subregions remained stable. The majority of vulnerable people are found in Eastern Africa: 94 million in 2017, or 71 percent of the total mountain vulnerable population of the continent. Western Africa and Northern Africa have the lowest numbers of vulnerable people in the region, about 7 million each.

Even in the subregions with fewer vulnerable people, their share to the total rural mountain population increased in the 2000–2017 period. The two subregions where the increase was more marked are Southern Africa where this share rose from 55 percent in 2000 to 78 percent in 2017 and Northern Africa (from 27 percent in 2000 to 41 percent in 2017) (Table 15).

Africa		2000	2012	2017
Number of people ('000)	Total mountain population	158 855	220 711	252 430
	Rural mountain population	132 343	172 496	196 031
	Vulnerable population	82 082	107 472	131 967
Population share (%)	Vulnerable population to total mountain population	52	49	52
	Vulnerable population to total rural population	62	62	67

Table 14: Total, rural and vulnerable mountain population in Africa in 2000, 2012 and 2017)

[1] The country grouping scheme and the composition of the regions and subregions are presented in Annex 1.



Map 4: Mountain areas considered vulnerable to food insecurity in Africa in 2017

Region/subregion	Number of vulnerable people ('000)			Change ('000)		Distribution of mountain vulnerable people (%)			Vulnerable people to total rural population (%)		
	2000	2012	2017	2000–2012	2012–2017	2000	2012	2017	2000	2012	2017
Africa	82 082	107 472	131 967	25 391	24 494	100	100	100	62	62	67
Eastern Africa	59 592	77 451	93 767	17 859	16 316	73	72	71	68	65	69
Middle Africa	8 327	11 540	14 743	3 213	3 204	10	11	11	60	63	68
Northern Africa	3 146	4 936	6 989	1 791	2 053	3.8	4.6	5.3	27	35	41
Southern Africa	6 244	8 018	9 561	1 774	1 543	7.6	7.5	7.2	55	69	78
Western Africa	4 774	5 528	6 906	754	1 378	5.8	5.1	5.2	65	61	71

Table 15: Trends and distribution of vulnerable rural mountain people by subregion in Africa in 2000, 2012 and 2017

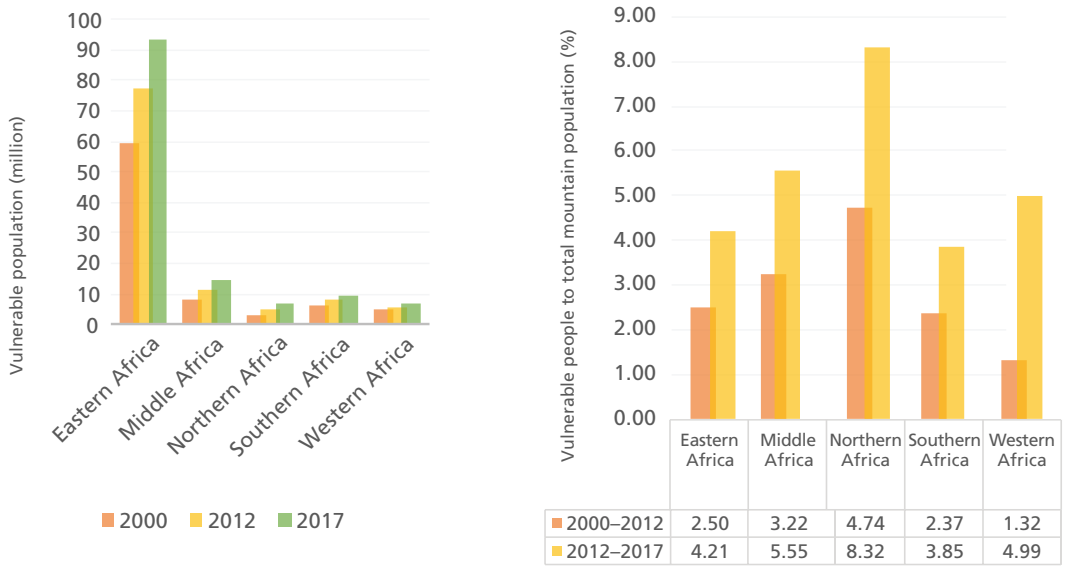


Figure 11: Vulnerable population changes and annual rate of change in Africa by subregion in 2000, 2012 and 2017

Africa is the only region in the developing world where the annual rate of change of the vulnerable population increased in the period 2012–2017 compared to the years 2000 to 2012. At the continental level this rate was 2.6 percent in 2000–2012 and 4.6 percent in 2012–2017. The highest annual increase was in Northern Africa, 8.3 percent from 2012 to 2017 (Figure 11).

The number of vulnerable people increased from 2000 to 2017 at all the elevation classes, except in class 1 and 2 (Table 16), following the increase of the overall mountain population in the same period.

Year	Number of vulnerable rural mountain people ('000)									Vulnerable people to total mountain population (%)
	Region	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	Class 7	Total	
	Africa	**-**	**165**	**7 519**	**25 896**	**22 048**	**21 883**	**4 571**	**82 082**	**52**
	Eastern Africa	-	165	7 084	22 379	16 335	9 828	3 801	59 592	62
	Middle Africa	-	-	320	2 295	2 468	2 886	358	8 327	51
	Northern Africa	-	-	9.0	280	624	2 119	113	3 145	15
	Southern Africa	-	-	106	935	2 285	2 654	265	6 245	38
2000	Western Africa	-	-	-	7.0	336	4 397	34	4 774	59
	Africa	**-**	**169**	**8 405**	**32 511**	**30 305**	**30 663**	**5 419**	**107 472**	**49**
	Eastern Africa	-	169	8 095	27 681	23 096	13 980	4 430	77 451	57
	Middle Africa	-	-	229	3 343	3 297	4 206	465	11 540	44
	Northern Africa	-	-	5.0	351	976	3 450	154	4 936	19
	Southern Africa	-	-	76	1 118	2 484	4 008	332	8 018	38
2012	Western Africa	-	-	-	19	452	5 019	38	5 528	50
	Africa	**-**	**101**	**9 422**	**41 916**	**36 606**	**37 859**	**6 063**	**131 967**	**52**
	Eastern Africa	-	101	9 125	35 994	27 343	16 238	4 966	93 767	60
	Middle Africa	-	-	219	3 858	4 354	5 798	514	14 743	48
	Northern Africa	-	-	6.0	526	1 476	4 794	186	6 988	23
	Southern Africa	-	-	70	1 497	2 761	4 877	356	9 561	41
2017	Western Africa	-	-	-	41	672	6 153	41	6 907	56

Most vulnerable people are found below 1 500 m: 116 million people, or 88 percent
Table 16: Vulnerable rural mountain people in Africa by subregions and mountain classes in 2000, 2012 and 2017

of the total vulnerable population in 2017, in line with the overall distribution of mountain people at the different elevation classes.

Latin America and the Caribbean

In 2017 there were 17 million estimated vulnerable rural mountain people in the Latin America and the Caribbean region, representing 31 percent of the rural mountain population and 10 percent of the total mountain population of the region (the lowest share of all developing regions). In absolute terms, there were increases in the number of vulnerable people of 1.7 million from 2000 to 2012 and of 330 000 from 2012–2017. The share of vulnerable people to the total mountain population remained stable from 2000 to 2017 (12 percent in 2000, 11 percent in 2012 and 10 percent in 2017). The share to the total rural population also remained stable, around 30 percent (28 percent in 2000, 32 percent in 2012 and 31 percent in 2017) (Table 17).

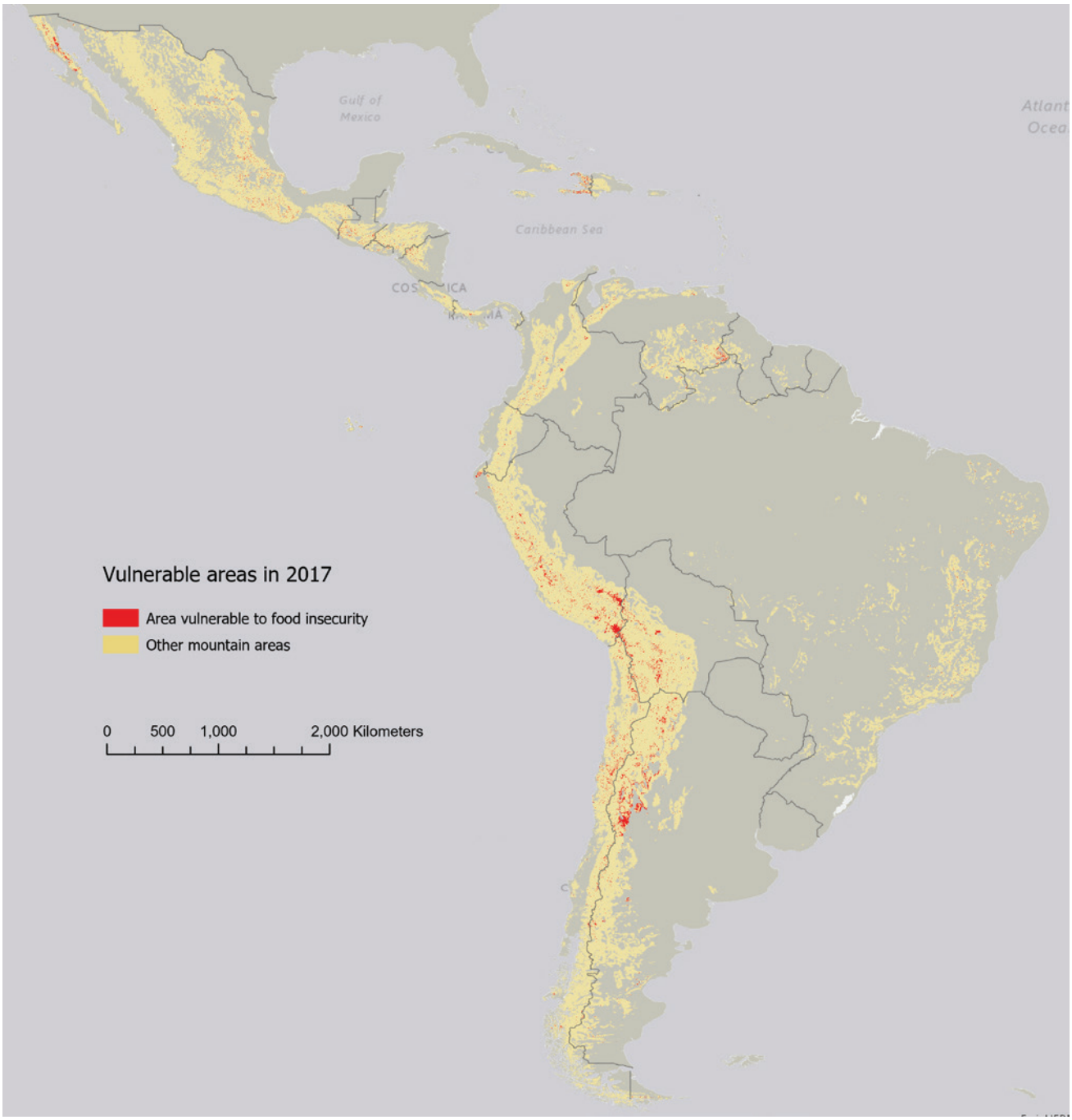
Latin America and the Caribbean		2000	2012	2017
Number of people ('000)	Total mountain population	127 709	157 780	167 501
	Rural mountain population	53 976	53 249	55 236
	Vulnerable population	15 179	16 832	17 160
Population share (%)	Vulnerable population to total mountain population	12	11	10
	Vulnerable population to total rural population	28	32	31

Table 17: Total, rural and vulnerable mountain population in Latin America and the Caribbean in 2000, 2012 and 2017

In 2017 more than half (52 percent) of all vulnerable people in the region were found in Central America (9 million people, representing 34 percent of the rural people of the subregion). South America was the region with the second highest number of vulnerable people, 7 million people, or 26 percent of its rural mountain population. Although lower in absolute numbers, (1.5 million people), the estimated vulnerable people in the Caribbean represented 42 percent of the rural mountain people of this subregion (Table 18).

Region	Number of vulnerable people ('000)			Change ('000)		Distribution of vulnerable mountain people (%)			Vulnerable people to total rural population (%)		
	2000	2012	2017	2000–2012	2012–2017	2000	2012	2017	2000	2012	2017
Latin America & the Caribbean	15 179	16 832	17 160	1 654	327	100	100	100	28	32	31
Caribbean	1.411	1 602	1 527	190	-74	9.3	9.5	8.9	49	44	42
Central America	7 799	8 777	8 896	977	120	51	52	52	33	36	35
South America	5 968	6 454	6 736	486	282	39	38	39	22	25	26

Table 18: Trends and distribution of vulnerable mountain people by subregion in Latin America and the Caribbean in 2000, 2012 and 2017



Map 5: Mountain areas considered vulnerable to food insecurity in Latin America and the Caribbean in 2017

From 2000 to 2017 the changes in the number of vulnerable people in the three subregions of Latin America and the Caribbean were very low, and particularly from 2012 to 2017. Overall in the period 2000–2017, vulnerable people increased in all subregions, but from 2012 to 2017 their numbers decreased in the Caribbean. The low values of changes should be considered with care, given the approximation and uncertainties in the estimates.

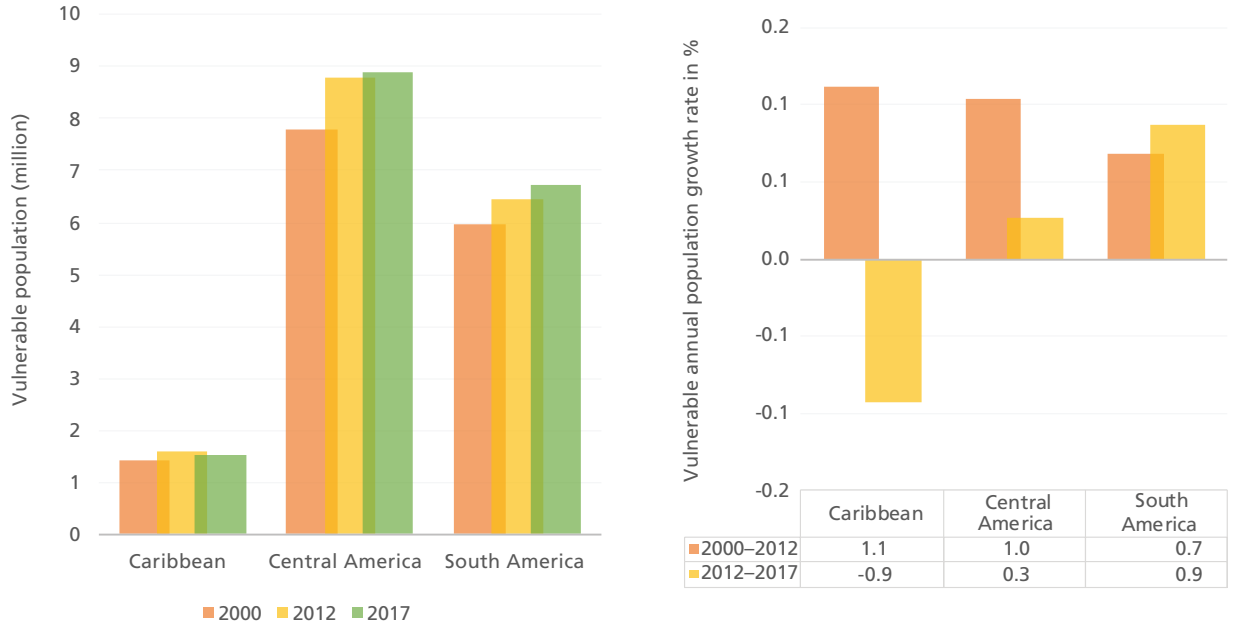


Figure 12: Vulnerable population changes and annual rate of changes in Latin America and the Caribbean by subregion in 2000, 2012 and 2017

The annual rate of change of the vulnerable rural mountain population in Latin America and the Caribbean was lower in the period 2012–2017 than from 2000 to 2012. (Figure 12).

The distribution of vulnerable people at the different elevation classes remained approximately stable throughout the period 2000–2017 (Table 19). Most vulnerable people lived in class 6. The decrease in the number of vulnerable people in class 1 (above 4 500 m) follows the decrease of the overall mountain population at these altitudes.

Year	Number of vulnerable people ('000)									Vulnerable people to total mountain population (%)
	Region	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	Class 7	Total	
2000	**Latin America & the Caribbean**	**624**	**1 595**	**2 104**	**2 369**	**1 782**	**6 213**	**491**	**15 178**	**12**
	Caribbean	-	-	-	16	74	1 313	9.0	1 412	40
	Central America	-	18	1 313	1 899	1 239	2 942	389	7 800	14
	South America	624	1 578	791	453	469	1 958	94	5 967	8.5
2012	**Latin America & the Caribbean**	**411**	**1 427**	**2 128**	**2 754**	**2 202**	**7 415**	**496**	**16 833**	**11**
	Caribbean	-	-	-	36	146	1 408	12	1 602	35
	Central America	-	11	1 184	2 119	1 419	3 649	395	8 777	13
	South America	411	1 416	945	599	636	2 358	88	6 453	7.4
2017	**Latin America & the Caribbean**	**356**	**1 623**	**2 277**	**2 821**	**2 216**	**7 376**	**490**	**17 159**	**10**
	Caribbean	-	-	-	41	103	1 373	10	1 527	33
	Central America	-	6.0	1 206	2 181	1 488	3 623	392	8 896	13
	South America	356	1 617	1 071	599	625	2 380	88	6 736	7.3

Table 19: Vulnerable rural mountain people in Latin America and the Caribbean by subregions and mountain classes in 2000, 2012 and 2017

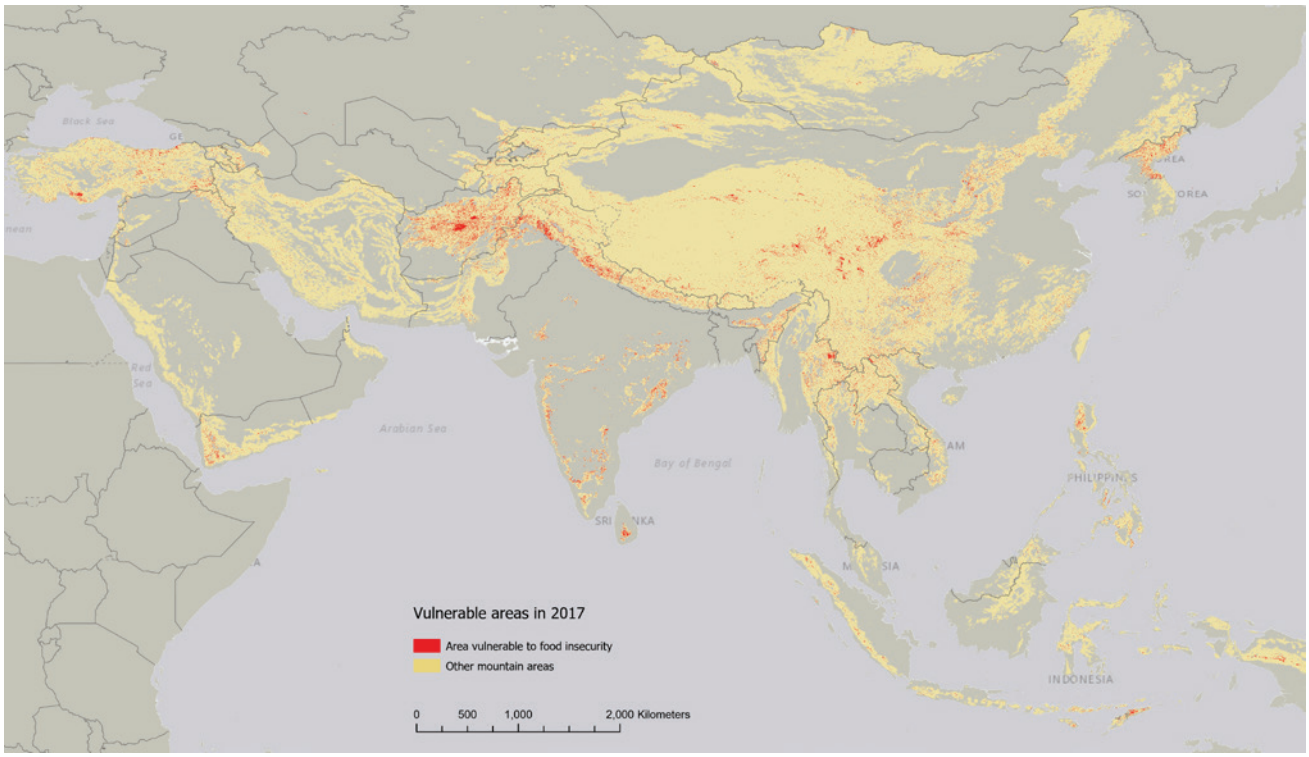
Asia

In 2017, there were 195 million estimated vulnerable rural mountain people in Asia, representing 34 percent of the total mountain population and 50 percent of the rural mountain population of the region. In Asia one rural mountain dweller out of two was estimated vulnerable to food insecurity in 2017. In absolute terms, there was an increase of 37 million vulnerable people from 2000 to 2012 and of 14 million from 2012–2017 (Table 20).

The share of vulnerable people out of the total mountain population increased (from 29 percent in 2000 to 34 percent in 2012 and 2017), and the share to the rural population also increased from 40 percent in 2000 to 50 percent in 2012 and 2017.

Asia		2000	2012	2017
Number of people ('000)	Total mountain population	491 570	536 353	580 283
	Rural mountain population	358 497	360 844	393 673
	Vulnerable population	144 523	181 342	195 006
Population share (%)	Vulnerable population to total mountain population	29	34	34
	Vulnerable population to total rural population	40	50	50

Table 20: Total, rural and vulnerable mountain population in Asia in 2000, 2012 and 2017



Map 6: Mountain areas considered vulnerable to food insecurity in Asia in 2017

Region	Number of vulnerable people ('000)			Change ('000)		Distribution of mountain vulnerable people (%)			Vulnerable people to total rural population (%)		
	2000	2012	2017	2000–2012	2012–2017	2000	2012	2017	2000	2012	2017
Asia	144 523	181 342	195 006	36 818	13 664	100	100	100	40	50	50
Central Asia	2 377	3 729	4 549	1 352	820	1.6	2.1	2.3	44	61	64
Eastern Asia	84 184	88 341	89 289	4 157	948	58	49	46	40	49	48
South-Eastern Asia	15 449	19 526	20 415	4 077	889	11	11	10	32	43	40
Southern Asia	35 953	55 577	64 010	19 624	8 433	25	31	33	52	59	59
Western Asia	6 559	14 169	16 742	7 610	2 573	4.5	7.8	8.6	26	41	40

Table 21: Trends and distribution of vulnerable mountain people by subregion in Asia in 2000, 2012 and 2017

Most of the vulnerable people (89 million) lived in Eastern Asia, the subregion with the highest mountain population and the one with the largest extent of mountain areas (6 million km^2). From 2000 to 2017 the number of vulnerable people increased in each of the Asian subregions as did their share to the total rural population (Table 21).

In Southern Asia the absolute numbers of vulnerable people grew more than elsewhere in the Asian mountains, showing an increase of 28 million more vulnerable people from 2000 to 2017 (20 million from 2000 to 2012 and 8 million from 2000 to 2017). In Central Asia, although the absolute values of the increases are modest compared to the other regions (1.4 million from 2000 to 2012 and 820 000 from 2012 to 2017), the share of vulnerable people to the total rural population increased more than in the other subregions, passing from 44 percent in 2000 to 64 percent in 2017. While in the year 2000 roughly one rural mountain dweller out of two was vulnerable to food insecurity in Central Asia, this proportion became two out of three in 2017.

The annual rate of change of the vulnerable rural mountain population in Asia was lower in the period 2012–2017 than from 2000 to 2012 in all subregions.

Growing rice in India (©Pan Himalayan Grass Roots Development Foundation)

Western Asia was the subregion with the most marked decrease in the annual change, which was 10 percent from 2000 to 2012, and 4 percent from 2012 to 2017 (Figure 13).

The number of vulnerable people increased from 2000 to 2017 in all elevation classes, except at the highest elevations (class 1). The distribution of the vulnerable population by mountain classes shows that in all subregions the highest numbers of vulnerable people are at the lower altitudes, particularly in mountain class 6 (Table 22).

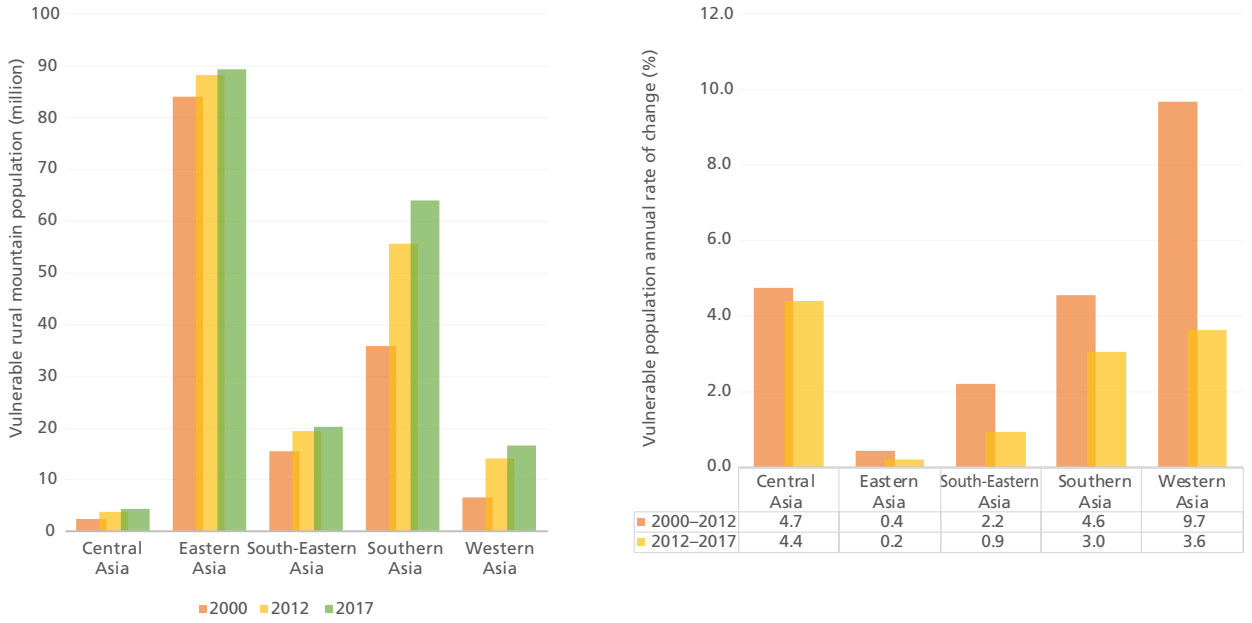


Figure 13: Vulnerable population changes and annual rates of change in Africa by subregion in 2000, 2012 and 2017

Year	Number of vulnerable people ('000)								Vulnerable people to total mountain population (%)
	Region	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	Class 7	Total	
	Asia	**970**	**1 406**	**5 171**	**18 919**	**27 096**	**84 481**	**6 481**	**144 524**	**29**
	Central Asia	6.0	74	91	348	681	1 128	49	2 377	20
	Eastern Asia	358	649	2 037	11 420	17 049	47 782	4 890	84 185	32
	South-Eastern Asia	2.0	7.0	4.0	260	2 300	12 554	322	15 449	28
	Southern Asia	604	676	2 469	5 087	5 110	21 064	942	35 952	34
2000	Western Asia	-	-	570	1 804	1 955	1 952	277	6 558	12
	Asia	**404**	**1 964**	**7 013**	**27 975**	**37 898**	**98 803**	**7 286**	**181 343**	**34**
	Central Asia	1.0	12	97	661	1 145	1 745	69	3 730	24
	Eastern Asia	343	1 439	2 683	12 669	18 008	48 173	5 026	88 341	36
	South-Eastern Asia	1.0	76	53	738	3 604	14 641	413	19 526	33
	Southern Asia	59	436	3 608	10 130	10 629	29 387	1 328	55 577	39
2012	Western Asia	-	-	572	3 777	4 512	4 858	450	14 169	20
	Asia	**361**	**1 946**	**7 442**	**31 543**	**41 359**	**104 641**	**7 713**	**195 005**	**34**
	Central Asia	-	10	119	850	1 445	2 034	91	4 549	26
	Eastern Asia	326	1 562	2 828	12 547	18 237	48 722	5 066	89 288	35
	South-Eastern Asia	-	70	62	847	4 194	14 807	436	20 416	31
	Southern Asia	35	304	3 528	12 935	12 605	33 063	1 540	64 010	40
2017	Western Asia	-	-	905	4 364	4 879	6 016	579	16 743	20

Table 22: Vulnerable rural mountain people in Asia by subregions and mountain classes in 2000, 2012 and 2017

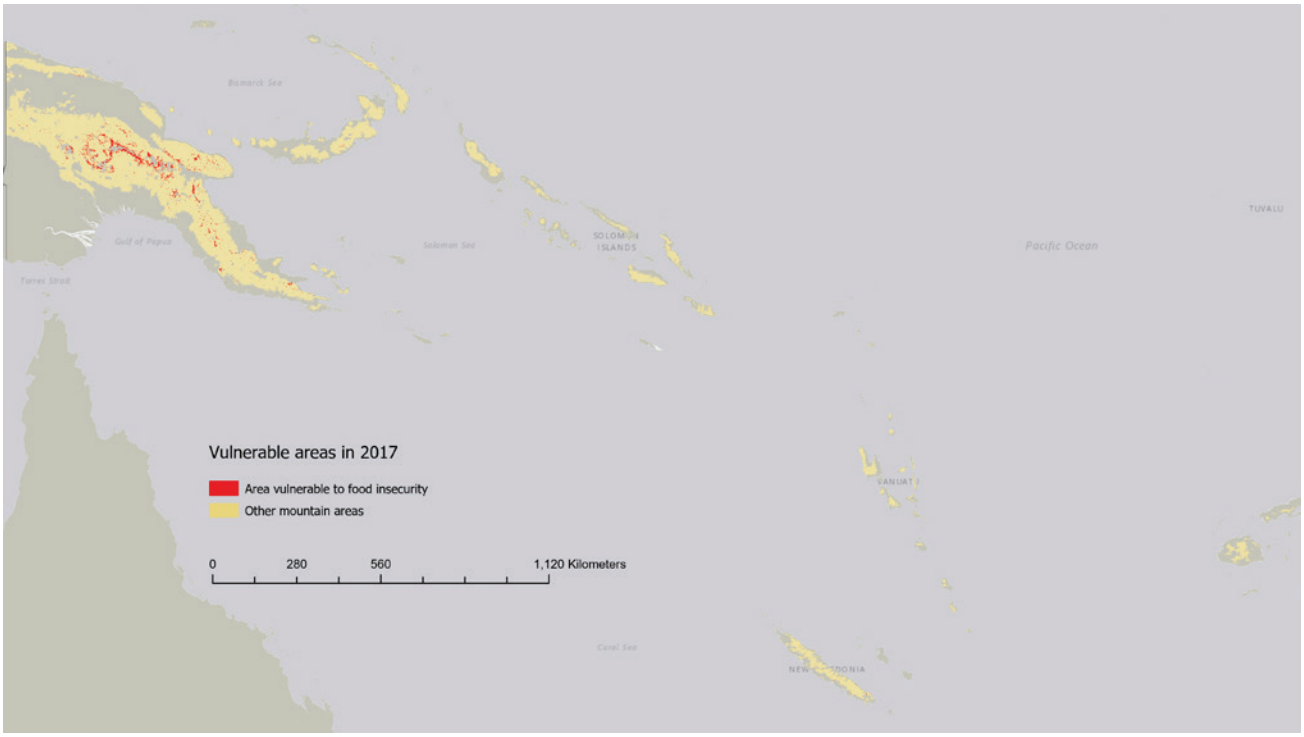
Oceania

This region, as already mentioned, is a particular case and the findings have to be taken with care as the small numbers of the mountain population and of the rural population mean great uncertainty in the estimates of vulnerable mountain people.

In Oceania, 1.4 million rural mountain people were considered vulnerable to food insecurity in 2017, representing 41 percent of the total mountain population and 45 percent of the rural mountain population of the subregion (Table 23). The share of vulnerable people to the total mountain population increased from 32 percent in 2000 to 41 percent in 2017. The share to the rural population increased even more, passing from 32 percent in 2000 to 45 percent in 2017. In absolute terms, the increase was 614 000 of more vulnerable people from 2000 to 2012, while from 2012 to 2017 there was no change.

Oceania		2000	2012	2017
Number of people ('000)	Total mountain population	2 580	3 163	3 472
	Rural mountain population	2 523	2 969	3 194
	Vulnerable population	823	1 437	1 439
Population share (%)	Vulnerable population to total mountain population	32	45	41
	Vulnerable population to total rural population	33	48	45

Table 23: Total, rural and vulnerable mountain population in Oceania in 2000, 2012 and 2017



Map 7: Mountain areas considered vulnerable to food insecurity in Oceania in 2017

In Oceania, nearly all of the mountain people are found in Melanesia, and this subregion is naturally where almost all vulnerable people lived in 2017 (Table 24).

Region	Number of vulnerable people ('000)			Change ('000)		Distribution of vulnerable mountain people (%)			Vulnerable people to total rural population (%)		
	2000	2012	2017	2000–2012	2000–2017	2000	2012	2017	2000	2012	2017
Oceania	823	1 437	1 439	614	1	100	100	100	33	48	45
Melanesia	817	1 433	1 434	615	1.5	99	100	100	33	48	45
Micronesia	-	-	-	0.0	0	-	-	-	-	-	-
Polynesia	5.8	4.4	4.3	-1.4	0	0.7	0.3	0.3	37	56	59

Table 24: Trends and distribution of vulnerable mountain people by subregion in Oceania in 2000, 2012 and 2017

The annual rate of change of the vulnerable rural mountain population in Oceania decreased to almost zero in the period 2012–2017, from a value of 6.2 percent in the period 2000–2012 (Figure 14).

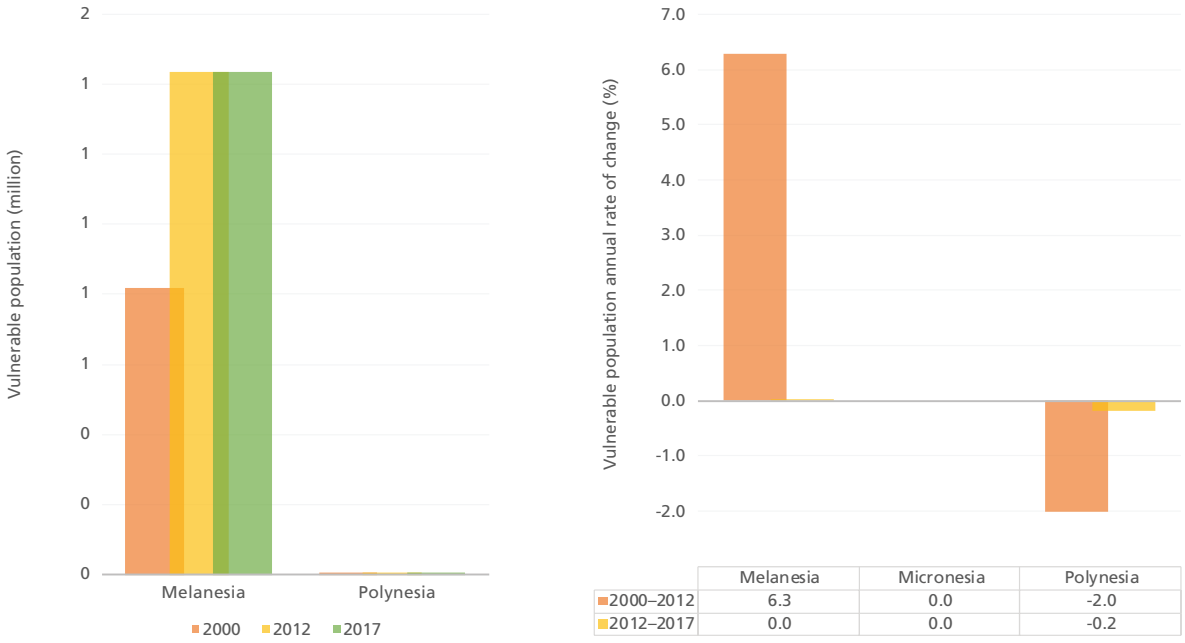


Figure 14: Vulnerable population changes and annual rates of change in Oceania by subregion in 2000, 2012 and 2017

Most of the vulnerable people live in mountain class 4, between 1 500 m and 2 500 m, and this distribution remained stable throughout the period 2000–2017. Mountain classes 3 and 6 show a decrease in the number of vulnerable people in 2017 compared to 2012 (Table 25) that is not explained by a decrease in total mountain population, which instead increased during the same period. However, these numbers have to be taken with due care given the possible variations of the estimates for small numbers.

Year	Number of vulnerable people ('000)									Vulnerable people to total mountain population (%)
	Region	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	Class 7	Total	
	Oceania	**-**	**-**	**63**	**501**	**99**	**101**	**59**	**823**	**32**
	Melanesia	-	-	63	501	99	95	59	817	32
	Micronesia	-	-	-	-	-	-	-	-	-
2000	Polynesia	-	-	-	-	-	6.0	-	6.0	31
	Oceania	**-**	**-**	**95**	**880**	**189**	**160**	**114**	**1 438**	**45**
	Melanesia	-	-	95	880	189	156	114	1 434	46
	Micronesia	-	-	-	-	-	-	-	-	-
2012	Polynesia	-	-	-	-	-	4.0	-	4.0	34
	Oceania	**-**	**-**	**68**	**906**	**204**	**148**	**113**	**1 439**	**41**
	Melanesia	-	-	68	906	204	143	113	1 434	42
	Micronesia	-	-	-	-	-	-	-	-	-
2017	Polynesia	-	-	-	-	-	4.0	-	4.0	34

Table 25: Vulnerable rural mountain people in Oceania by subregions and mountain classes in 2000, 2012 and 2017

Farm in Papua New Guinea (@FAO/Giorgio Grussu)

Rice terraces in Ifugao, Philippines (©FAO/Michelle Geringer)

Methodological notes: Measuring vulnerability to food insecurity

Reference population

The model to estimate the number of people vulnerable to food insecurity uses local crop and livestock production data. It was applied only to the rural areas of developing countries where agriculture and pastoralism are the prominent economic activities. More specifically, the areas on which the vulnerability assessment was performed are those defined as agro-pastoral. This is a subset of rural areas and includes all land cover types where it is expected that agricultural and pastoral activities take place (croplands, grasslands, shrubland and sparse vegetation, open forests). These areas have been identified by overlaying the Spatial Production Allocation Model (SPAM) and the Livestock Distribution Database layers over the ESA–CCI land cover.[2]

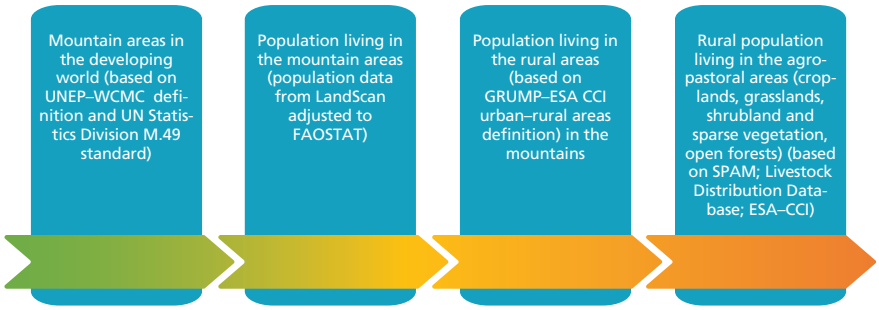


Figure 15: Process to define the reference population for the estimation of vulnerability to food insecurity in mountain areas of developing countries.

Herd in search of water, Qinghai-Tibetan Plateau (©Helene Copin)

[2] European Space Agency (ESA). Land Cover CCI PRODUCT USER GUIDE VERSION 2.0 DOCUMENT REF: CCI-LC-PUGV2) https://www.esa-landcover-cci.org/?q=webfm_send/84

Not-assessed population: areas outside the agro-pastoral zone and urban areas

For the reasons given above, people living in rural areas outside the agro-pastoral zone were not included in the estimation of the vulnerability to food insecurity. It is considered in fact that the crop/livestock model used by this study cannot properly estimate the access to food and balanced diets for people living in these areas.

In the tables and graphs giving the share of vulnerable people to the total rural mountain people, this group is reported together with the non-vulnerable. This means that the percentages reported might underestimate the real share of vulnerable people. In fact, there is no information on the not-assessed population but it is expected that some of them, although excluded from the model, are actually vulnerable. Annex 2 contains the numbers of the not-assessed population by subregions.

People living in urban areas were also excluded.

Estimation of the number of vulnerable people

Primary crop production for the major crops (beans, cassava, maize, potato, rice, wheat) and the five main livestock commodities (cattle, chickens, goats, pigs, sheep), obtained from the SPAM, the Livestock Distribution Database and adjusted to FAOSTAT, is converted to kilocalories (kcal), and live animals to grammes of protein using conversion factors provided by the FAO Nutrition Database. The average minimum energy from crops and protein availability from animal sources is set as 1 370 kcal/person/day and 14 g/person/day of protein, respectively. As in the model used in FAO (2015a), these values are lower than those established by the international dietary guidelines (World Health Organization [WHO], FAO, United Nations University [UNU])[3] in order to account for sources of food available to people who are not captured by the model. The threshold of 1 370 kcal from crop products corresponds to 80 percent of the minimum energy requirements and the 14 grammes of protein from animal products threshold corresponds to a minimum level of protein requirements.

This study considers as vulnerable to food insecurity populations living in rural mountain areas where agricultural production cannot provide local people with an average amount of energy from crops and amount of protein from animals that are above these thresholds. The model also takes into account the situation of areas where there are surpluses of production of either crops or livestock well above the thresholds of vulnerability. In fact it is assumed that if the availability of energy from crops or protein from livestock is high enough, part of the production can be traded to ensure a balanced diet. Specifically, the model considers that whenever the level of energy from crops or the amount of proteins from animal sources is at least twice the threshold values (that is, 2 740 kcal or 28 g of protein)

[3] The suggested daily requirement of energy for an adult varies from 1 680 to 1 990 kcal depending on the demographic and anthropometric characteristics of the country. The amount of 1 370 kcal/person/day corresponds to 80 percent of the amount of energy required to be in good health and perform a light level of activity as estimated in low-income countries. The amount of 14 grammes of protein from animal source was set as 35 percent of 10 percent of the contribution of proteins to the Minimum Dietary Energy Requirement (MDER), which is the minimum share of protein required for a balance diet. The safe level of protein consumption is set at about 58 g per adult per day.

the population is considered not at risk of being food insecure.[4] It is very important to recognize that these values (2 740 kcal or 28 g of protein) do not refer to nutrition requirements but are set to adjust the model and avoid overestimating the population at risk of food insecurity.

The overall approach to estimating the number of vulnerable people is outlined below:

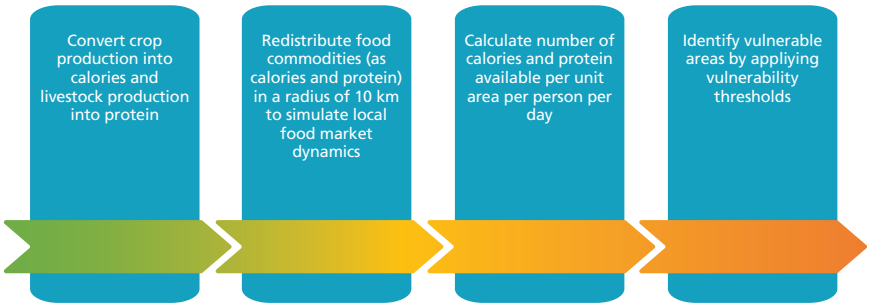


Figure 16: Process to define the reference population for the estimation of vulnerability to food insecurity in mountain areas of developing countries

This methodology was applied to the three reference years considered by this study (2000, 2012 and 2017). Data was recalculated for the years 2000 and 2012 for comparability reasons and for updating the figures from the 2015 study (FAO, 2015a) which did not include mountain elevation class 7. Given the adjustments made to the methodology compared to FAO, 2015a, the results of this study are not comparable to those published in 2003 and 2015 (FAO, 2003 and FAO, 2015a). Patterns in mountain vulnerability that were discussed in the 2015 report however are not contradicted in this report.


Siblings in Afghanistan (©Maryam Farzami)

[4] This latter threshold should not be seen as a normative threshold of human requirements but rather as a "calibration" threshold set to adjust for under- or over-reporting information on crops or livestock production.

5

Drivers of vulnerability to food insecurity in mountain regions

Mountains in Ecuador (©FAO/Thomas Hofer)

5. Drivers of vulnerability to food insecurity in mountain regions

Mountains in Morocco (©FAO/Thomas Hofer)

The preceding section presented the estimated numbers of rural mountain people living in developing countries who are vulnerable to food insecurity, based on an approximation of the local availability of calories and protein coming from agro-pastoral production.

The risk for mountain people to fall below a safe minimum threshold of food security, defined as "vulnerability to food insecurity", is caused by several environmental and socio-economic factors. As highlighted by the most recent editions of *State of Food Security and Nutrition in the World* (FAO, 2017; FAO, 2018; FAO, 2019), conflicts, climatic variability and extremes, and economic slowdowns and downturns are the key drivers of the recent increases in food insecurity in the world. In mountain areas, in addition to these, land degradation and natural disasters can lead to acute shortage of food.

Insufficient access to basic services such as transport, markets, health care and education is common in many rural mountain areas and it reduces their resilience and their capacity to cope with food deficit.

This section discusses these potential stressors and their linkages with the number of vulnerable people estimated in the previous chapter.

Stressors may induce or force changes that alter existing equilibriums and can cause physical and economic conditions to become unbalanced and unsustainable. The stressors considered in the analysis are:

- natural hazards
- conflicts
- structural constraints, such as: distance to (food) markets; and difficulty accessing town facilities and infrastructure, including education, health care,

amenities, food services, non-food shops, access to water and sanitation, technology and communication, electricity, hotels, etc.
- increased land degradation
- climatic variability

This list does not represent an order or ranking for importance or severity of the stressors.

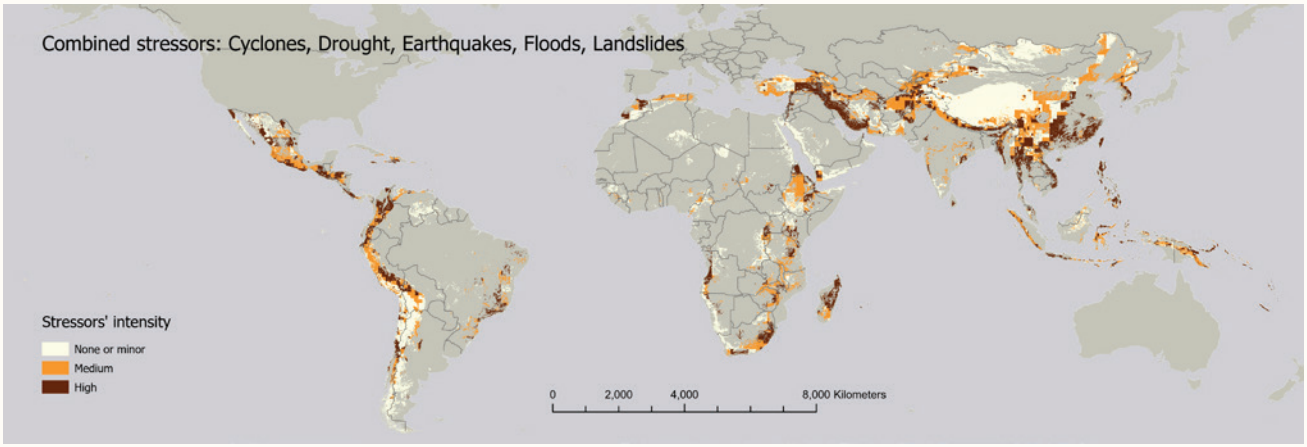
Natural hazards

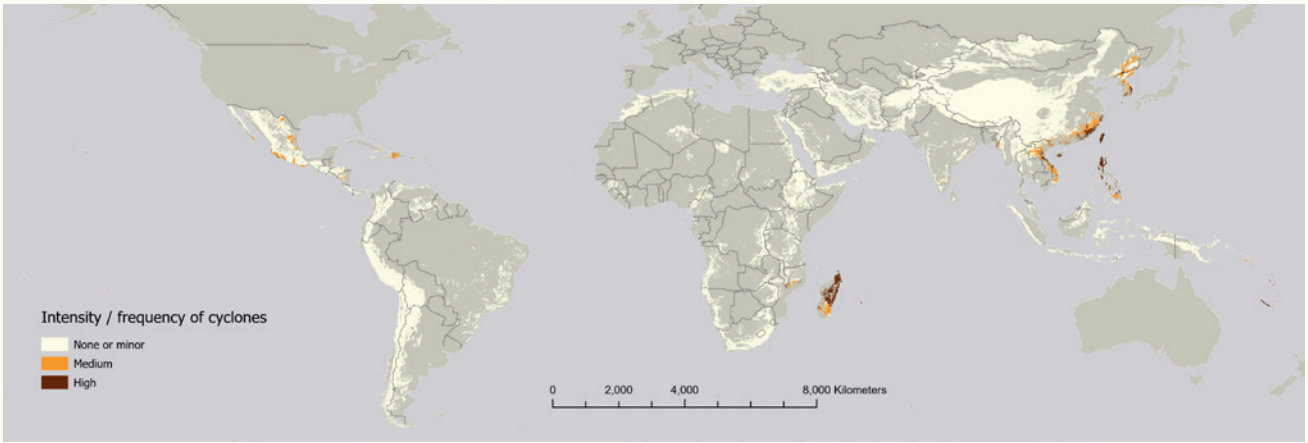
Natural hazards not only impact mountain environments, they also severely affect the lives and livelihoods of mountain people with negative effects that can persist for several years. Population growth, tourism and socio-economic development in mountains further increase the exposure of people and infrastructures to natural hazards. This trend is forecasted to continue in the future (IPCC, 2019a, p. 162).

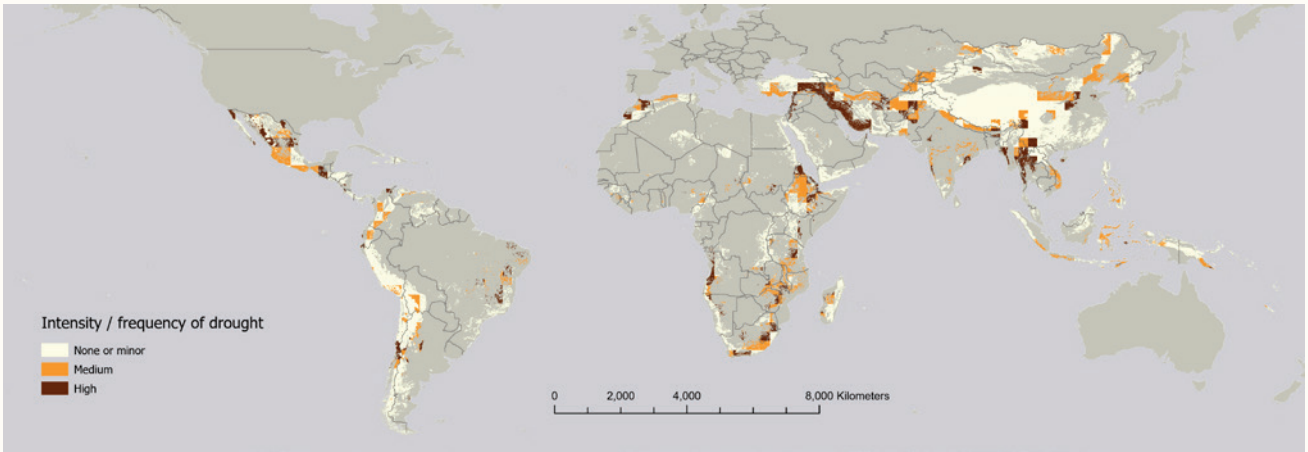
FAO (2015b) assessed that, between 2003 and 2013 in developing countries, the agricultural sector absorbed about 22 percent of the total damage and losses caused by natural hazards, rising to 25 percent when only climate-related disasters were considered. The agricultural sector is particularly affected by climate-induced disasters such as floods, drought and tropical storms, which have increased in number and intensity during the last decade. Drought is the most devastating, and it is responsible for more than 80 percent of the damage and loss to livestock and crop production.

The impact of disasters on agriculture has a direct effect on livelihoods and food security. Disasters can cause unemployment and a decline in wages and income among farmers and farm labourers, lower the availability of food commodities in local markets, reduce the purchasing capacity of households, restrict access to food, and force the sale of vital productive assets and erode livelihoods, particularly among the most vulnerable households (FAO, 2015b).

In an attempt to provide some visual representation of past occurrence of natural disasters in mountain areas, maps of disaster-prone mountain areas in developing countries were generated from data on natural hazards provided by the Natural Disaster Hotspot database by SEDAC of the National Aeronautics and Space Administration's (NASA, United States of America) Earth Observing System Data and Information System. Among the existing data sets, this one was chosen as the most appropriate for this study, as it includes comparable data for all the stressors that are particularly relevant in the mountains. This project maintained and made available to the public five data sets on the frequency and distribution of cyclones, drought, earthquakes, floods and landslides from 1980 to 2000. Based on the occurrence and intensity of these events for the period of about 20 years, these data sets provide a scale of intensity and frequency of these events and allow their visualization on maps; the greater the number and intensity of the events, the higher the relative class value for each given location. Map 8 presents the geographic distribution of natural hazards in mountain areas.

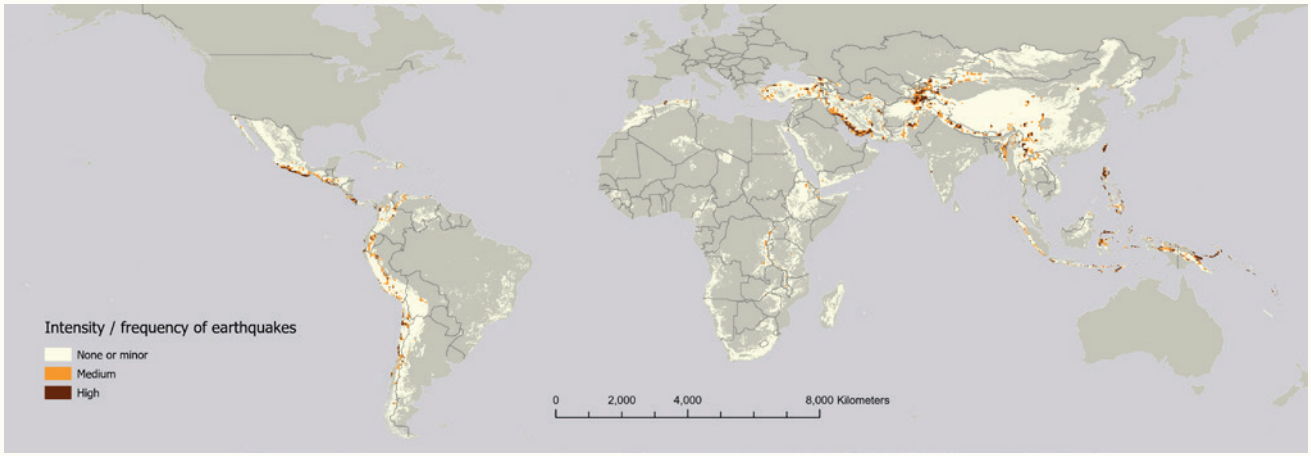


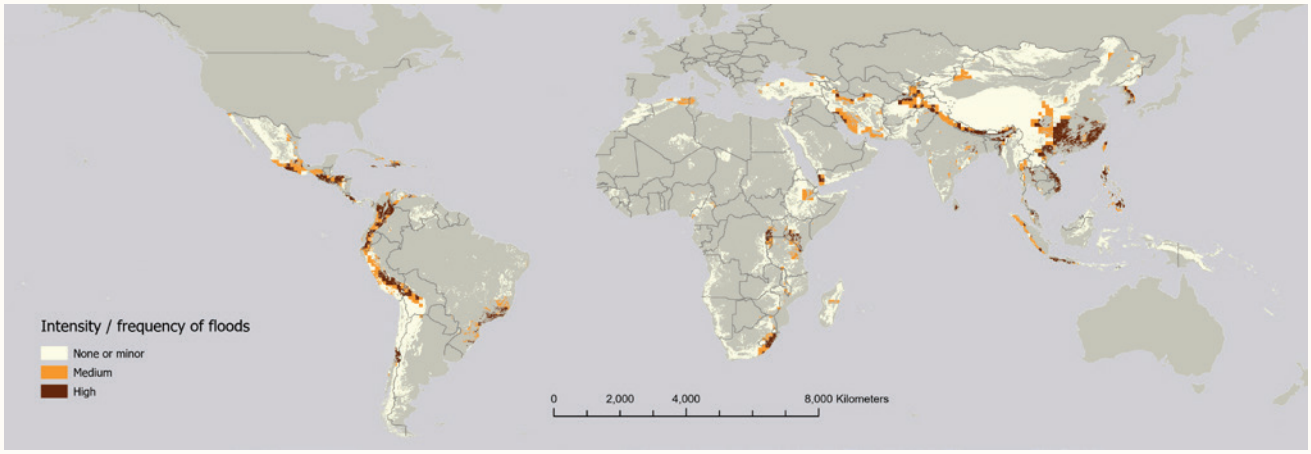


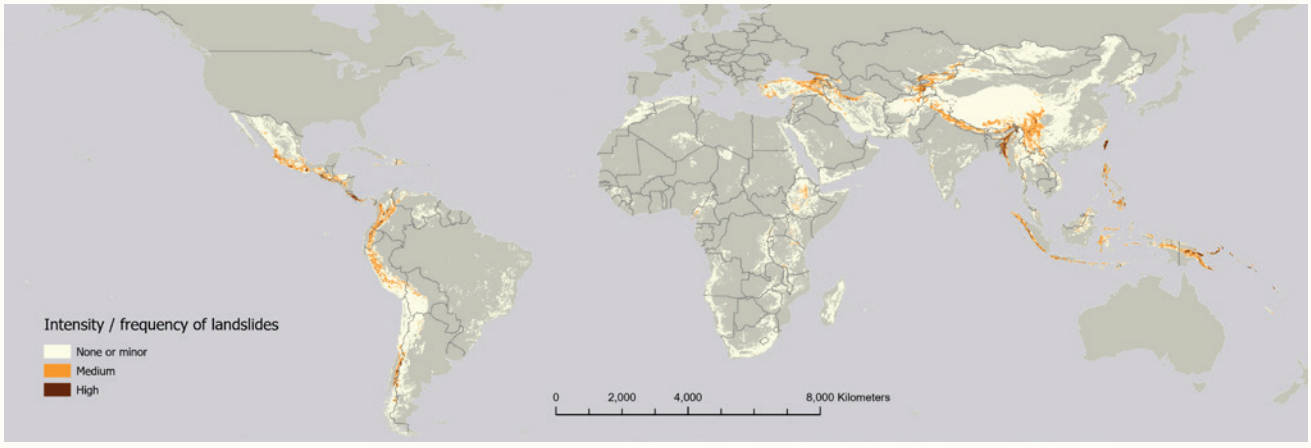


Map 8: Geographic distribution of natural hazards in the mountain areas of developing countries based on their frequency and intensity (1980–2000) (source: CIESIN-SEDAC)

Map 8 (cont.)

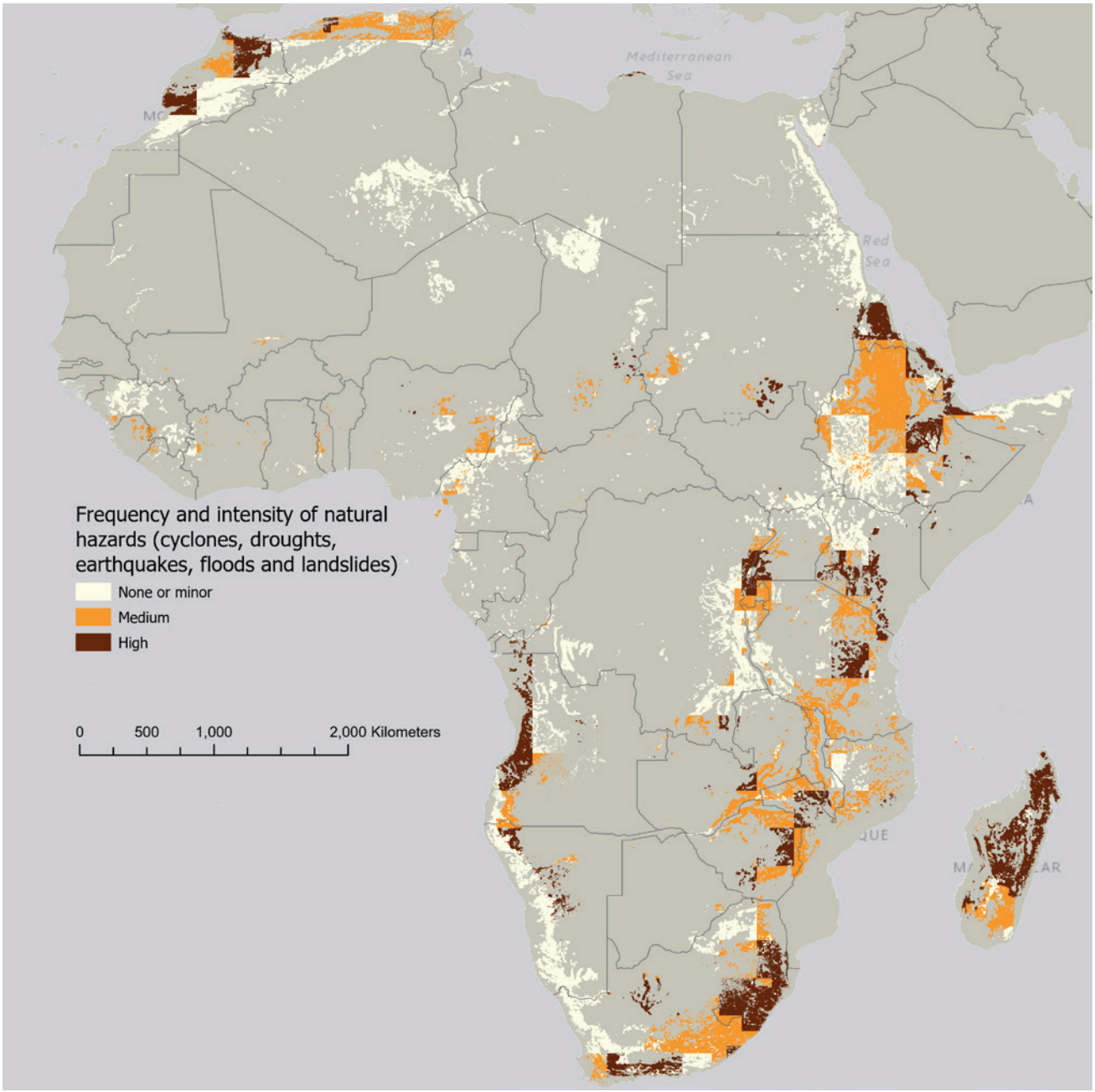

Intensity / frequency of earthquakes
None or minor
Medium
High
0
2,000
4,000
8,000 Kilometers


Intensity / frequency of floods
None or minor
Medium
High
0
2,000
4,000
8,000 Kilometers


Intensity / frequency of landslides
None or minor
Medium
High
0
2,000
4,000
8,000 Kilometers

The same data sets were used to generate maps of the frequency and intensity of natural hazards for Africa, Latin America and the Caribbean, Asia and Oceania (Maps 9, 10, 11, 12).

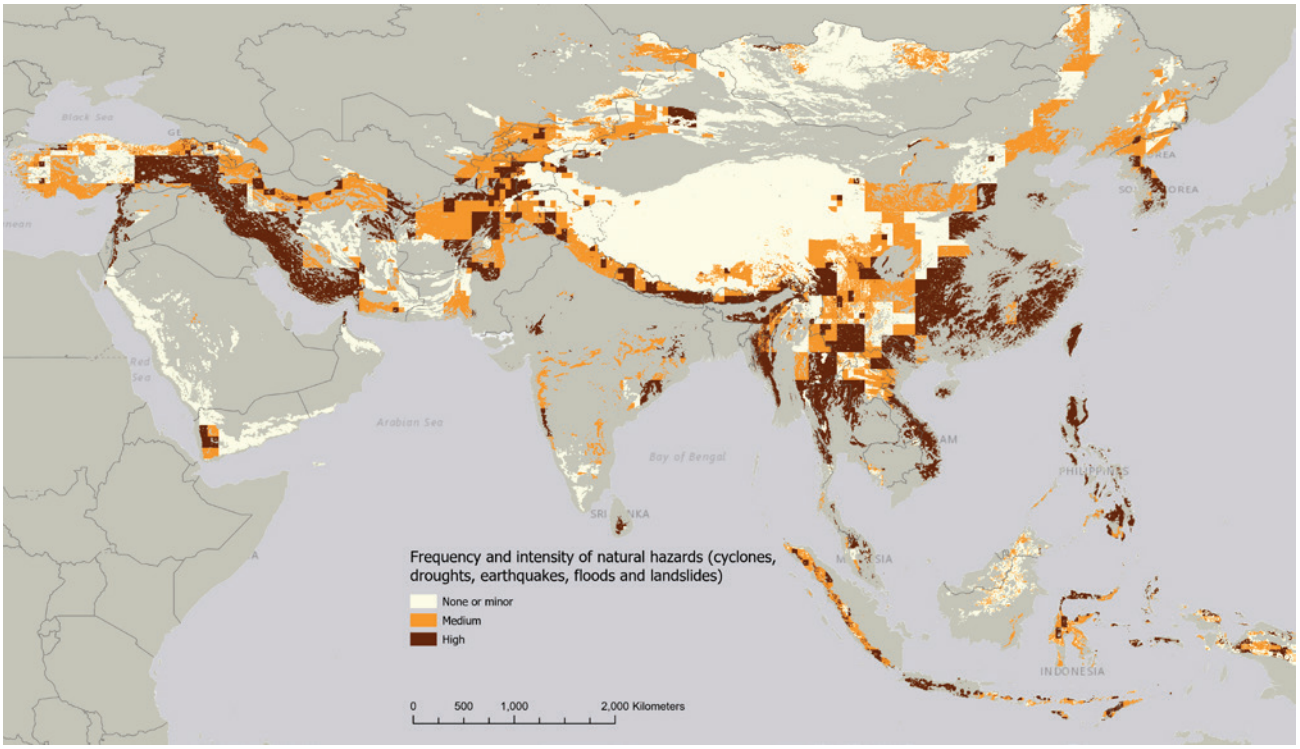
For this study, the data was also overlaid with mountain population data from 2017. Although the SEDAC data set refers to the years from 1980 to 2000 and does not include more recent information, it nevertheless allows the estimation of mountain peoples' exposure to past natural hazards and can give an indication of the disruption to mountain livelihoods caused.



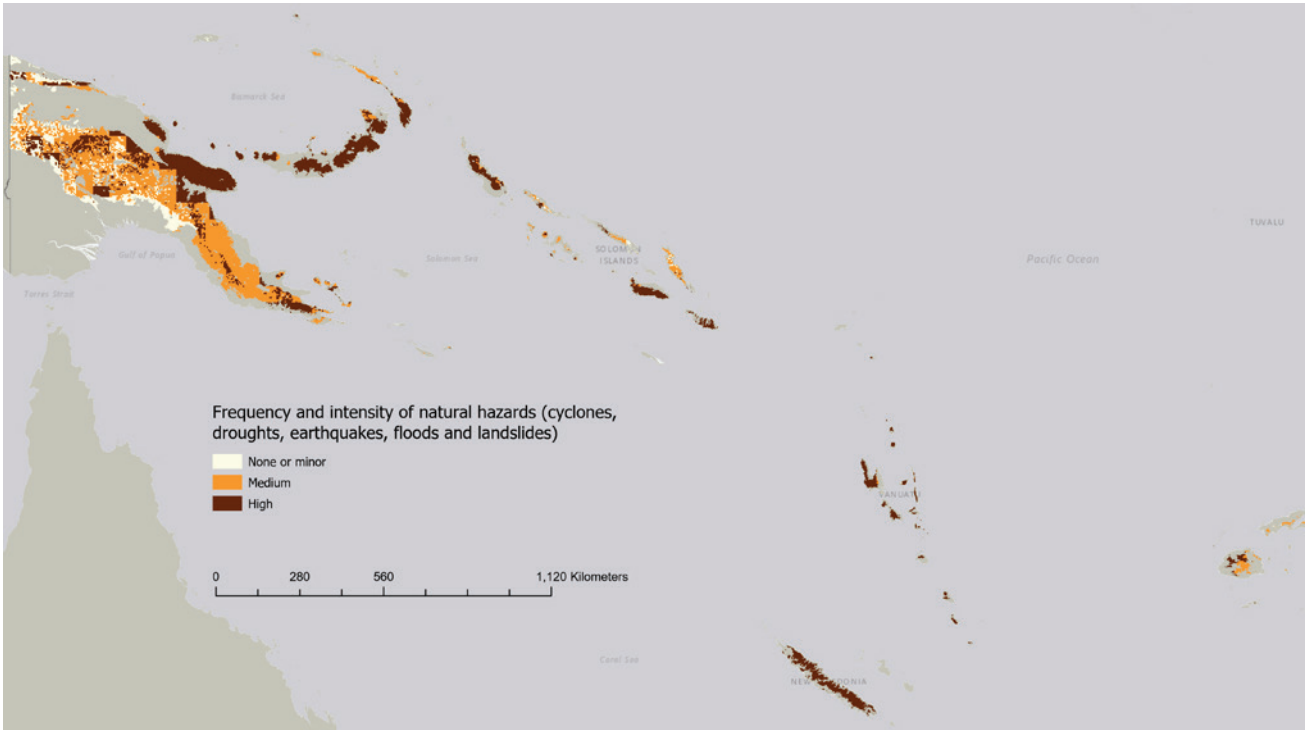
Map 9: Frequency and intensity of natural hazards in the mountain areas of Africa 1980–2000

The outcome of the data analysis shows that in developing countries 516 million rural mountain people lived in mountain areas affected by past natural hazards with medium to high exposure (241 million, or 47 percent, were those with high exposure). The estimated number of people vulnerable to food insecurity was 275 million with medium to high level of exposure (122 million or 44 percent with high exposure).

Map 10: Frequency and intensity of natural hazards in the mountain areas of Latin America and the Caribbean 1980–2000



Map 11: Frequency and intensity of natural hazards in the mountain areas of developing countries in Asia 1980–2000



Map 12: Frequency and intensity of natural hazards in the mountain areas of developing countries in Oceania and the Pacific 1980–2000

The distribution of people in the different land cover/land use classes shows that 89 million people vulnerable to food insecurity lived in cropland areas having a high exposure to past natural hazards and 32 million people lived in open forest areas with medium and high exposure to past natural hazards (Figure 17).

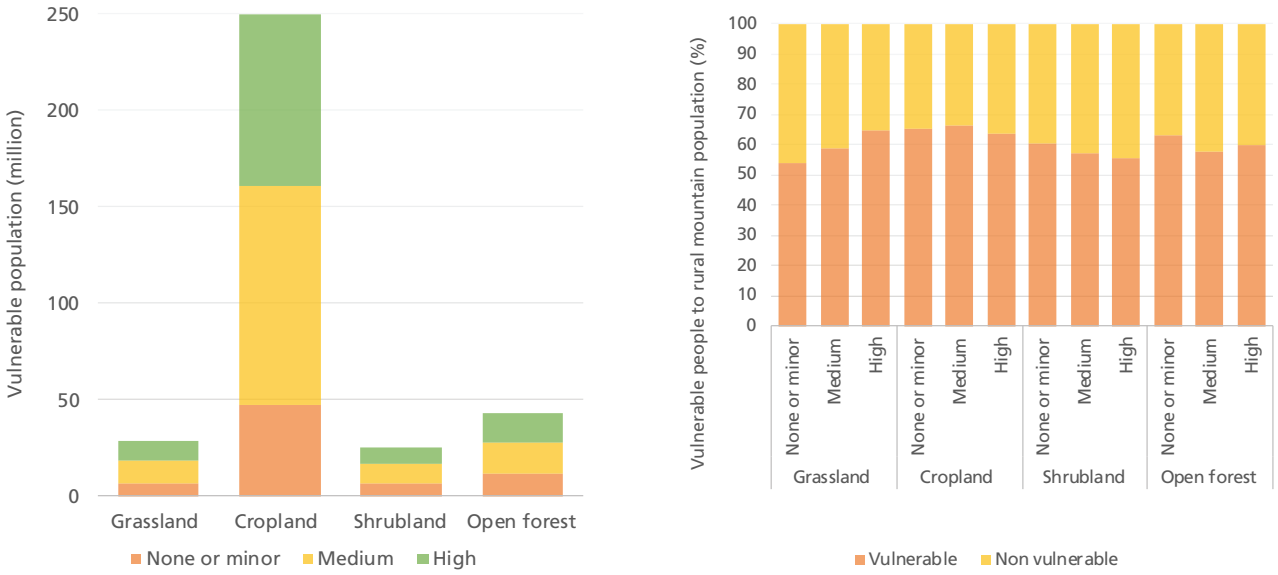


Figure.17: Estimated number of rural mountain people exposed to natural hazards by land cover types

Seventy-one percent of the people considered vulnerable to food insecurity and exposed to the risk of natural hazards resided in mountain areas sited between 300 m and 2 500 m altitude (mountain classes 4, 5 and 6). (Figure 18).

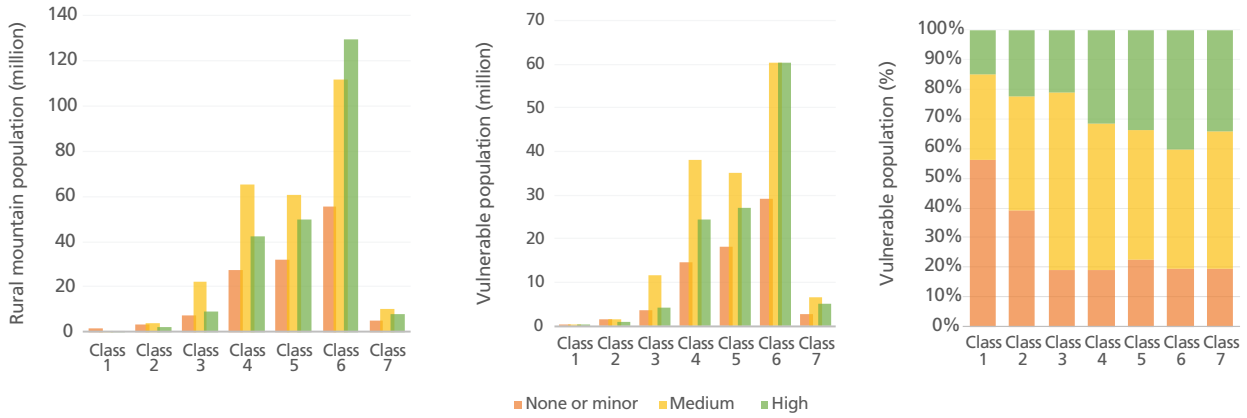


Figure 18: Estimated number of rural mountain people and vulnerable mountain people in 2017 living in areas subject to past natural hazards in developing countries, by mountain classes

Conflicts

According to the *State of Food Insecurity and Nutrition in the World* (FAO *et al.*, 2017) the majority of the 815 million chronically food-insecure and malnourished people in the world – 489 million – live in countries affected by conflicts. The report also noted that in the past decade the number of violent conflicts around the world has increased, in particular in countries already facing food insecurity, with negative impacts on food production and availability. On average, 56 percent of the population in countries affected by conflict live in rural areas, where they largely depend on agriculture. Conflicts negatively affect all aspects of agriculture, from production, harvesting, processing and transport to input supply, financing and marketing. Conflicts also undermine the capacity to cope with problems of food shortage, and food insecurity itself can become a trigger for violence and instability. (FAO *et al.*, 2017).

For rural mountain people, who largely depend on subsistence agriculture for food security, the impacts of conflicts can be severe.

FAO *et al.*, 2017 also notes that the concurrence of conflict and climate-related natural disasters is likely to increase with climate change, as climate change not only threatens food insecurity and malnutrition, but can also contribute to further downward deterioration into conflict, protracted crisis and continued fragility. Problems of acute food insecurity and malnutrition tend to be magnified where competition over productive land and water has been identified as a potential trigger for conflict, as loss of land and livelihood resources, worsening labour conditions and environmental degradation negatively affect and threaten household and community livelihoods.

Many of the areas where the most protracted conflicts are concentrated are mountainous zones: including the Horn of Africa, the Great Lakes region of Africa, Central America, and the region between Afghanistan, India and Pakistan (FAO, 2017).

The data set used in this study is the one produced by the joint project between the Uppsala Conflict Data Program (UCDP) at the Department of Peace and Conflict Research, Uppsala University, and the Center for the Study of Civil War at the Peace Research Institute Oslo (PRIO). The fully georeferenced data (version 19.1) includes information on the frequency and type of conflicts.

Purple rice in India (©Pan Himalayan Grassroots Development Foundation)

For the present study, data on intensity and distribution of conflicts in mountain areas were combined with the 2017 mountain population and the estimates of rural mountain people vulnerable to food insecurity in 2017 to provide an approximate measure of the mountain people living in areas affected by conflicts. Although this approach does not provide an explanation for the changes in the number of people vulnerable to food insecurity among mountain dwellers, it does provide information on location and intensity of conflicts during the period 2000–2018, and can offer a useful perspective about the possible effects of this stressor on food security.

Three types of conflicts were considered:

- type 1: state-based conflicts (fighting either between states, or between a state and a rebel group);
- type 2: non-state conflicts (conflicts in which none of the warring parties is a state); and
- type 3: one-sided violence (the use of armed force by a government or by a formally organized group against civilians).

The type of conflict provides an indication on the relative potential extent of the conflicts (that is, their area of influence in a given region). An inter-state conflict is likely to have a greater effect on food security than localized low-intensity conflict, and on a larger area.

The casualties generated provide estimates of the magnitude of the conflict as the number of reported deaths is considered to be a direct reflection of the level of devastation and instability caused by the conflict.

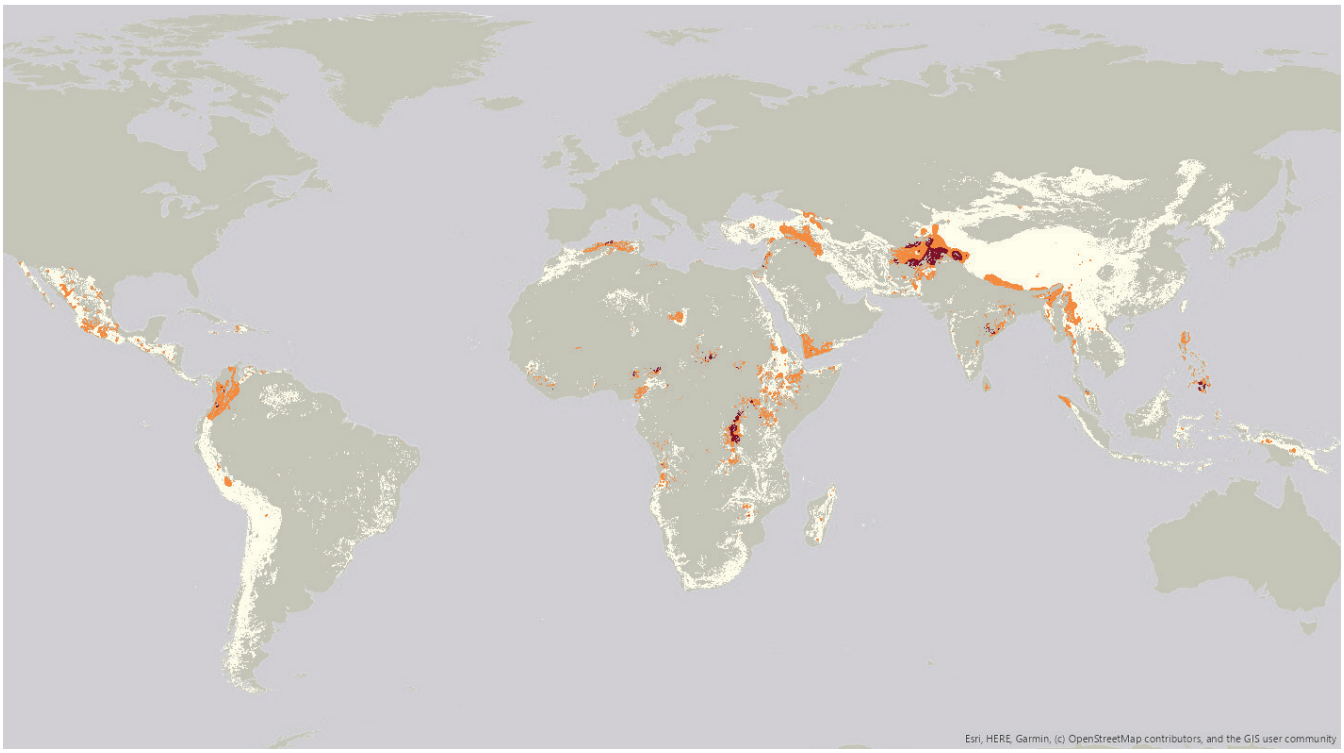
Between 2000 and 2018 there were cumulatively nearly 35 000 armed conflicts in the mountains of developing countries (31 percent of the conflicts occurring in these countries), in which more than 250 000 people died. Of the 35 000 armed conflicts, 27 600 were state-based conflicts and they caused 216 000 deaths.

The distribution and the intensity of the conflicts are uneven among the regions of the developing world (Map 13).
The map is based on a categorization of conflict by their intensity, according to the number of deaths (Table 26)

Intensity	Number of deaths		
	Conflict type 1	Conflict type 2	Conflict type 3
1 – none or very low	3.0	0.0	0.0
2 – medium	470	50	30
3 – high	3 700	290	600

Table 26: Categorization of conflicts in intensity classes (number of deaths)

When the population data for 2017 are combined with those on the distribution



Map 13: Distribution and intensity of conflicts in the mountain areas of developing countries (2000–2018)

and intensity of conflicts, the results show that there were 212 million rural people in the mountains identified as areas with medium and high intensity of conflicts between 2000 and 2018 (50 million of them in areas of frequent and/or intense conflict).

When the data on the numbers of vulnerable people are also considered, the results show that there were 128 million people living in areas where conflicts of medium or high frequency/intensity occurred.

In line with the distribution of vulnerable mountain people in the various elevation classes, there were very few people in areas affected by conflicts at the highest elevation classes. The greatest number of people in areas affected by conflicts was in the areas between 3 500 m and 300 m. Mountain class 4 is the only elevation class where there are more vulnerable mountain people living in areas affected by medium or high conflicts (almost 40 million people) than in the others (about 37 million people) (Figure 19).

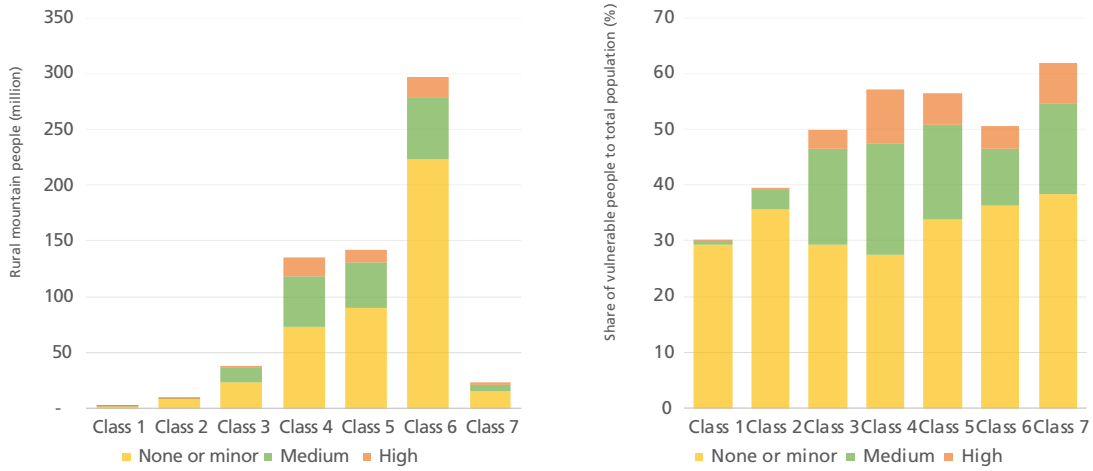


Figure 19: Estimated number of total rural mountain people and vulnerable rural mountain people in 2017 living in areas exposed to conflict by mountain classes

Limited access to food markets

For small farmers, food security is also related to their ability to access and use market facilities (FAO, 2016). This is particularly relevant in mountains where family farming is dominant. Travel time to markets is one of the factors that increase the vulnerability of rural people, by reducing their access to alternative sources of food and their capacity to cope with food shortage.

Without considering security issues, the capacity to reach a destination within an acceptable time lag depends on various elements, including:

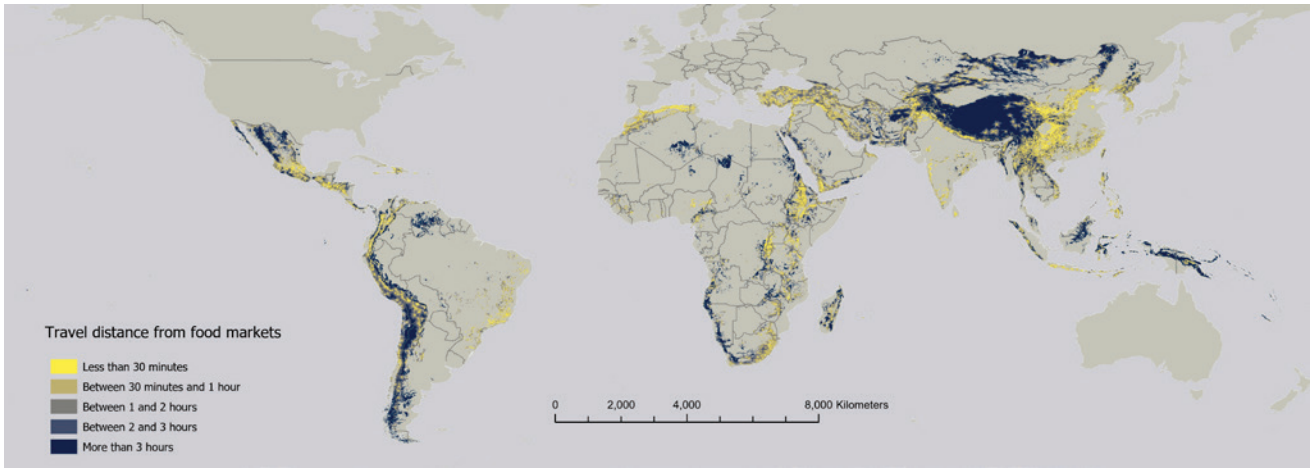
- type and condition of roads
- density of the road network
- terrain slopes
- navigable rivers and water courses
- natural barriers.

For this study, a model was developed to estimate the travel time from any location to the closest centre where there are likely to be food markets. Areas with a population density greater than 2 000 people per km^2 were considered as potential markets. Accordingly, a market coincides with a settlement having a population density above 2 000 people per km^2, assuming that, in those settlements, food is available and widely traded.

A travel time of more than one hour from any such potential food market was chosen as a cut-off value for determining if rural mountain people were living in remote areas (travel distance greater than one hour). (Map 14).

The results indicate that in 2017, 85 million rural mountain people lived more than one-hour travel time from the closest market. Out of those, 34.5 million people (41 percent of the considered population) were vulnerable to food insecurity.

From 2000 to 2017, the average travel time (in hours) from areas assessed as vulnerable to the closest settlement (where at least one food market is expected to exist) decreased by nearly one hour. (Figure 20).



Map 14: Travel time to the closest food markets in hours for rural mountain people in 2017

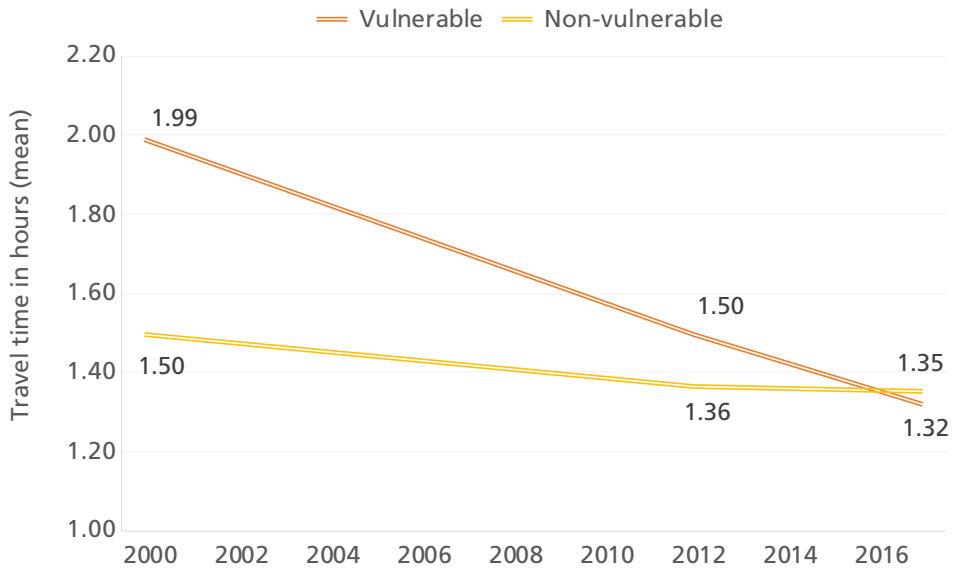


Figure 20: Average distance from the closest food markets


Market in Malawi (©Macpherson Nthara)

Access to infrastructure and services

The likelihood of food insecurity is influenced, among other factors, by household-level conditions such as education, health, assets and expenses as well as by regional level conditions such as infrastructure, markets and enabling institutions (IFAD, 2011). People living in marginal areas often have limited capacity to develop adaptive measures for facing crises and emergencies.

The density of, and proximity to, services and facilities is an indication of the potential capacity of people to access and mobilize financial resources, sell their goods, and benefit from basic and advanced services. For this study, density of, and proximity to, services and facilities has been used to make a geographical categorization of mountains in the developing countries in areas with varying levels of "service availability." In these areas, it is expected that food is available independently from that which is locally produced because it is traded with other national or international suppliers.

The likelihood that people living in very low-developed areas will have access to essential supplies (not just food) depends on their ability to move to a suitable supply area and buy the required commodities and services at affordable prices.

The analysis of the density of, and proximity to, services and facilities is based on:

1. the number of services available in each zone (i.e. density of services); and
2. the physical accessibility of these services.

The methodology makes use of crowdsourced data, providing georeferenced information on services and facilities as point data. Data is classified using standard categories, which include shops, supermarkets, hotels, schools and universities, health centres, water and energy supply, communication facilities, rents and other business, recreational and cultural centres, etc. The detection of areas at distance from these facilities identifies isolated zones (including where governments and humanitarian aid agencies may be less able to provide support to vulnerable people in case of emergency). On the contrary, closer proximity to markets, services and

Mountain festival (©Achyut Tiwari)

Camels transporting maize straw (©FAO/Giulio Napolitano)

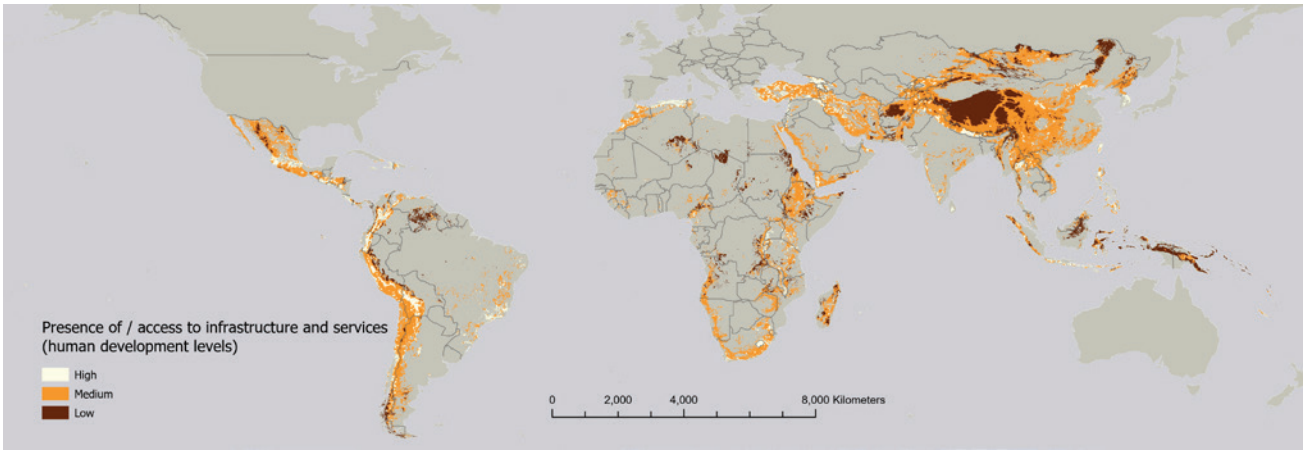
infrastructure increases people's coping capacity, offering more options to access food, beyond local availability.

Twelve categories of services were considered, representing densities of: education, health care, amenities, food services, non-food shops, access to water and sanitation, technology and communication, electricity, hotels, etc.

The values of the 12 layers were combined to obtain a scale of "service availability" for each location (pixel). The model also assumes that the presence of a road network mitigates the effect of the poor density of services in remote areas, also because most of the services are located along roads.

Map 15 shows that the availability, and accessibility, of services and town facilities is lacking in vast areas of the mountains of the world, especially in Asia and Africa.

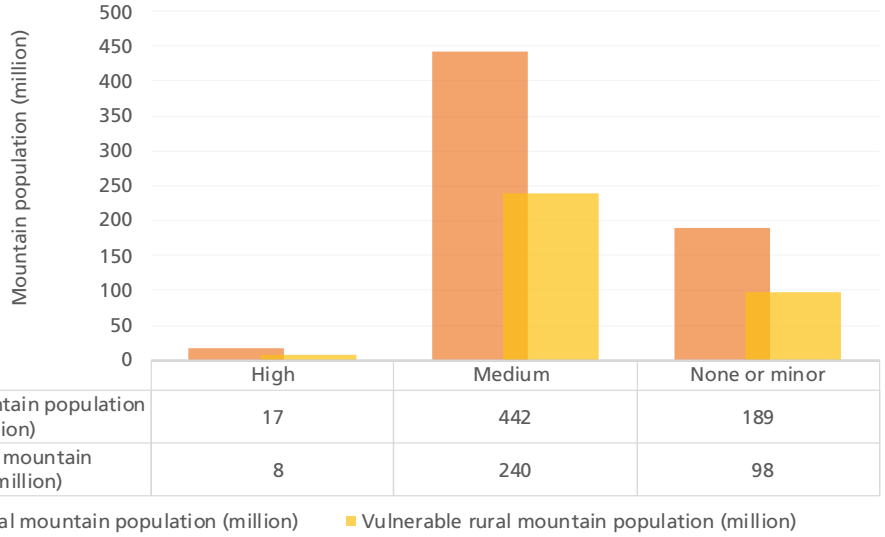
By combining the geographic distribution of service availability with that of mountain population in 2017, the study found that only 189 million rural mountain people in the developing countries (29 percent of the total rural mountain population) lived in areas with high service availability, while the remaining 459 million had limited or very limited access to infrastructure and services. Out of those, 442 million people lived in areas with limited access to services such as



Map 15: Geographic distribution of service availability in mountain areas

education, water, electricity, sanitation and shops: in these areas, the availability and accessibility of suppliers of good and services is not entirely constrained but their number might be low. The remaining 17 million lived in remote areas with no or very limited access to basic facilities and services (Figure 21).

When this information is combined with the estimates of rural vulnerable mountain people, it results in a similar outcome: in 2017 only 98 million rural mountain people vulnerable to food insecurity had easy access to infrastructure and services, a vast majority (240 million) had only a limited access to these resources and 7 million people had no or very limited access to basic town facilities and services (Figure 21).



	High	Medium	None or minor
Total rural mountain population (million)	17	442	189
Vulnerable rural mountain population (million)	8	240	98

Figure 21: Estimated total and vulnerable rural mountain people living at different levels of service availability in 2017

Increased land degradation

Land degradation refers to a reduction in the land's biological productivity. It ranks among the greatest environmental challenges that affect the livelihoods of millions of people around the globe (UNCCD, 1994; MA, 2005). It is mainly a consequence of intensive human activities, such as deforestation, improper farm management practices, overgrazing, urbanization and industrialization, but also extreme weather events, drought and other natural causes.

Fighting land degradation is important in the 2030 Agenda for Sustainable Development, and efforts to establish Land Degradation Neutrality (LDN) as a global objective culminated in 2015, when the LDN concept became part of the Sustainable Development Goals (SDGs). LDN is closely linked to SDG Target 15.3, which aims to "combat desertification, restore degraded land and soil, including land affected by desertification, drought, and floods, and strive to achieve a land degradation-neutral world" by 2030, and for which the UNCCD is the custodian agency. It represents a paradigm shift in land management policies and practices, and is a unique approach that counterbalances the expected loss of productive land with the recovery of degraded areas. LDN is defined as "a state whereby the amount and quality of land resources necessary to support ecosystem functions and services and enhance food security remain stable or increase within specified temporal and spatial scales and ecosystems."

Slash and burn in India (©Shanthungo Ezung)

The UNCCD Secretariat and the Global Mechanism (GM) of the UNCCD, with the support of multiple international partners, and through the Land Degradation Neutrality – Target Setting Programme (LDN–TSP),[5] are supporting interested countries to identify land degradation drivers and trends, define a land degradation baseline and establish LDN targets and associated measures to achieve LDN: as of November 2020, 124 countries are committed to set voluntary LDN targets and 102 countries have successfully completed this process" (Global Mechanism of the UNCCD, 2019).[6]

At the 14th Conference of the Parties of the UNCCD held in 2019 (UNCCD COP14) in New Delhi, India, the Global Mechanism of the UNCCD and the Mountain Partnership Secretariat (MPS)/FAO presented a Briefing Note entitled: "Vulnerability to food insecurity in mountain regions: land degradation and other stressors" (FAO and UNCCD, 2019). In that study, particular emphasis is given to changes in land degradation versus the increase/decrease in vulnerable people, and the publication presented, among other things, the results of an analysis of the changes in land degradation that occurred in mountain areas of developing countries from 2012 to 2017 combined with the estimates of the number of vulnerable rural mountain people in the same areas for 2017. The results obtained from the data analysis are also complemented with the information provided by the Land Degradation Neutrality (LDN) Target Setting Programme of the UNCCD. The information provided by the LDN Target Setting Programme (LDN–TSP) was collected through the completed national LDN target setting reports of those countries participating in the programme.[7] Particularly useful for this purpose are the "hotspots" located in the mountains and cited in the national reports as depleted areas to be monitored during LDN implementation: those "hotspots" are used here to randomly verify the correspondence between their description and the land degradation changes estimated by the study, as well as to gather information on the underlying drivers of land degradation operating in each hotspot.

[5] https://www.unccd.int/actions/ldn-target-setting-programme

[6] https://www.unccd.int/publications/land-degradation-neutrality-target-setting-initial-findings-and-lessons-learned

[7] https://knowledge.unccd.int/home/country-information/countries-with-voluntary-ldn-targets

Given the importance of land degradation as a potential stressor for rural mountain people, some of the key drivers of land degradation, identified through the completed national LDN target setting reports, are highlighted below. In general, deforestation, human population pressure and poor agricultural practices have been recognized as the three most frequently identified causes of land degradation.
Conversion of forest to other land cover types is the most alarming problem because of the consequent reduction of soil organic carbon stock, acceleration of soil erosion and loss of biomass and biodiversity. In some countries forest land is seriously threatened because of extensive deforestation and encroachment from other land use types. The decrease of grassland is often linked to the increase in cropland.

Human population growth, infrastructure development, and the need to ensure food security for all citizens are the primary causes of the expansion of cropland.
Improper soil management and poor agricultural practices that lead to decline in agricultural productivity are another important driver of land degradation.
Locally, soil/water pollution, overgrazing, forest and bush fires, mining activities, and poor management of wetlands and water bodies are important factors depleting natural resource capital.

Extreme weather events, especially drought, but also other natural causes, are a major concern especially in arid and semi-arid countries, as they strongly contribute to the depletion of natural resources and threaten local economies due to their impact on agriculture.

Preventing soil erosion in Tanzania (©FAO/Daniel Hayduk)

The results of the analysis highlighted that land degradation is seriously impacting agriculture, endangering the sustainability of crop production and animal husbandry, especially in areas where land degradation is rapidly progressing.
The study found that the numbers of mountain people vulnerable to food insecurity and those living on degraded land are related, i.e., the incremental depletion of natural resources is behind the potential increase in food insecurity. This result was seen as pointing to a strong dependency of rural mountain people on land resources and a lack of sustainable land management practices able to stem land degradation. Aggregated data by continent, land cover type and intensity of land degradation change showed that agricultural expansion and management are the major contributors of environmental depletion, especially in Africa and Asia. This was also confirmed by the analysis of the national LDN target setting reports.

African mountain regions, especially in Eastern Africa (the Great Rift Valley range), present the highest population growth rate and increase in vulnerability to food insecurity from 2012 to 2017. Between 2012 and 2017, out of the 132 million mountain people vulnerable to food insecurity, 86 million lived in areas characterized by limited to very extensive land degradation changes, and 27 million of them lived in areas where the rate of land depletion was moderate to very high.

In mountainous Asian countries the results show mixed trends, with both increases and decreases of vulnerability occurring when land degradation change intensifies. In India, for example, the number of vulnerable people in 2017 was approximately 30 million (12 percent increase from 2012), 13 million of whom were living on land that had progressively degraded over the same period. In comparison, Myanmar showed an opposite trend, where vulnerability increased more than land degradation. In Myanmar's mountains between 2012 and 2017, the number of vulnerable people increased to nearly four million, while fewer than two million people were living on land that had degraded, showing that land degradation is not the only stressor causing vulnerability.

In the Latin America and the Caribbean region, the analyses confirmed the presence of isolated pockets of vulnerable populations distributed along the Andes and Caribbean islands affected by intense climate variability and land degradation.

Livestock grazing on mountain, India (©Abhishek Ghoshal)

This situation urges countries to avoid and reduce future land degradation and reverse past degradation, putting a greater emphasis on improved and sustainable land management practices in order to reduce vulnerability to food insecurity. Agroecology, conservation agriculture, land resource conservation and integrated/inclusive land use planning based on a landscape approach are important measures to mitigate the negative impacts of land degradation and other mountain stressors, and to develop a harmonious balance between the use and protection of land resources.

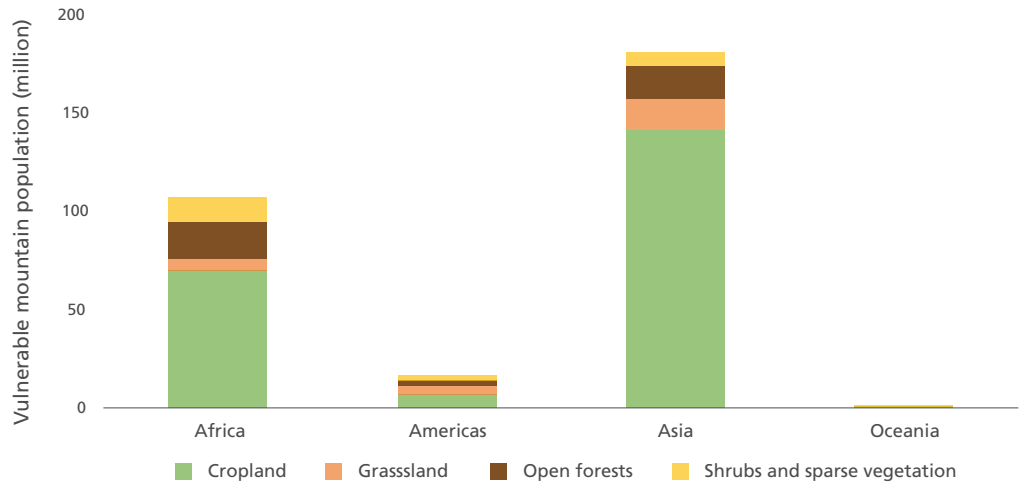


Figure 22: Estimated number of rural mountain people vulnerable to food insecurity (by continent) living on different land cover types

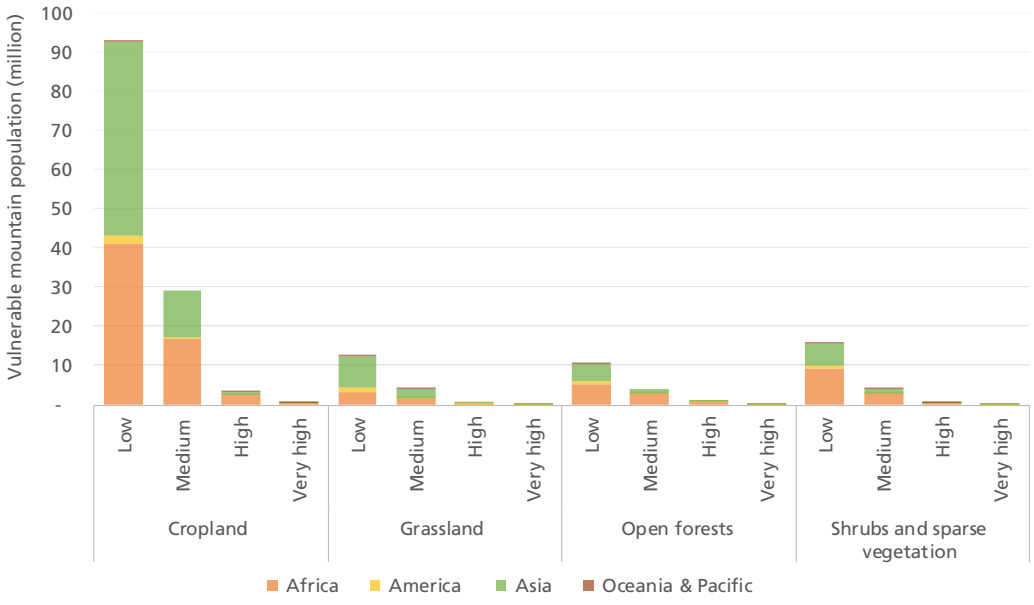


Figure 23: Estimated number of rural mountain people vulnerable to food insecurity (by continent) living in areas affected by different levels of land degradation changes and types of land cover

Climatic Variability

The Special Report on the Ocean and Cryosphere in a Changing Climate (SROCC) (IPCC, 2019a) highlighted that "since the mid-20th century, the shrinking cryosphere in the Arctic and high-mountain areas has led to predominantly negative impacts on food security, water resources, water quality, livelihoods, health and well-being, infrastructure, transportation, tourism and recreation, as well as culture of human societies, particularly for indigenous peoples."

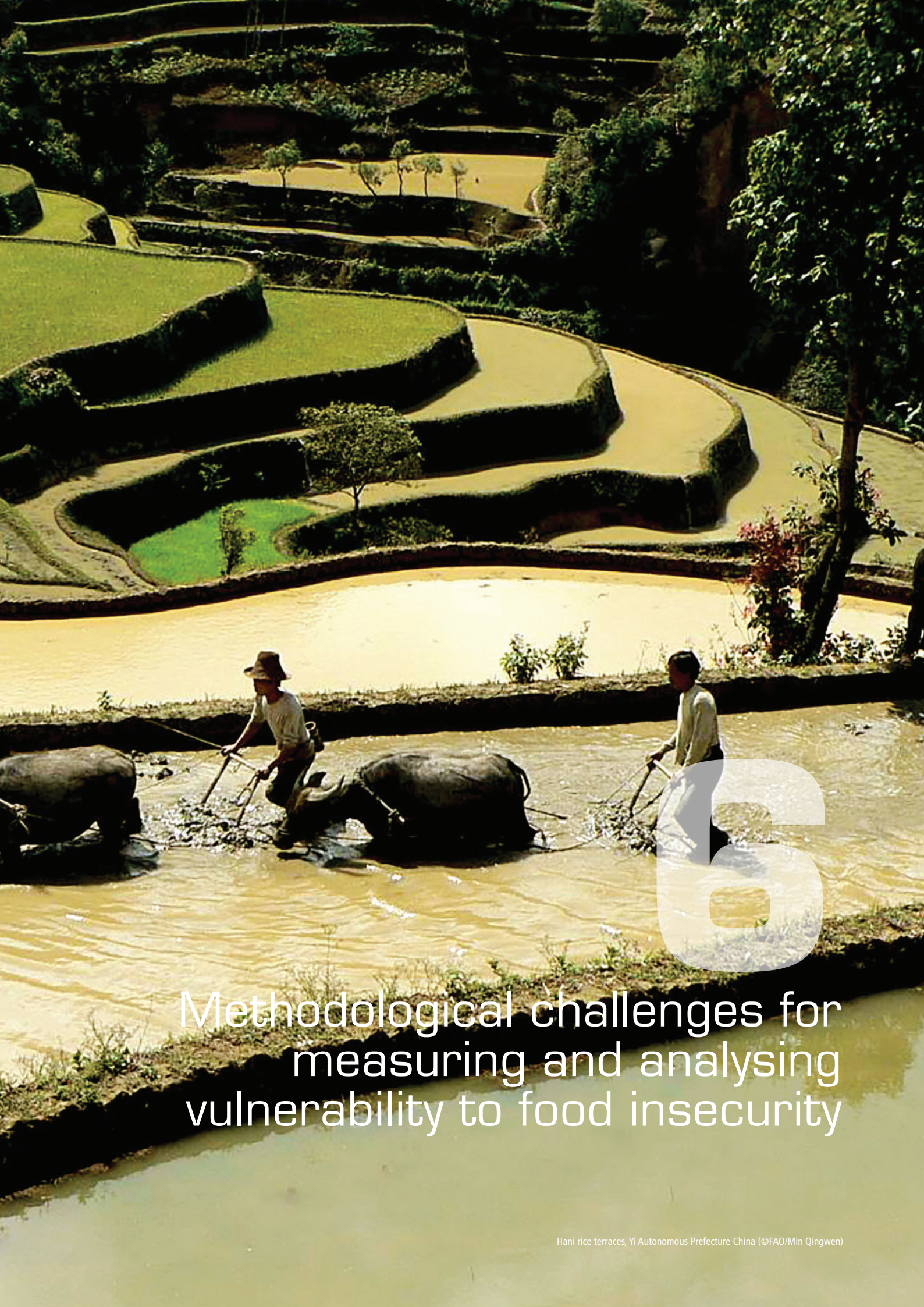
In many regions of the world, changing climatic conditions are already altering crop cycles, causing unpredictable yields and sometimes crop failure (FAO, 2008). The 2018 edition of the *State of Food Security and Nutrition in the World* (FAO *et al.*, 2018) found that, overall, climate extremes are threatening to erode and reverse the gains made in ending hunger and malnutrition as they are, together with conflicts, among the key drivers behind the recent increase in global hunger. Most importantly, changes in climate are threatening all dimensions of food security: food availability, access, utilization and stability. Droughts have been the most disruptive climatic events as they have caused more than 80 percent of the total damage and losses in agriculture (FAO *et al.*, 2018).

It has not been possible, for this study, to derive reliable information at regional or global levels on climatic variability in mountain areas from the available global weather satellite products (such as the Climate Hazards Group InfraRed Precipitation with Station data (CHIRPS) and the NASA Earth Exchange Global Daily Downscaled Climate Projections (NEX–GDDP) for air temperature). Variability in rainfall and temperature patterns in mountains is difficult to assess because it is affected by several factors that change with altitude, latitude and land cover, and any climate-related assessment would require finer and more precise data not provided by the internationally available data.

Therefore, an approach for linking climatic variability to changes in the vulnerability of mountain people similar to the one used for natural hazards and conflicts has not been possible. However, the IPCC Special Report on the Ocean and Cryosphere in a Changing Climate (IPCC, 2019a) has provided clear indications of the impact of climate on mountain agriculture and ecosystems. Some key facts from the report are presented in the following paragraphs.

View of the Mullah Ghulam farm, Afghanistan (©FAO/Giulio Napolitano)

- Snow cover and glaciers are being severely affected by increasing air temperatures and the occurrence of rain on snow events. This is especially relevant at low elevation, where snow cover, glaciers and permafrost have decreased during the last decades. Moreover, the duration of snow cover has decreased in nearly all regions by an average of five days per decade. These negative trends are forecasted to continue throughout the 21st century.
- Glacier retreat and permafrost thaw are also decreasing the stability of mountain slopes while increasing the number and area of glacial lakes, resulting in a change in frequency, magnitude and areas affected by natural hazards (IPCC, 2019a). The increase of glacier lakes is particularly concerning because some will emerge in areas closer to unstable mountains, increasing the risk of glacial lake outburst floods, one of the most devastating types of disasters affecting mountain areas.
- Tourism and recreational activities are particularly impacted by the decrease in snow cover, permafrost thaw and glacier retreat. For example, 46 United Nations Educational, Scientific and Cultural Organization (UNESCO) World Heritage natural sites include glaciers, and in 33 sites glaciers are one, if not the main, reason for which they have been chosen by UNESCO. Depending on the considered scenario, between 8 and 21 of these glaciers are forecasted to become completely extinct by 2100.
- Climate change and climatic variability have a strong impact on mountain peoples' food security by impacting mountain agriculture and pastoralism, the two main sources of food in mountain areas.
- Changes in snow and glaciers have changed the amount and seasonality of runoff in snow-dominated and glacier-fed river basins affecting water resources and agriculture, contributing to a decrease in agricultural yields in high mountains. Moreover, the reduction in streamflow due to glacier retreat and reduced snow cover has led to reduced water availability for irrigation of crops. Rising air temperatures are also having an impact on agriculture in mountain areas because they increase crop evapotranspiration, increasing the water demand for crop production. These changes are forecasted to continue in the future as snow cover and glaciers continue to decline, with negative impacts on agriculture but also on hydropower and water quality. These changes are particularly relevant for rural communities living in high mountains since they have historically relied on adequate levels of soil moisture and planting time derived from irrigation water coming from glaciers and snowmelt water. Consequently, a change in the cryosphere puts these communities at risk of vulnerability to food insecurity.
- What happens in the high mountains also has an impact on the lowlands. Specifically, lowland agricultural areas which receive water from rivers fed by glacier melt and snowmelt are expected to be negatively impacted by the above-mentioned changes.
- Finally, climate change has several other impacts on mountain communities, one of the most important being relocation due to climate-related disasters such as floods or debris flows that destroy houses, infrastructures and pastures.



6

Methodological challenges for measuring and analysing vulnerability to food insecurity

Hani rice terraces, Yi Autonomous Prefecture China (©FAO/Min Qingwen)

6. Methodological challenges for measuring and analysing vulnerability to food insecurity

Estimating the number of mountain people vulnerable to food insecurity and analysing the potential drivers of vulnerability pose many methodological challenges. This study required standardized models, which could be applied over vast areas including disparate regions and climates. Internationally available data were needed and used; extrapolations and assumptions were made based on the best scientific knowledge to generalize information where data is lacking. All methodological choices were made following consultations with experts within and outside FAO.

The considerations given below help understand the limits of the study and should be taken into account for the correct interpretation of the results.

The model to estimate vulnerability to food insecurity is based on locally available crop and livestock production and therefore it specifically applies only to the mountain areas defined as agro-pastoral, excluding a part of the rural population, as well as all urban areas. This approach leaves out 103 million rural mountain people (10 percent of the total mountain population in developing countries) and 356 million urban people (35 percent of the total mountain population in developing countries). These populations remain "not-assessed" and the study does not provide information on their status. As the percentages of vulnerable people presented in the study are considered to the total rural mountain population, there is probably an underestimation of the real share of vulnerable people, as the not-assessed are grouped with the non-vulnerable although there is no information on their vulnerability status.

In some subregions the number of the not-assessed population is more than 25 percent of the entire rural population – the most relevant are Melanesia (52 percent), Micronesia (100 percent) and Central America (35 percent). This presents a challenge to the model because it leaves out a large chunk of the rural population, making the vulnerability results partial. This is particularly relevant for

Oceania, where more than half of the entire rural mountain population falls in the not-assessed category.

This study does not take into consideration the wild sources of food, both plant and animal, that are available to rural mountain people and that can be important sources of subsistence consumption, thereby mitigating vulnerability to food insecurity. Similarly, it does not take into account lesser-known crops cultivated in the agro-pastoral areas which also contribute substantially to mitigating the risk of food insecurity for rural mountain people.

The study was not able to assess the direct impact of each of the stressors on vulnerability, but could only identify areas where estimated vulnerable populations in 2017 overlapped with areas impacted by past occurrence of natural hazards and conflicts over a 20-year period. Another issue faced by the analysis of the stressors is that, because of their heterogeneity and the global scale of the analysis, it was not possible to create a model that summed up all of them into a single matrix to measure their combined effects on the vulnerability (nor on the population in general) of mountain communities.

The lack of accurate data on temperature and rainfalls made impossible an analysis of the impact of climatic variability in mountain areas. Therefore, a literature review was carried out instead, limiting the investigation and the juxtaposition of climatic data with the rural population and vulnerability data.

Because of the lack of disaggregated data by age and gender, the study does not provide information on the status and exposure of mountain people known to be the most vulnerable to the risk of food insecurity, such as women, children and youth, and indigenous communities.


Quinoa (©FAO/Claudio Guzman)

Sources of Uncertainty

All modelled estimates are uncertain. Best practices in communicating model output for decision-making include a careful identification and discussion of sources of uncertainty. The third principle of official statistics states that "to facilitate a correct interpretation of the data, the statistical agencies are to present information according to scientific standards on the sources, methods and procedures of the statistics" which, among other things, help to provide an assessment of uncertainty in modelled output. Policy-makers can benefit from a clear description of uncertainties in inputs and outputs because these can provide policy-relevant probabilities, estimates of worst-case scenarios, and odds of particular outcomes.

Uncertainties in input data

The level of accuracy of the input data, on which the estimates depend, is variable. While using the vulnerability results produced by this study, one should consider that the accuracy of some of the input data is often unknown or difficult to estimate. These uncertainties affect the results, which, consequently, should be taken as indicative of the degree of vulnerability to food insecurity occurring in the considered regions and subregions.
The following lines provide information on origin of the uncertainty in the quality of the results, which depends on both input data quality/accuracy and processing steps.

- Population: The accuracy of the LandScan population data is not explicitly mentioned in the data set's metadata and therefore it is difficult to assess (a LandScan data assessment made for Poland estimated a maximum level of accuracy against national data of 73 percent). For this study, LandScan data were adjusted to match FAOSTAT estimates for the years 2000, 2012 and 2017. On average the conversion factor between LandScan and FAOSTAT national data was 1.03, which shows that the two data sets are well aligned.
- Land cover: The accuracy of the ESA–CCI land cover map for the year 2015 was assessed by the European Space Agency (ESA, 2017), using the GlobCover 2009 validation data set. The validation method consisted of a two-step measurement, which yielded an overall accuracy of 71.45 percent in the first case and 75.4 percent in the second. The LDN monitoring and reporting system identifies three sub-indicators of land degradation: trends in land cover, trends in land productivity, and trends in carbon stock above and below ground. Through the LDN Target Setting Programme, and in cooperation with international partners, an important input to the participating countries was the provision of software tools, such as Collect Earth, Trends.Earth and SoilGrids, to access, process, analyse and publish earth observation data. However, national data on the three LDN sub-indicators were not always available and several countries used the default data to establish the LDN baseline and prepare national estimates (Global Mechanism of the UNCCD, 2019).
- Crop production: the Spatial Production Allocation Model (SPAM) includes a variety of inputs such as national and subnational crop production statistics, satellite data on land cover, maps of irrigated areas, biophysical crop suitability assessments, population density, secondary data on irrigation and rain-fed production systems, cropping intensity, and crop prices. This information is compiled and integrated to generate estimates of the spatial distribution of individual crops. The accuracy of the data generated by this model is not provided in the metadata. SPAM crop production data at pixel level are adjusted to match FAOSTAT crop production data country totals. The conversion factor varies from crop to crop. For example, that of maize for the year 2017 is 6.5, which means that the FAOSTAT value is 6.5 times higher than the one assessed by the SPAM data set. For wheat in 2017 the conversion factor is 1.4.
- Livestock production: The FAO Livestock Production System database is derived from several input data such as national statistics, livestock suitability area, land cover, etc. For the estimation of vulnerability, the boundaries of the production areas of the considered species as defined by the livestock data set were adapted to the ones of the agro-pastoral area defined using the ESA–CCI land cover. To ensure consistency with FAOSTAT, livestock production values were then adjusted to match the FAOSTAT live animal data set. As an example, the average conversion factor for cattle, for 2017, was 11.8. Crop and livestock production data were converted to kcal and grammes of protein using global conversion factors for each crop provided by the FAO Nutrition Database. The conversion of livestock species into grammes of protein was made using regional conversion factors. In both cases, the estimates of kcal and protein available in each location introduce approximations that are difficult to quantify because of the variables and conditions occurring at local levels. The results are also influenced by the thresholds and conditions applied to determine vulnerability to food insecurity.

Other uncertainties concern the estimation of the frequency and intensity of the stressors, which depend on the type and quality of the data used. In some cases the accuracy of the results depends on the quality and resolution of the satellite data used (e.g. for land degradation estimates), while in other cases results are mostly influenced by the completeness of the input data sets (e.g. density of road network from crowdsourced data) and to a much lesser extent on their positional accuracy.

It would have been useful to analyse the combined effect of multiple stressors and estimate their cumulative impact on people's livelihoods. However, additional local data and information would have been required to generate meaningful results and draw conclusions on the combined impact of the mountain stressors.

For example, the Global Assessment Report on Disaster Risk Reduction published by the United Nations Office for Disaster Risk Reduction in 2019 (UNDRR, 2019) noted that data collection on natural disasters is often fragmented, non-universal and not comparable, although data availability and quality are improving in many countries, and that the capacity of national statistical offices to include disaster-related data in the official statistics is increasing.

Countries should strengthen national and regional information systems and increase technical capacities, and access to quality and high-resolution data should be improved. Closer interaction among national stakeholders and international agencies/partners involved in data and information systems could improve national capacities.

Mountain life (©Global Himalayan Expedition)

7

Conclusions and the way forward

©Saad Amer

7. Conclusions and the way forward

Mountain farm in Afghanistan (©Hamid Reza Rahmani)

This study provides information on the demographic trends of mountain populations and on the distribution and trends of vulnerability to food insecurity in mountain areas in developing countries from 2000 to 2017. It also presents geographic evidence of the occurrence of some important stressors that may threaten the livelihoods of rural mountain people in developing countries and that can lead to populations being vulnerable to food insecurity.

The study confirms the trends highlighted in the previous report (FAO, 2015a) that the mountain population is increasing in all developing countries, along with the overall population growth. With the population, the pressure on natural resources increases, including land degradation, as does the exposure of mountain people to natural hazards and other impacts of climate change, such as drought, and also water security. Land degradation and water scarcity are global issues that spare no region. Countries have already acknowledged the interdependency of land and water management and the multiple benefits of reversing land degradation for sustainable development, water security and resilience to natural hazards such as drought (UNCCD and FAO, 2020).

The data generated by this study reinforce the awareness that many mountain communities in all regions of the developing countries live in a precarious situation of exposure to the risk of food insecurity and to the threat of livelihood loss.

In Africa, the mountains of the Eastern and Southern regions are threatened by stressors like population increase, over-exploitation of land and water resources, drought, flooding and landslides. The highlands of Eritrea and Ethiopia are heavily cultivated using traditional methods, which do not always optimize the already scarce water resources. The land of Eastern Africa is severely affected by increasing land degradation.

The Himalayan populations face serious problems due to their remoteness, poor accessibility and a high dependence on natural resources, which are the main determinants of poverty and vulnerability together with socio-economic inequities. The Hindu Kush hosts millions of people who live far from markets and basic facilities and their ability to cope with emergencies (e.g. natural disasters) is poor.

Rural Caribbean communities face challenges because of the scarcity of economically exploitable and arable land, and their inevitable dependency on other countries for food and energy. Islands present an additional natural constraint that makes access to markets and services particularly difficult. The inhabitants are, therefore, forced into small-scale economies because of the small size of firms, high infrastructure costs (limiting economic diversification), and a heavy dependence on a few commodities and a few overseas markets.

South America presents one of the highest concentrations of people in the highlands, which makes them particularly vulnerable to changing weather events. Although vulnerability in the Andes is not high in absolute terms, it affects a considerable number of small communities that are often difficult to reach because of the high altitude, steep slopes and poor road infrastructure. Arable land is also limited, and several rural communities live on local production as almost the only resource for their subsistence. For those communities, land degradation, induced by climate variability (e.g. landslides and intensive soil erosion), is a serious challenge.

The rural communities of the Pacific islands face numerous challenges because of the high occurrence of natural disasters, as well as their susceptibility to international economic shocks and global financial crises. The unstable economic performance of these states has caused more urban and rural poverty, with the consequent expansion of small settlements and their subsequent impacts on land clearing and environmental degradation. This has increased vulnerability to food insecurity caused by the inability to look after their environment and engage in self-production.

Key findings

Mountains cover 39 million km^2, or 27 percent, of the world's land surface. In 2017, the global mountain population reached nearly 1.1 billion, which is 15 percent of the world's population, with an increase of 89 million people since 2012. The increase added almost entirely (86 million people) to the mountain population in the developing countries, which reached one billion people in 2017.

Population has increased in all the regions of the developing world. Only the areas at the highest mountain altitudes (above 3 500 m) have continued to experience a depopulation trend in the last 17 years, while at all other elevations population has increased. In all African subregions, in South America and in Central and Western Asia, the population density is higher in the mountains than in the lowlands.

In the developing countries, 648 million people (65 percent of the total mountain population) live in rural areas. Half of them, 346 million, were estimated to be vulnerable to food insecurity in 2017. In other words, one of two rural mountain dwellers in the developing countries lives in an area where the daily availability of calories and protein was estimated to be below the minimum threshold needed for a healthy life.

In the five years from 2012 to 2017 the number of vulnerable people increased in the mountains of developing countries, approximately at the same pace as the total mountain population. Although the proportion of vulnerable people to the total mountain population did not change, the absolute number of vulnerable people increased globally by 40 million, representing an increment of 12.5 percent from 2012 to 2017.

The number of vulnerable people has increased in all regions of the developing world. More than half the increase in absolute numbers was observed in Africa (25 million more vulnerable people from 2012 to 2017, bringing the total to 132 million people, and their share to 67 percent of the total rural population), and particularly in Eastern Africa.

The vulnerability to food insecurity of the mountain people in the developing world is compounded by the presence and occurrence of natural hazards and armed conflicts that disrupt livelihoods or put strain on the natural resources on which mountain people depend.

Approximately 516 million rural people were estimated to live in mountain areas affected by past natural hazards with medium to high exposure (of which 241 million, or 47 percent, were those with high exposure). The estimated number of people vulnerable to food insecurity was 275 million with medium to high level of exposure (122 million or 44 percent with high exposure).

An estimated 212 million rural people in the mountains lived in areas identified as having medium to high intensity of conflicts between 2000 and 2018, 50 million of them in areas of frequent and/or intense conflict. The numbers of vulnerable people living in areas where conflicts of medium or high intensity occurred were estimated at 128 million people.

Isolation and distance from food markets and limited access to services and facilities undermine mountain peoples' capacity to cope with the lack of local food production. In 2017, 85 million rural mountain people lived at more than one-hour travel distance from the closest market. Out of those, 34.5 million people (41 percent of the considered population) were vulnerable to food insecurity.

Only 29 percent of the rural mountain population lived in areas with high service and facilities availability such as education, health care, amenities, food services, non-food shops, access to water and sanitation, technology and communication, electricity or hotels. The majority of the rural mountain population, approximately 442 million people, live in areas with limited service availability, and 17 million people (almost 3 percent of the rural mountain population) were estimated to have no or very low access to basic town facilities and services.

Land degradation is seriously impacting agriculture, endangering the sustainability of crop production and animal husbandry and water security, especially in areas where land degradation is rapidly progressing. In most developing countries, the impact of unsustainable agriculture practices on land degradation is very high. Other factors include climate-related extreme weather events, especially drought, which also threaten people's livelihoods; land use changes from natural land cover into farmlands, grazing lands, human settlements and urban centres; intensive use of technology, intensive exploitation of groundwater resources; and others.

There is a strong dependency of rural mountain people on land resources and a lack of sustainable land management practices able to stem land degradation. The vulnerability trends observed at regional level show differences among continents and subregions. In Africa, from 2012 to 2017 out of the 132 million mountain people vulnerable to food insecurity, 86 million lived in areas characterized by limited to very extensive land degradation changes, and 27 million of those lived in areas where the rate of land degradation was moderate to very high.

As reported by the IPCC, climatic variability is posing serious threats and challenges to mountain environments and communities, and its negative impacts are forecasted to worsen in the coming century. Glaciers are melting especially at lower elevations and this is decreasing the stability of mountain slopes while increasing the extent of the areas affected by natural hazards, which are in turn severely affecting mountain communities' livelihoods. Climate extremes are threatening to erode and reverse the gains made in ending hunger and malnutrition, a negative effect particularly relevant for mountain communities, which are already vulnerable to food insecurity. Mountain agriculture is being negatively affected by the decrease in water resources available in the river basins fed by snow and glaciers.

Strengthening future vulnerability assessments

It is hoped that the results of this study may induce governments and other stakeholders to conduct more in-depth investigations on mountain stressors and on better identification of the most vulnerable groups, which might remain hidden in global studies. The COVID-19 pandemic has exposed the vulnerabilities of global food systems. In particular, the implications of the pandemic on the livelihoods of mountain people, still unfolding, will be important to consider both in rural and urban areas.

Apiculture in Afghanistan (©Nasim Seyamak)

In line with the recommendations of the Briefing Note: "Vulnerability to food insecurity in mountain regions: land degradation and other stressors" (FAO and UNCCD, 2019), the present study provides additional recommendations for concrete actions that can be taken to improve the availability and quality of data for future estimates of vulnerability to food insecurity. This information is meant to advise relevant stakeholders on how to strengthen the support to vulnerable mountain populations, also in order to preserve, and possibly increase, ecosystem services and biodiversity.

The study's findings highlight that government actions to combat land degradation, adapt to climate change, strengthen agricultural value chains and promote economic development are fundamental to reducing vulnerability to food insecurity in mountain regions.

Key recommendations:

- Encourage Mountain Partnership member countries and UNCCD country Parties to integrate the processes for estimating vulnerability to food insecurity in mountain regions within the UNCCD national action programmes and the Voluntary National Reviews, for the implementation of the 2030 Agenda for Sustainable Development.
- Include gender issues in vulnerability assessment frameworks. Despite progress and the commitment of countries to achieving the SDGs, the persistence of gender data gaps and the lack of quality, updated, reliable and comparable data are still serious constraints.
- Seek financial support and international expertise and opportunities offered by financial resources mobilized within the framework of the SDG implementation process in order to address mountain vulnerability to food insecurity.
- Invest in building national data capacities, train mountain experts, improve national capacities in remote sensing and Geographic Information System (GIS) data analysis, provide access to national georeferenced data through public portals and websites, and use common data standards to ensure data

Discussing Participatory Guarantee Systems (©FAO/Michelle Geringer)

compatibility and integration. Web portals would be an excellent tool to enable on-the-fly data analyses and queries to help inform the general public and to provide a roadmap of ongoing initiatives on relevant vulnerabilities in order to improve knowledge and/or enable access to data on vulnerability.

- Engage governments, the UNCCD, the Mountain Partnership and other relevant international organizations and non-governmental organizations in an international forum to continue and improve the work done so far, and foster national partnerships. In this context, the Mountain Partnership and Land Degradation Neutrality national working groups and stakeholders' networks would be a valuable addition in gathering expert advice on how to improve future assessments.

Children in Kyrgyzstan (©Alma Karsymbek)

Promoting inclusive policies and food security in mountain regions

Global Meeting of the Mountain Partnership, 2017 (©FAO/Roberto Cenciarelli)

Ultimately, the goal of this study is to call on decision-makers and others stakeholders to strengthen cooperative action to reduce the vulnerability of mountain people, in particular local communities and indigenous people, and of the most vulnerable among them, often women and children.

To remove food insecurity and malnutrition in mountain areas, countries can promote the conservation and sustainable use of mountain biodiversity. They can support sustainable food systems including those associated with traditional crops and diets, by recognizing the economic and environmental role of family farming and by creating the enabling environment to make it a driver of progress and inclusive growth in mountains.

Countries, when possible, should create the enabling environment for the integrated landscape approach. This could not only provide benefits to the land, but also offer solutions for multiple climate change and biodiversity issues.

Land governance accompanied by security of tenure is becoming more important with growing populations and accompanying competition for increasingly limited resources. With the growing global demands for food, feed, biofuels, conservation and urban expansion, and competition between domestic and international land users, land governance will become increasingly important (van der Esch *et al.*, 2017).

The *Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests in the Context of National Food Security* (FAO, 2012) serve as a reference and set out principles and internationally accepted standards for practices for the responsible governance of tenure. They provide a framework that States can use when developing their own strategies, policies, legislation, programmes and activities.

A lack of secure tenure can lead to degradation of land resources, as users lack incentives or the capacity to manage them with long-term productivity in mind. Securing land tenure, which is an important factor for implementing sustainable land management (SLM) practices and achieving land degradation neutrality (LDN), and providing access to productive resources, diversifying livelihoods and implementing practical actions to safeguard decent work opportunities, particularly for youth in rural areas, will increase the coping capacity of mountain people and will reduce inequalities and social and political instability (UNCCD, 2019; Deininger, 2003; Fenske, 2011)

Additional efforts should be made to mainstream gender in the development of mountain-related policies and plans aimed at reducing pressures on natural resources and the environment, including land degradation and water shortage, and increasing economic sustainability of local livelihoods. This can be done through participatory actions, inclusive of community and gender perspectives and of indigenous and traditional knowledge (UNCCD and FAO, 2020).

The environmental and socio-economic effects of COVID-19 on mountain peoples' livelihoods, though not yet quantified, threaten to increase the inequality gaps in mountains and slow down progress towards the 2030 Agenda.

The UN Decade of Action 2020–2030 calls for accelerating sustainable solutions to the world's challenges, such as reducing poverty and inequalities. The UN Decade on Ecosystem Restoration present opportunities for improving degraded ecosystems in mountain regions. Strong, effective and coordinated action in favour of sustainable mountain development is one solution to end hunger and protect mountain ecosystems.

World Mountain Forum, 2014 (©Alma Karsymbek)

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- FAO 2020. Livestock Distribution Database. Rome. http://www.fao.org/geonetwork/srv/en/main.search?any=Livestock+GLW&hitsPerPage=10 à
- International Food Policy Research Institute's (IFPRI) Spatial Production Allocation Model (SPAM)
- GlobCover 2009 validation data set http://due.esrin.esa.int/page_globcover.php
- LandScan data https://landscan.ornl.gov/landscan-datasets

Annex 1

Country grouping scheme

Geographical region and composition
World
Africa
Eastern Africa
Middle Africa
Northern Africa
Southern Africa
Western Africa
Americas
Latin America and the Caribbean
Caribbean
Central America
South America
North America
Asia
Central Asia
Eastern Asia
South-Eastern Asia
Southern Asia
Western Asia
Europe
Eastern Europe
Northern Europe
Southern Europe
Western Europe
Oceania
Australia and New Zealand
Melanesia
Micronesia
Polynesia

Geographical region and composition of each region
Africa
Eastern Africa
Burundi
Comoros
Djibouti
Eritrea
Ethiopia
Kenya
Madagascar
Malawi
Mauritius
Mayotte
Mozambique
Réunion
Rwanda
Seychelles
Somalia
South Sudan
Uganda
United Republic of Tanzania
Zambia
Zimbabwe
Middle Africa
Angola
Cameroon
Central African Republic
Chad
Congo
Democratic Republic of the Congo
Equatorial Guinea
Gabon
Sao Tome and Principe

Northern Africa

Algeria
Egypt
Libya
Morocco
Sudan
Tunisia
Western Sahara

Southern Africa

Botswana
Eswatini
Lesotho
Namibia
South Africa

Western Africa

Benin
Burkina Faso
Cabo Verde
Cote d'Ivoire
Gambia
Ghana
Guinea
Guinea-Bissau
Liberia
Mali
Mauritania
Niger
Nigeria
Saint Helena
Senegal
Sierra Leone
Togo

Americas

Latin America and the Caribbean

Caribbean

Anguilla
Antigua and Barbuda
Aruba
Bahamas
Barbados
Bonaire, Sint Eustatius and Saba
British Virgin Islands
Cayman Islands
Cuba
Curaçao
Dominica
Dominican Republic
Grenada
Guadeloupe
Haiti
Jamaica
Martinique
Montserrat
Puerto Rico
Saint-Barthélemy
Saint Kitts and Nevis
Saint Lucia
Saint Martin (French part)
Saint Vincent and the Grenadines
Sint Maarten (Dutch part)
Trinidad and Tobago
Turks and Caicos Islands
United States Virgin Islands

Central America

Belize
Costa Rica
El Salvador
Guatemala
Honduras
Mexico
Nicaragua
Panama

South America

Argentina
Bolivia (Plurinational State of)
Brazil
Chile
Colombia
Ecuador
Falkland Islands (Malvinas)
French Guiana
Guyana
Paraguay
Peru
Suriname
Uruguay
Venezuela (Bolivarian Republic of)

North America

Bermuda
Canada
Greenland

Saint Pierre and Miquelon
United States of America

Asia

Central Asia

Kazakhstan
Kyrgyzstan
Tajikistan
Turkmenistan
Uzbekistan

Eastern Asia

China
China, Hong Kong SAR
China, Macao SAR
Democratic People's Republic of Korea
Japan
Mongolia
Republic of Korea

Southern Asia

Afghanistan
Bangladesh
Bhutan
India
Iran (Islamic Republic of)
Maldives
Nepal
Pakistan
Sri Lanka

South-Eastern Asia

Brunei Darussalam
Cambodia
Indonesia
Lao People's Democratic Republic
Malaysia
Myanmar
Philippines
Singapore
Thailand
Timor-Leste
Viet Nam

Western Asia

Armenia
Azerbaijan
Bahrain
Cyprus
Georgia
Iraq
Israel
Jordan
Kuwait
Lebanon
Oman
Qatar
Saudi Arabia
State of Palestine
Syrian Arab Republic
Turkey
United Arab Emirates
Yemen

Europe

Eastern Europe

Belarus
Bulgaria
Czech Republic
Hungary
Poland
Republic of Moldova
Romania
Russian Federation
Slovakia
Ukraine

Northern Europe

Åland Islands
Channel Islands
Denmark
Estonia
Faroe Islands
Finland
Guernsey
Iceland
Ireland
Isle of Man
Jersey
Latvia
Lithuania
Norway
Sark
Svalbard and Jan Mayen Islands
Sweden
United Kingdom of Great Britain and Northern Ireland

Southern Europe
Albania
Andorra
Bosnia and Herzegovina
Croatia
Gibraltar
Greece
Holy See
Italy
Malta
Montenegro
North Macedonia
Portugal
San Marino
Serbia
Slovenia
Spain

Western Europe
Austria
Belgium
France
Germany
Liechtenstein
Luxembourg
Monaco
Netherlands
Switzerland

Oceania
Australia and New Zealand
Australia
New Zealand
Norfolk Island

Melanesia
Fiji
New Caledonia
Papua New Guinea
Solomon Islands
Vanuatu

Micronesia
Guam
Kiribati
Marshall Islands
Micronesia (Federated States of)
Nauru
Northern Mariana Islands
Palau

Polynesia
American Samoa
Cook Islands
French Polynesia
Niue
Pitcairn
Samoa
Tokelau
Tonga
Tuvalu
Wallis and Futuna Islands

Developed and developing regions
Developing regions
Africa
Americas excluding North America
Asia excluding Cyprus, Israel and Japan
Oceania excluding Australia and New Zealand

Developed regions
Australia and New Zealand
North America
Europe
Cyprus
Israel
Japan

Annex 2

FURTHER STATISTICS ON VULNERABLE MOUNTAIN PEOPLE IN DEVELOPING COUNTRIES

Subregion	Mountain population (000)					Percentage of not assessed to total rural mountain population (%)
	Not Vulnerable ('000)	Not Assessed (outside the agro-pastoral area) ('000)	Not Assessed (within the agro-pastoral area) ('000)	Vulnerable ('000)	Total Rural Mountain Population ('000)	
Africa	**51 343**	**12 698**	**0.9**	**131 989**	**196 031**	**6.5**
Eastern Africa	34 815	6 855	0.6	93 775	135 446	5.1
Middle Africa	3 785	3 284	0.3	14 748	21 818	15
Northern Africa	8 442	1 454	0.0	6 997	16 892	8.6
Southern Africa	2 423	222	-	9 562	12 206	1.8
Western Africa	1 878	883	-	6 907	9 668	9.1
Latin America & the Caribbean	**20 298**	**17 775**	**0.3**	**17 163**	**55 236**	**32**
Caribbean	1 106	981	0.0	1 528	3 615	27
Central America	7 787	9 006	0.0	8 899	25 692	35
South America	11 405	7 787	0.3	6 736	25 929	30
Asia	**127 305**	**71 346**	**0.2**	**195 021**	**393 673**	**18**
Central Asia	2 083	450	0.0	4 550	7 083	6.4
Eastern Asia	64 860	30 850	0.0	89 290	185 000	17
South-Eastern Asia	19 084	12 148	0.0	20 416	51 648	24
Southern Asia	24 150	19 726	0.1	64 010	107 886	18
Western Asia	17 129	8 172	0.0	16 756	42 056	19
Oceania & Pacific	**106**	**1 648**	**0.9**	**1 439**	**3 194**	**52**
Melanesia	105	1 646	0.5	1 435	3 186	52
Micronesia	-	0.1	0.0		0.1	100
Polynesia	0.8	1.7	0.4	4.4	7.3	29
Developing World	**199 053**	**103 467**	**2.2**	**345 612**	**648 134**	**16**

Table 27: Rural mountain population in developing countries by vulnerability class – 2017

Subregion	Mountain population ('000)					Percentage of not assessed to total rural mountain population (%)
	Not Vulnerable	Not Assessed (outside the agro-pastoral area)	Not Assessed (within the agro-pastoral area)	Vulnerable	Total Rural Mountain Population	
Africa	**54 631**	**10 380**	**1.9**	**107 483**	**172 496**	**6.0**
Eastern Africa	35 994	5 699	1.5	77 456	119 150	4.8
Middle Africa	4 045	2 839	0.4	11 540	18 425	15
Northern Africa	8 256	961	0.0	4 938	14 155	6.8
Southern Africa	3 471	191	0.0	8 022	11 684	1.6
Western Africa	2 865	689	0.0	5 528	9 082	7.6
Latin America & the Caribbean	**19 879**	**16 532**	**0.1**	**16 838**	**53 249**	**31**
Caribbean	1 031	1 013	0.0	1 605	3 648	28
Central America	7 331	8 013	0.0	8 779	24 123	33
South America	11 517	7 507	0.1	6 454	25 478	29
Asia	**117 620**	**61 872**	**0.2**	**181 352**	**360 844**	**17**
Central Asia	2 024	367	0.0	3 729	6 120	6.0
Eastern Asia	62 523	29 042	0.0	88 341	179 907	16
South-Eastern Asia	15 834	10 327	0.0	19 526	45 688	23
Southern Asia	21 842	16 796	0.1	55 581	94 219	18
Western Asia	15 397	5 340	0.0	14 174	34 911	15
Oceania & Pacific	**109**	**1 422**	**0.9**	**1 437**	**2 969**	**48**
Melanesia	108	1 419	0.4	1 433	2 961	48
Micronesia	-	0	0.0	-	0	100
Polynesia	0.8	2.0	0.6	4.4	7.8	33
Developing World	**192 239**	**90 206**	**3.1**	**307 110**	**589 558**	**15**

Table 28: Rural mountain population in developing countries by vulnerability class – 2012

Subregion	Mountain population ('000)					Percentage of not assessed to total rural mountain population (%)
	Not Vulnerable	Not Assessed (outside the agro-pastoral area)	Not Assessed (within the agro-pastoral area)	Vulnerable	Total Rural Mountain Population	
Africa	**40 345**	**9 891**	**2.1**	**82 104**	**132 343**	**7.5**
Eastern Africa	23 392	5 246	0.9	59 598	88 237	5.9
Middle Africa	2 948	2 539	1.1	8 327	13 815	18
Northern Africa	7 035	1 461	0.0	3 160	11 656	13
Southern Africa	4 931	131	-	6 244	11 306	1.2
Western Africa	2 039	515		4 775	7 328	7.0
Latin America & the Caribbean	**21 013**	**17 779**	**3.2**	**15 181**	**53 976**	**33**
Caribbean	760	713	-	1 412	2 884	25
Central America	7 893	7 941	-	7 802	23 636	34
South America	12 360	9 126	3.2	5 968	27 456	33
Asia	**134 240**	**79 728**	**1.3**	**144 527**	**358 497**	**22**
Central Asia	2 659	394	-	2 377	5 431	7.3
Eastern Asia	83 019	43 861	0.1	84 184	211 064	21
South-Eastern Asia	14 195	18 090	0.0	15 449	47 734	38
Southern Asia	19 908	13 267	1.2	35 954	69 130	19
Western Asia	14 458	4 116	0.0	6 562	25 137	16
Oceania & Pacific	**101**	**1 594**	**2.9**	**826**	**2 523**	**63**
Melanesia	99	1 586	0.2	820	2 506	63
Micronesia	-	2.2	-	-	2.2	100
Polynesia	1.8	5.2	2.7	5.8	15	51
Developing World	**195 699**	**108 992**	**9.5**	**242 638**	**547 339**	**20**

Table 29: Rural mountain population in developing countries by vulnerability class – 2000

This study presents a geographic and demographic picture of the world's mountain areas and assesses the vulnerability to food insecurity of mountain dwellers in developing countries.

The results show that in the mountains of developing countries the population has continued to increase while food security has not improved since the last assessment in 2012. In the mountains in developing countries, one in two rural dwellers lives in an area where the daily availability of calories and protein might fall below the minimum threshold needed for a healthy life.

In many mountain areas, isolation, distance from services and markets, conflicts, natural hazards and land degradation all contribute to making rural people vulnerable to food shortages. The study includes a geographical presentation of the occurrence of these factors in the mountain areas where people are estimated to be vulnerable to food insecurity.

Climatic variability is threatening the stability of mountain ecosystems and people's livelihoods, and its negative effects are expected to worsen in the coming century.

This study is a call to national governments and the international community to give urgent attention to the threats affecting mountain livelihoods and ecosystems and to develop policies to reduce the negative effects of climate change in mountains, control land degradation in critical areas, preserve mountain ecosystem services, and improve infrastructure and services for mountain people in the spirit of the UN 2030 Agenda of leaving no one behind.

ISBN 978-92-5-133716-5

9 789251 337165

CB2409EN/1/12.20

Italian Development Cooperation
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Swiss Confederation

Federal Department of Economic Affairs, Education and Research EAER
Federal Office for Agriculture FOAG