



# Degradace půd a deforestace

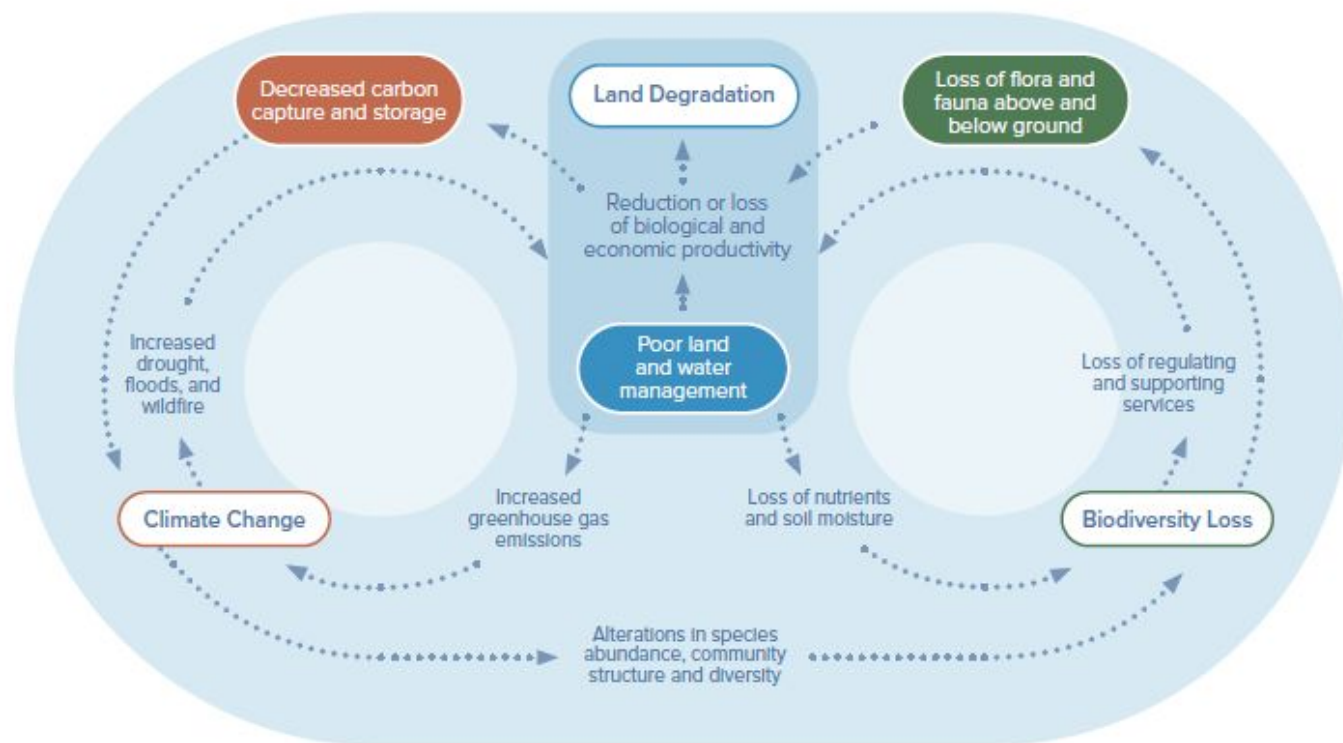
EENSb1124 Globální environmentální problémy  
Tomáš Chabada 273763@mail.muni.cz

# Čo nás čaká

- Biomy
- Krajinný pokryv a jeho zmeny
- Půda
- Degradace půd
- Lesy a jejich využití
- Deforestation

FIGURE 1.3

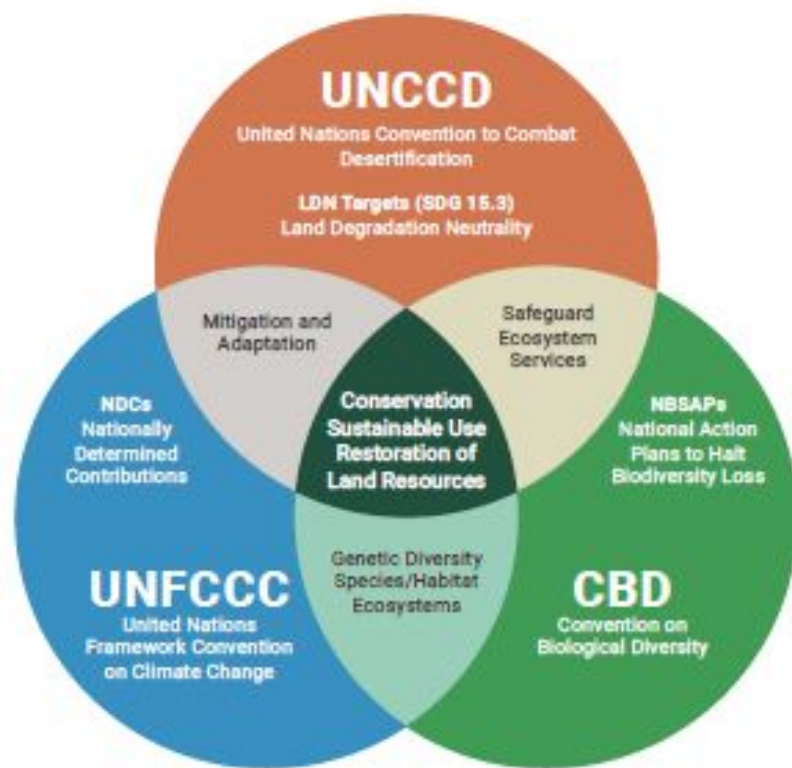
Feedback loops between land degradation, climate change, and biodiversity loss



Source: Millennium Ecosystem Assessment, 2005.

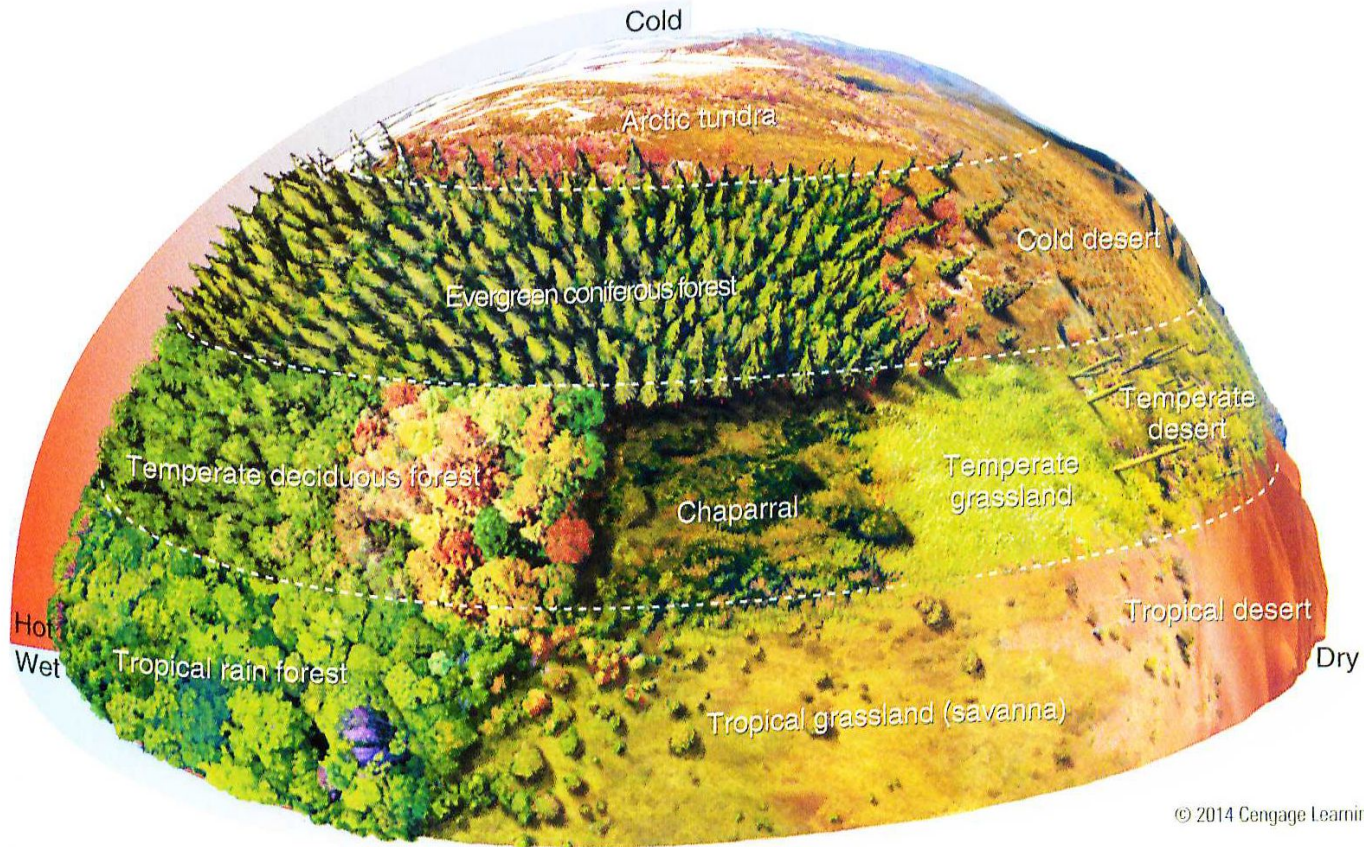
FIGURE 3.1

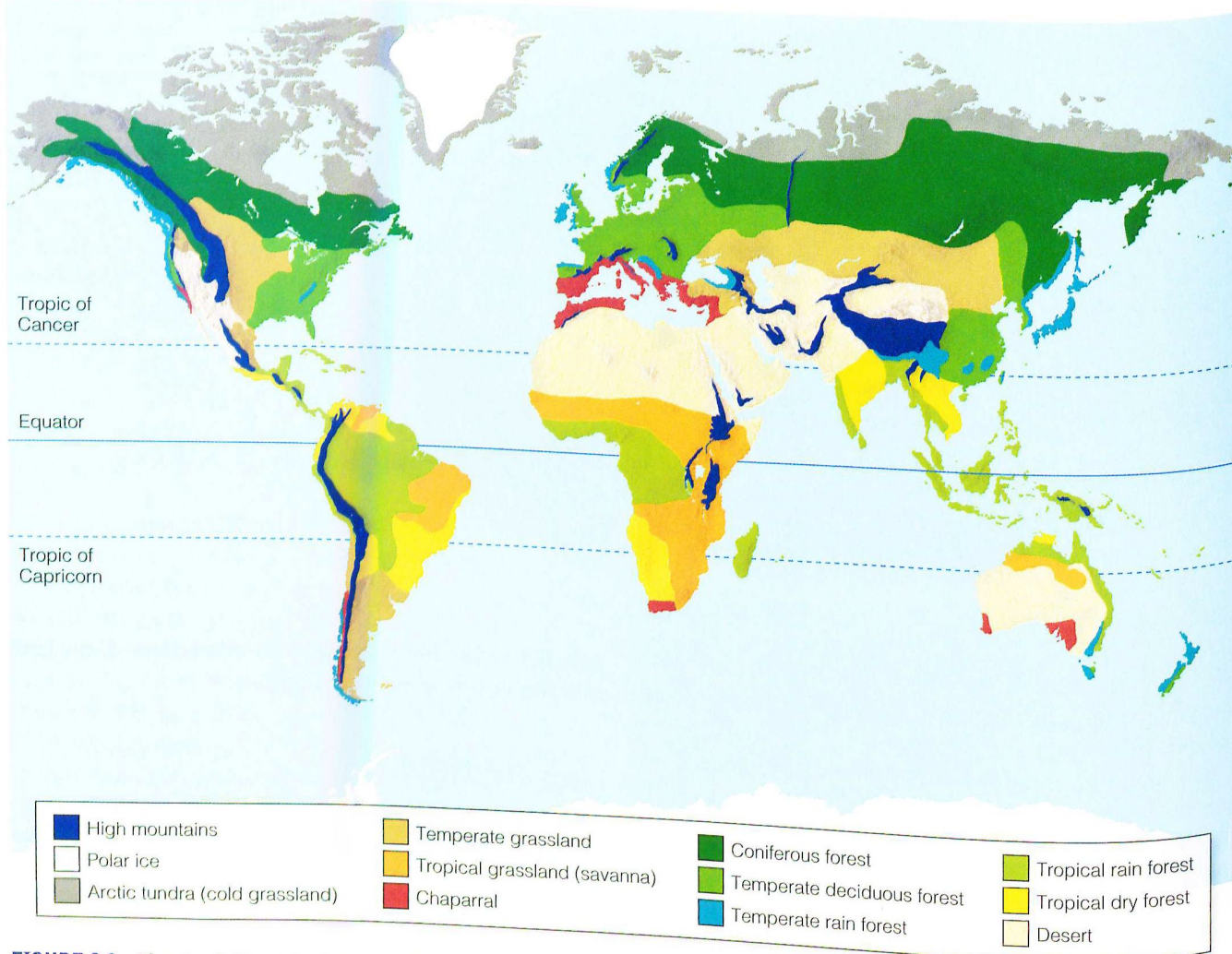
Land restoration and the Rio Conventions



# Biomy, krajinný pokryv a jeho změny

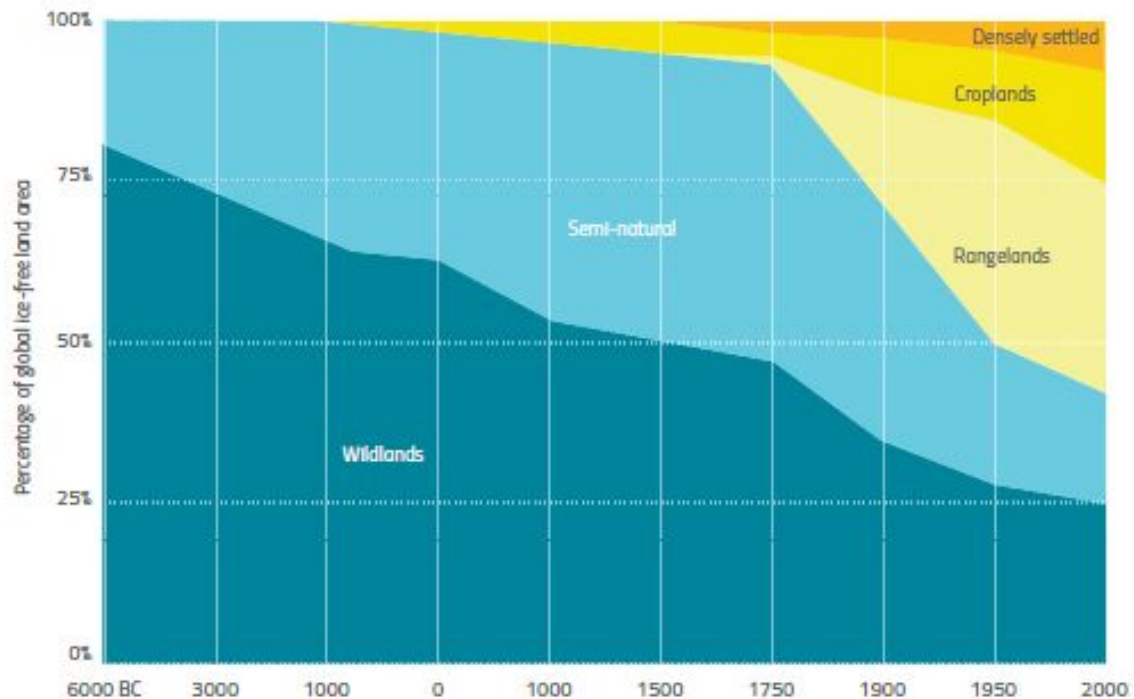
# Biomy (Myers & Spoolman, 2014)





**FIGURE 9.3** The earth has a variety of major biomes.

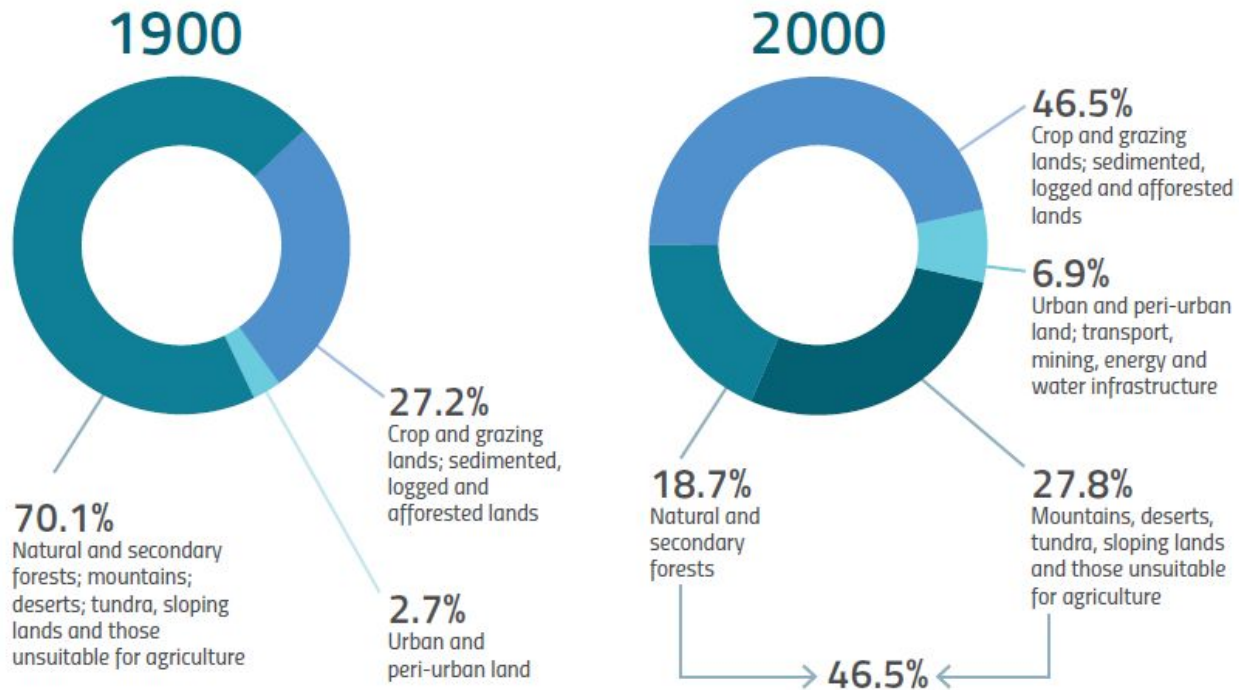
Figure 2.1:  
Transformation of the  
biosphere over 8000  
years: Adapted from,<sup>4</sup>  
Based on<sup>5</sup>



Zdroj: UNCCD.  
*Global Land  
Outlook. 2017*



Figure 2.4: A century of land use change:  
Based on 1900<sup>47</sup>  
and 2000<sup>48</sup>



Zdroj: UNCCD.  
*Global Land  
Outlook. 2017*

# Land use definitions for agricultural and non-agricultural land cover

The categories have been defined and grouped within their relevant categories and sub-categories based on standardised UN Food and Agricultural Organization (FAO) definitions.

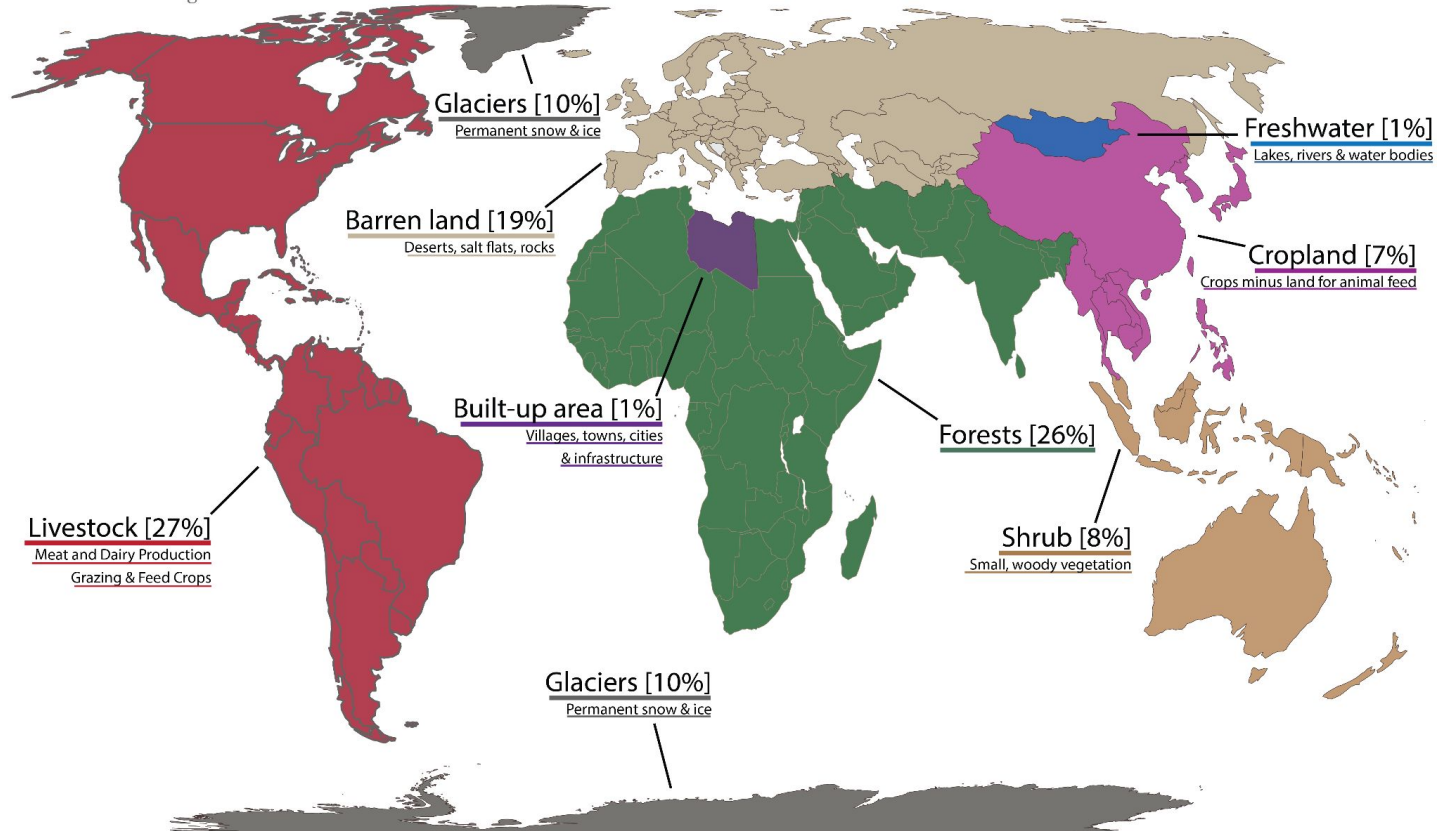


# How the world's land is used: Total area sizes by type of use & land cover

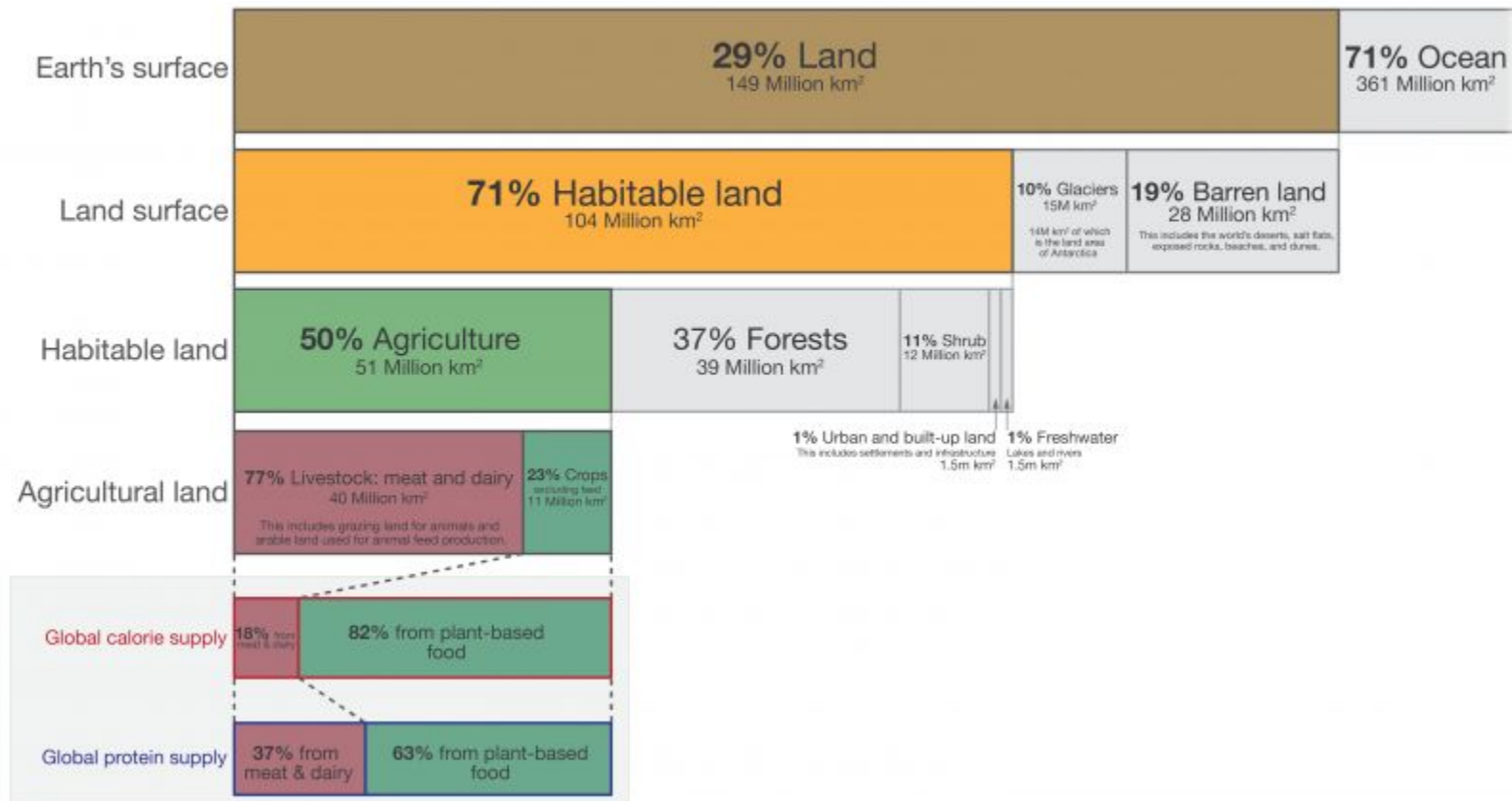
Global surface area if land was aggregated by usage or terrain cover. Land categories are not shown by their distribution around the world but are representative of the total area that they cover.

Land uses as a percentage of global land area area are shown in square brackets.

- Cropland is shown as land area used for crop production minus area used for production of animal feed.
- Livestock area is inclusive of both grazing land and cropland for animal feed. 'Barren land' refers to land cover in which less than one-third of the area has vegetation or other cover.

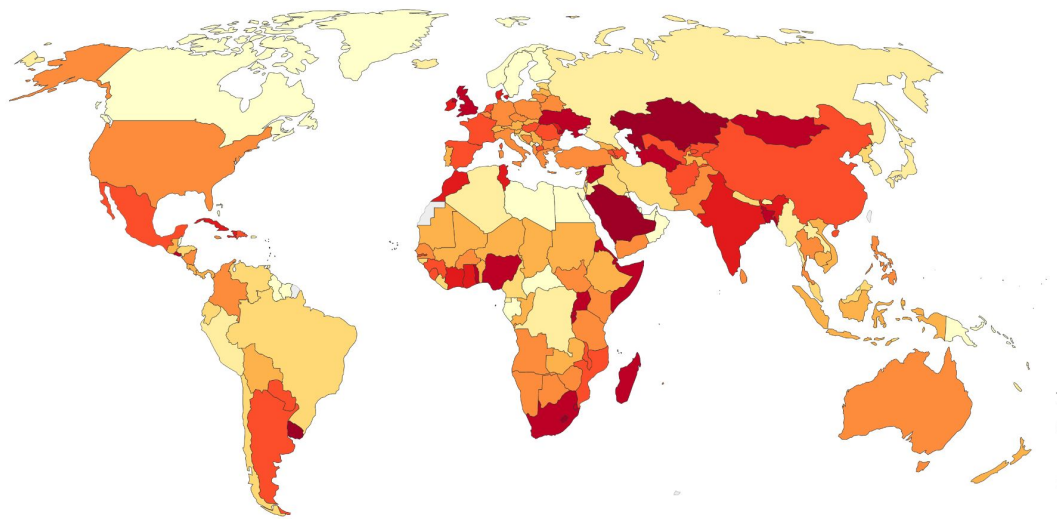


# Global land use for food production



# Share of land area used for agriculture, 2018

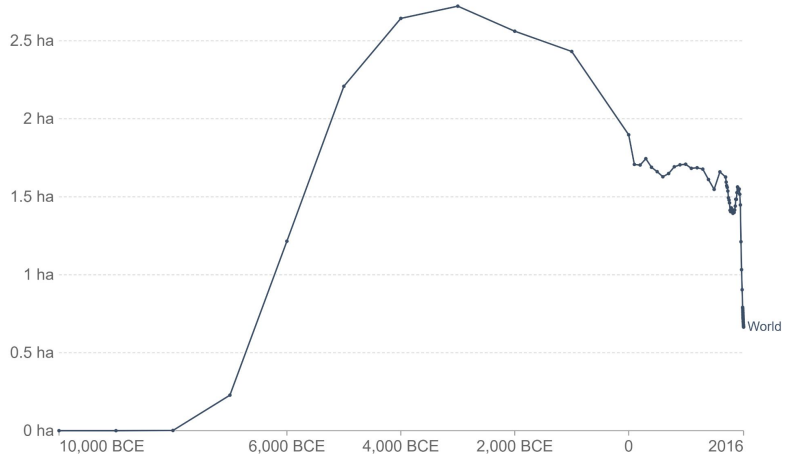
The share of land area used for agriculture, measured as a percentage of total land area. Agricultural land refers to the share of land area that is arable, under permanent crops, and under permanent pastures.



Source: Food and Agriculture Organization of the United Nations (via World Bank)  
OurWorldInData.org/yields-and-land-use-in-agriculture/ • CC BY

## Agricultural land use per person

This dataset is showing estimates of the total agricultural land area – which is the combination of cropland and grazing land – per person. It is measured in hectares per person.



Source: History Database of the Global Environment (HYDE)

OurWorldInData.org/land-use • CC BY

# The world has passed peak agricultural land

While sources disagree on how much land we use for agriculture, many suggest that the world has passed the peak. This is due to a reduction in global land used for pasture\*. Global cropland use continues to increase.

## Global agricultural land use (croplands plus pasture for livestock)

5 billion hectares

4 billion hectares

3 billion hectares

2 billion hectares

1 billion hectares

0 hectares

1000 1200 1400 1600 1800 1900 2000

Agricultural land use increased rapidly from the year 1700. By 1960, it had more than quadrupled.

Peaks in 2000

Peaks in 1990

### HYDE 3.2 – Goldewijk et al. (2017)

- Measured from national census data, combined with gridded data of population density and land modelling
- Estimates global agricultural land use peaked around 2000

### UN Food and Agriculture Organization (FAO)

- Measured from national census data; country reports; and expert estimates
- Global agricultural land use peaked around 2000

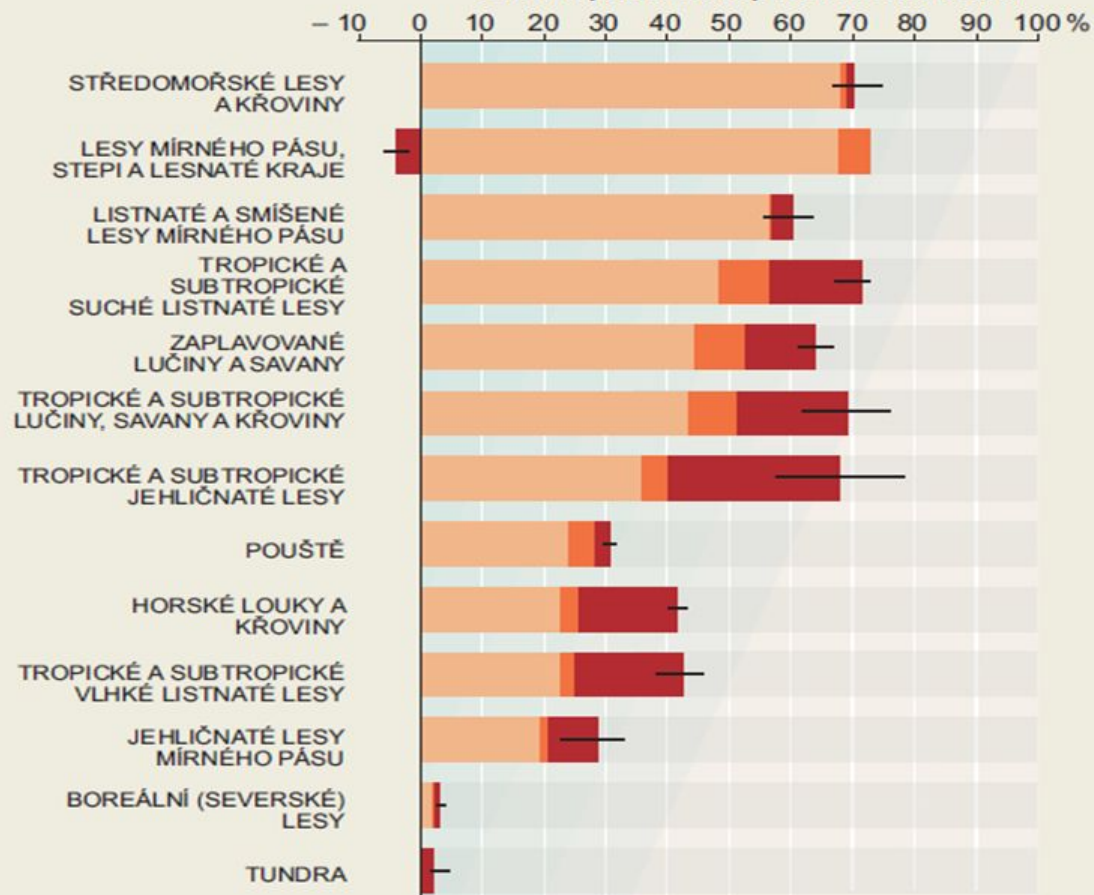
### Taylor and Rising (2021)

- Measured from national census data, combined with gridded data of population density and land modelling
- Global agricultural land use peaked in the 1990s

\*A peak in global pasture land does not mean that it has peaked everywhere. In tropical regions, it continues to increase, often at the expense of carbon-rich habitats.

Sources: Goldewijk et al. (2017). Anthropogenic land use estimates for the Holocene – HYDE 3.2; Taylor and Rising (2021). Tipping point dynamics in global land use. Food and Agriculture Organization of the United Nations.

### Zlomek potenciálně přetvořeného území



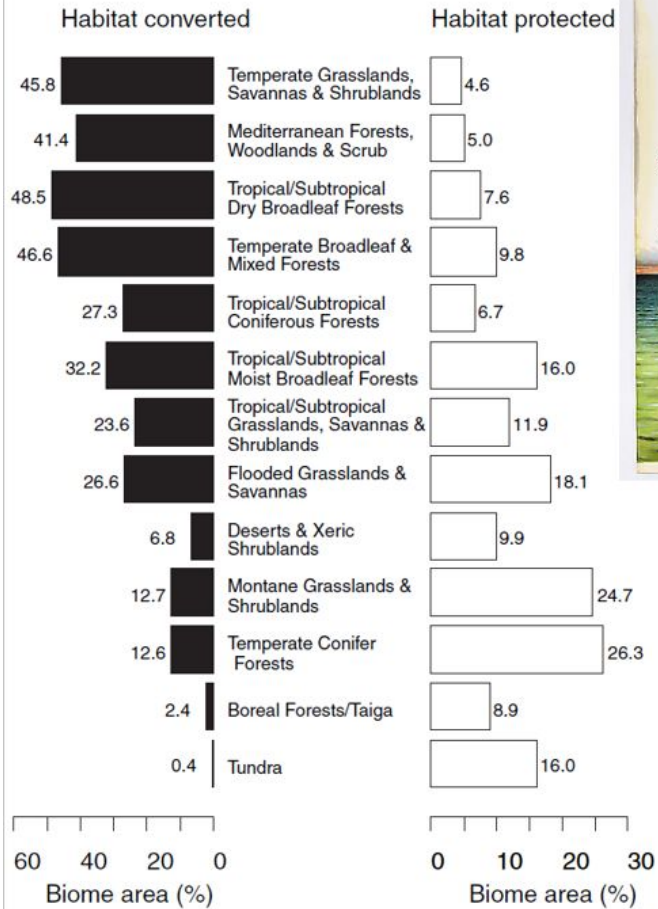
#### Přeměny původních biómů<sup>a</sup>

ztráta před r. 1950

ztráta mezi r. 1950 a 1990

předpokládaný ztráta do r. 2050<sup>b</sup>

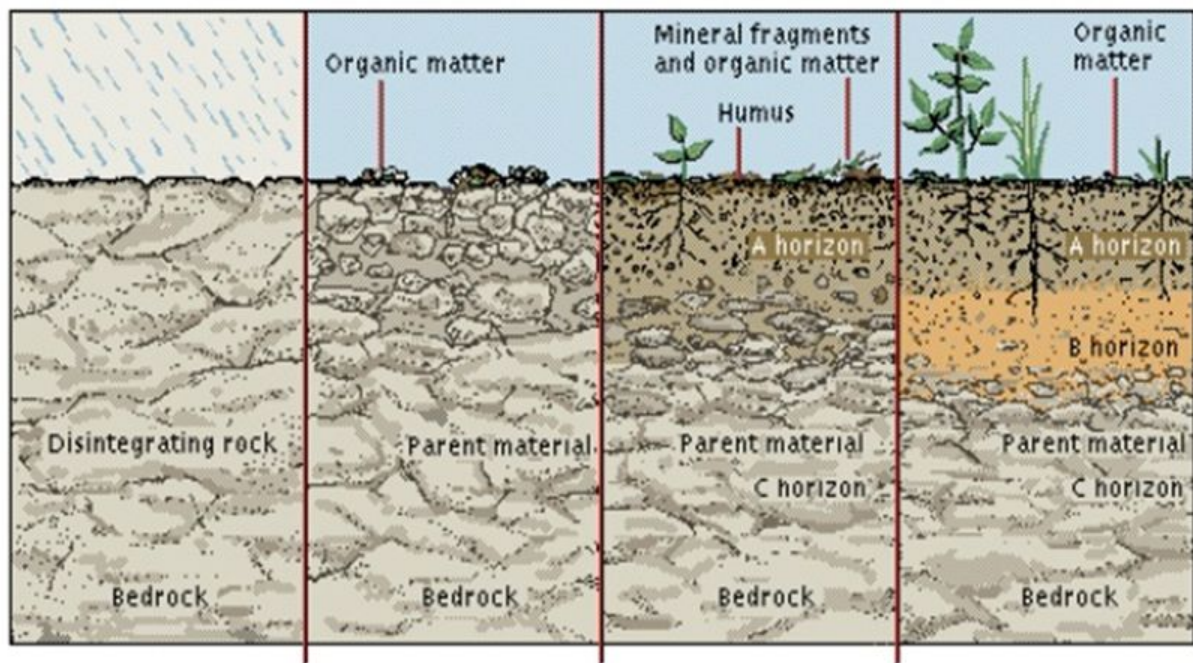
# Globální ekologická katastrofa? Krize biodiverzity?





Půda, Degradace půd

# STAGES OF SOIL DEVELOPMENT



Bedrock begins to disintegrate

I

Organic materials facilitate disintegration

II

Horizons form

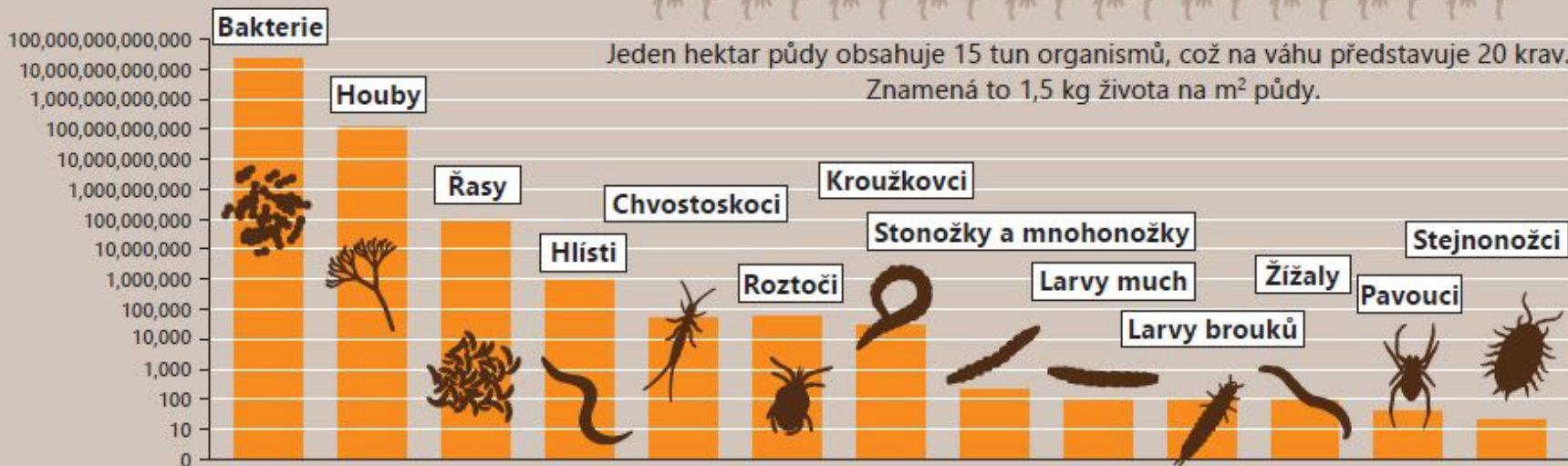
III

Developed soil supports thick vegetation

IV

## PŮDY HEMŽÍČÍ SE ŽIVOTEM

Počet živých organismů v 1 m<sup>3</sup> svrchní půdy  
v mírném klimatu, logaritmické měřítko

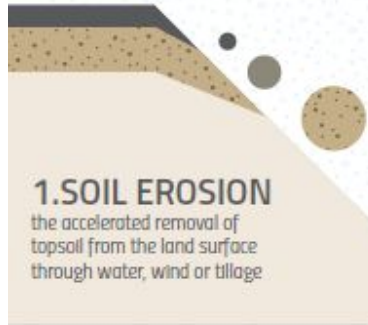


# Degradace půd

- Půdní eroze
- Desertifikace
- Přepásání
- Zasolování půd
- Podmáčení (Zamokřování)
- Deforestace
- Zhutnění půdy
- Okyselování
- Kontaminace půdy (těžkými kovy a pesticidy, dusičnany...)
- Úbytek organické hmoty (úbytek půdního organického uhlíku a biologické rozmanitosti půdy)

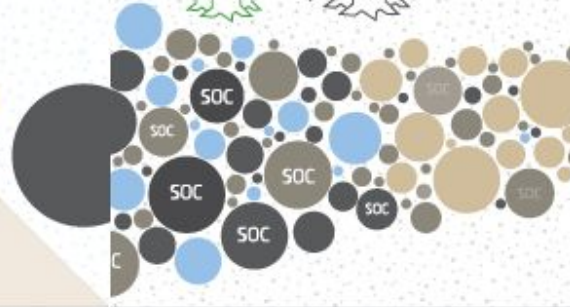
### 1. SOIL EROSION

the accelerated removal of topsoil from the land surface through water, wind or tillage



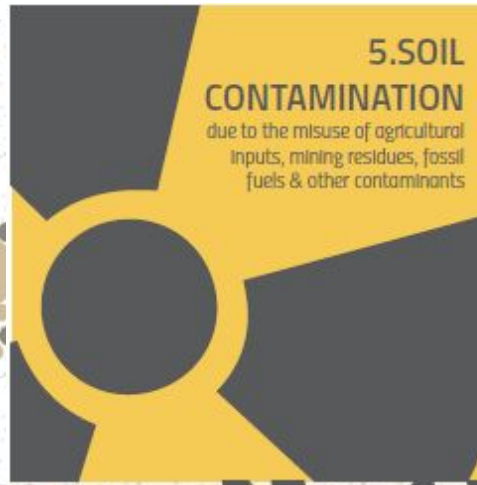
### 2. LOSS OF SOIL ORGANIC CARBON

primarily as a result of land use change



### 5. SOIL CONTAMINATION

due to the misuse of agricultural inputs, mining residues, fossil fuels & other contaminants



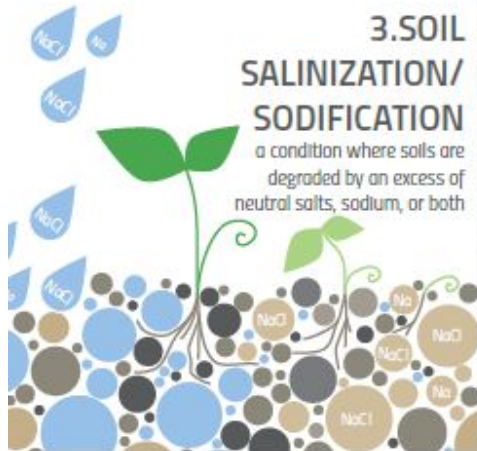
### 6. SOIL ACIDIFICATION

a natural, long-term process caused by precipitation & decomposition of vegetation



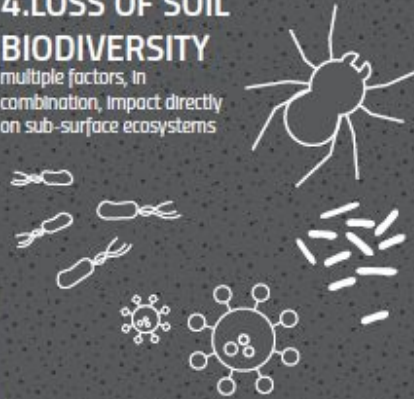
### 3. SOIL SALINIZATION/ SODIFICATION

a condition where soils are degraded by an excess of neutral salts, sodium, or both



### 4. LOSS OF SOIL BIODIVERSITY

multiple factors, in combination, impact directly on sub-surface ecosystems



### 7. SOIL COMPACTION

dramatically reduces long-term productivity of soils



### 8. SOIL SEALING & LAND TAKE

due to rapid urbanization & lack of land use planning

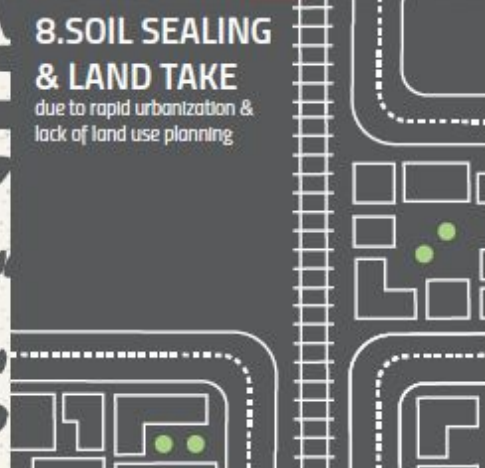


Table 3 1 Anthropogenic direct drivers of land degradation and restoration.

Anthropogenic direct driver	Example subcategories of direct driver	Examples of linked degradation processes
<b>Grazing land management</b>	Change in extent of grazing lands, livestock type, stocking rates, rotation regimes, supplementary feeding, irrigation and water management, pasture improvement	Fragmentation of native vegetation, loss of biotic diversity, soil erosion, soil compaction, change in soil and nutrient content, salinization, change in runoff and infiltration regimes of water, nutrients and agrochemicals, invasive species, change in fire regimes, woody encroachment
<b>Croplands and agroforestry management</b>	Change in extent of croplands and agroforestry systems including drainage of wetlands, crop type, crop rotation and/or sequence, soil management, harvesting and fallow cycles, agricultural inputs, irrigation	Fragmentation of native vegetation, soil erosion, soil compaction, change in soil nutrient content, change in runoff and infiltration regimes of water, nutrients and agrochemicals, soil and water salinization, sedimentation, water contamination, species invasions, change in fire regime, atmospheric pollution and deposition
<b>Forests and tree plantation management</b>	Change in extent of managed and planted forests, harvesting intensity, rotation regimes, silvicultural techniques	Fragmentation of native vegetation, soil erosion, soil compaction, change in soil nutrient content, change in runoff and infiltration regimes of water, nutrients and agrochemicals, sedimentation, water contamination, change in species composition and invasions, changes in above-ground and below-ground biomass, changes in carbon stocks, fire regime change
<b>Non-timber natural resource extraction</b>	Fuelwood harvesting, hunting, harvesting of wild foods, fodder, medicinal and other products	Change in species abundance and composition, vegetation structure and above-ground biomass
<b>Fire regime changes</b>	Changes in frequency, intensity, season and timing of fire, including fire suppression	Change in species composition and above-ground biomass, soil erosion, species invasions, change in soil nutrient content, change in runoff and infiltration regimes of water, nutrients and agrochemicals

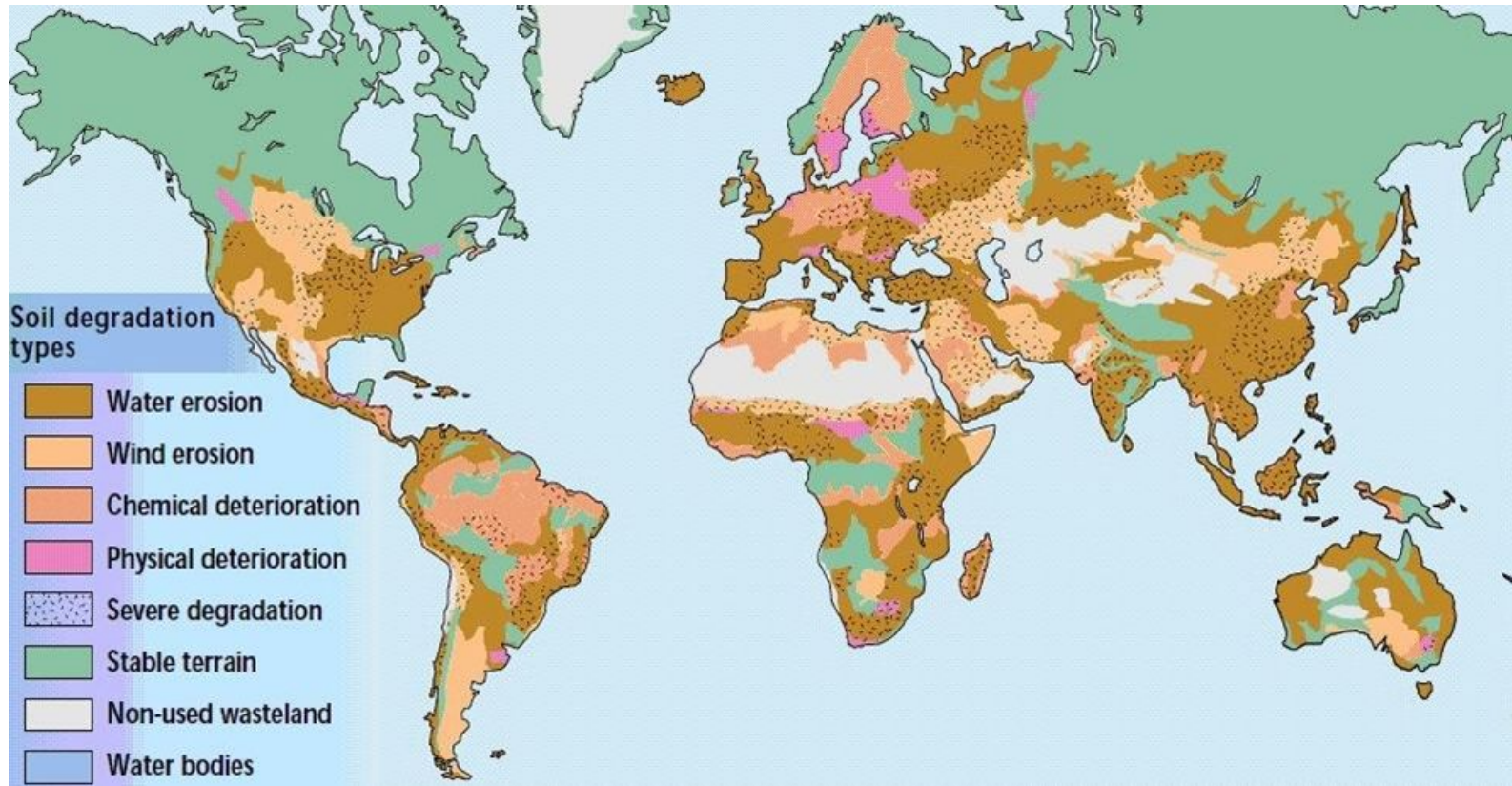
Zdroj: IPBES.  
*The assessment report on Land Degradation and Restoration.*  
 2018.

<b>Introduction of invasive species</b>	Not applicable	Change in species composition, vegetation structure and above-ground biomass, change in fire regime, spread of disease and pests
<b>Extractive industry development</b>	Mine type, extraction and refining techniques, pollutant discharge and spoil disposal, reclamation, spatial planning	Soil pollution and compaction, water contamination, altered runoff regimes, change in groundwater reserves, atmospheric pollution and deposition
<b>Infrastructure and industrial development and urbanization</b>	Land clearance, dams and hydroelectric power plants, roads and railways, other infrastructure development, irrigation	Soil pollution and compaction, water contamination, altered runoff regimes, change in groundwater reserves, atmospheric pollution and deposition

<b>Indirect drivers</b>	<b>Subcategories of indirect driver</b>
<b>Demographic</b>	Population growth rate; migration and population mobility (including to urban centers); density; age structure
<b>Economic</b>	Demand and consumption; poverty; commercialization and trade; urbanization; industrialization; labour markets; prices; finance
<b>Science, knowledge and technology</b>	Education; indigenous and local knowledge; taboos; research and development investments; access to technology; innovation; communication and outreach
<b>Institutions and governance</b>	Public policy (regulatory and incentive based); property rights; customary law; certification; international agreements and conventions (trade, environment and so on); competencies of formal institutions; informal institutions (social capital)
<b>Cultural</b>	Worldviews; values; religion; consumer behaviour; diet

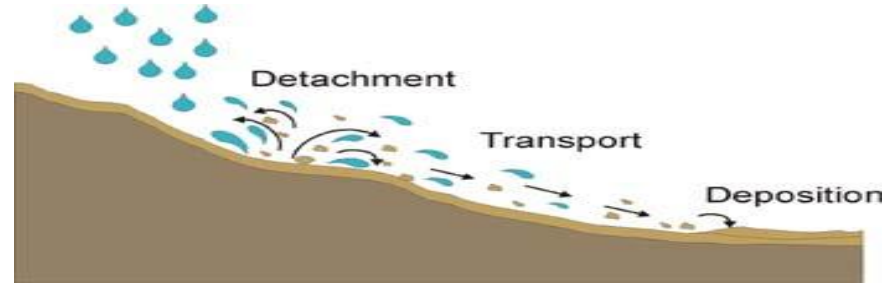
Zdroj: IPBES.  
*The assessment report on Land Degradation and Restoration.*  
 2018.

# Typy půdní degradace





# Půdní eroze

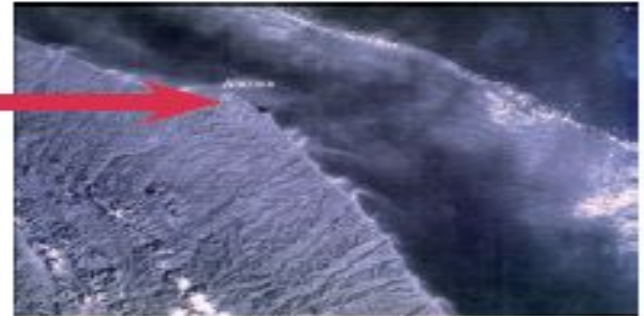


- Ztráta půdy - pohyb půdních částic, hlavně povrchové vrstvy a ornice
- Erozi mizí průměrně 2,5 cm půdy za 25 let (Pimentel 2010)
- Obnova 2,5 cm půdy trvá průměrně 500 let (Pimentel 2010)
- Ročně se ztratí 30-40 mld. t. ornice (Moldan 2015) - ztráta půdy z hektaru 10-35 t ročně (Pimentel 2010)
- Z 14,7 milionů km<sup>2</sup> zemědělských půd ohroženo 9 mil. (1,7 mil. vážně ohrožených půd)

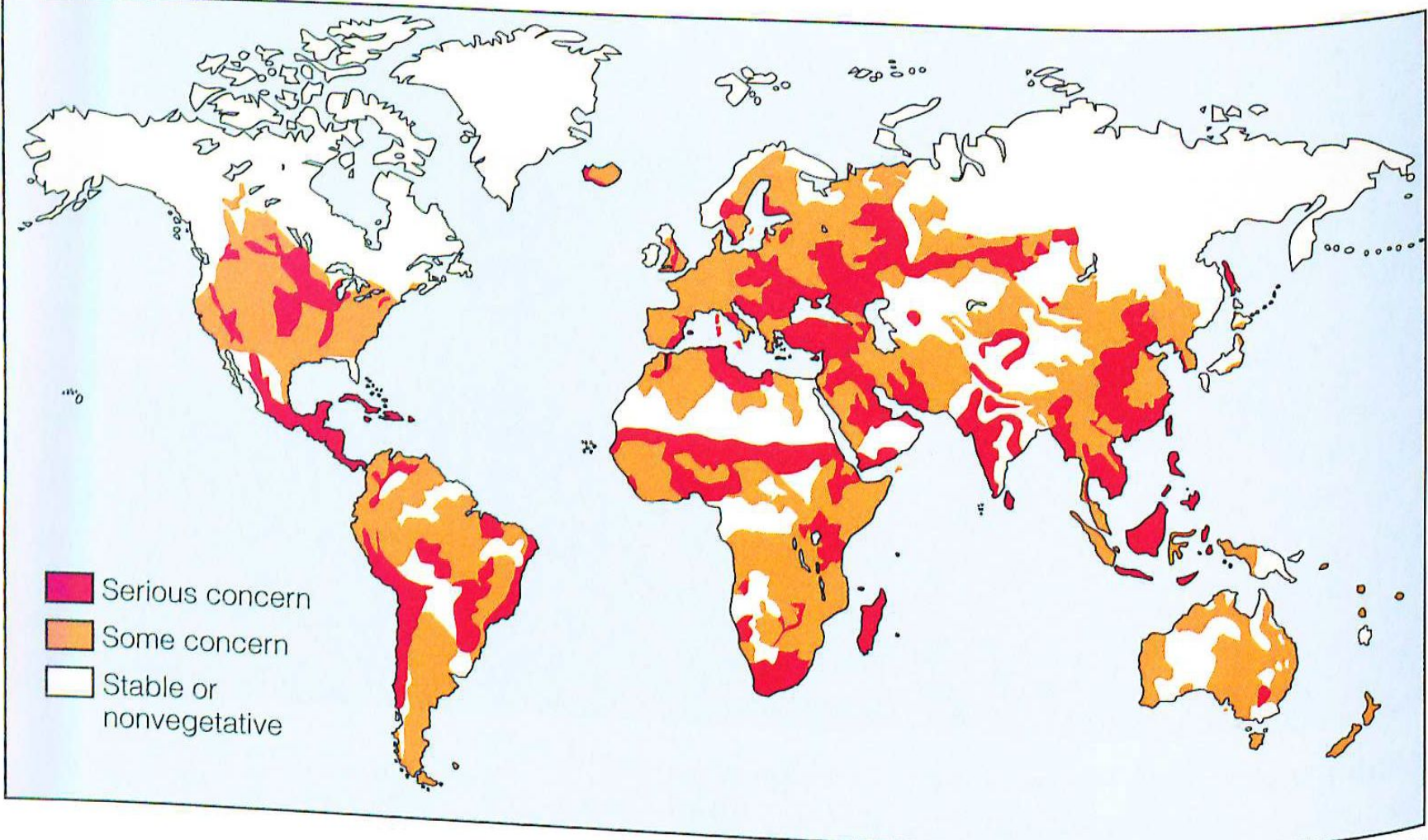


# Škody způsobené erozí

Škody působené na místě vodní eroze	Škody působené mimo místo vodní eroze
<ul style="list-style-type: none"><li>• Ztráta organické hmoty</li><li>• Degradace půdní struktury</li><li>• Zhutnění půdního povrchu</li><li>• Snížená infiltrace vody</li><li>• Snížený přítok do zásoby podzemní vody</li><li>• Ztráta půdy na povrchu</li><li>• Odstraňování živin</li><li>• Zvýšení podílu hrubé půdní frakce</li><li>• Tvorba rýh a strží</li><li>• Vykořenění rostlin</li><li>• Snížení úrodnosti půdy</li></ul>	<ul style="list-style-type: none"><li>• Znečištění vody</li><li>• Eutrofizace vody</li><li>• Povodně</li><li>• Zanesení infrastruktury</li><li>• Ucpání odvodňovacích sítí</li><li>• Změny tvaru vodních toků</li><li>• Zanesení vodních cest a přístavů</li></ul>



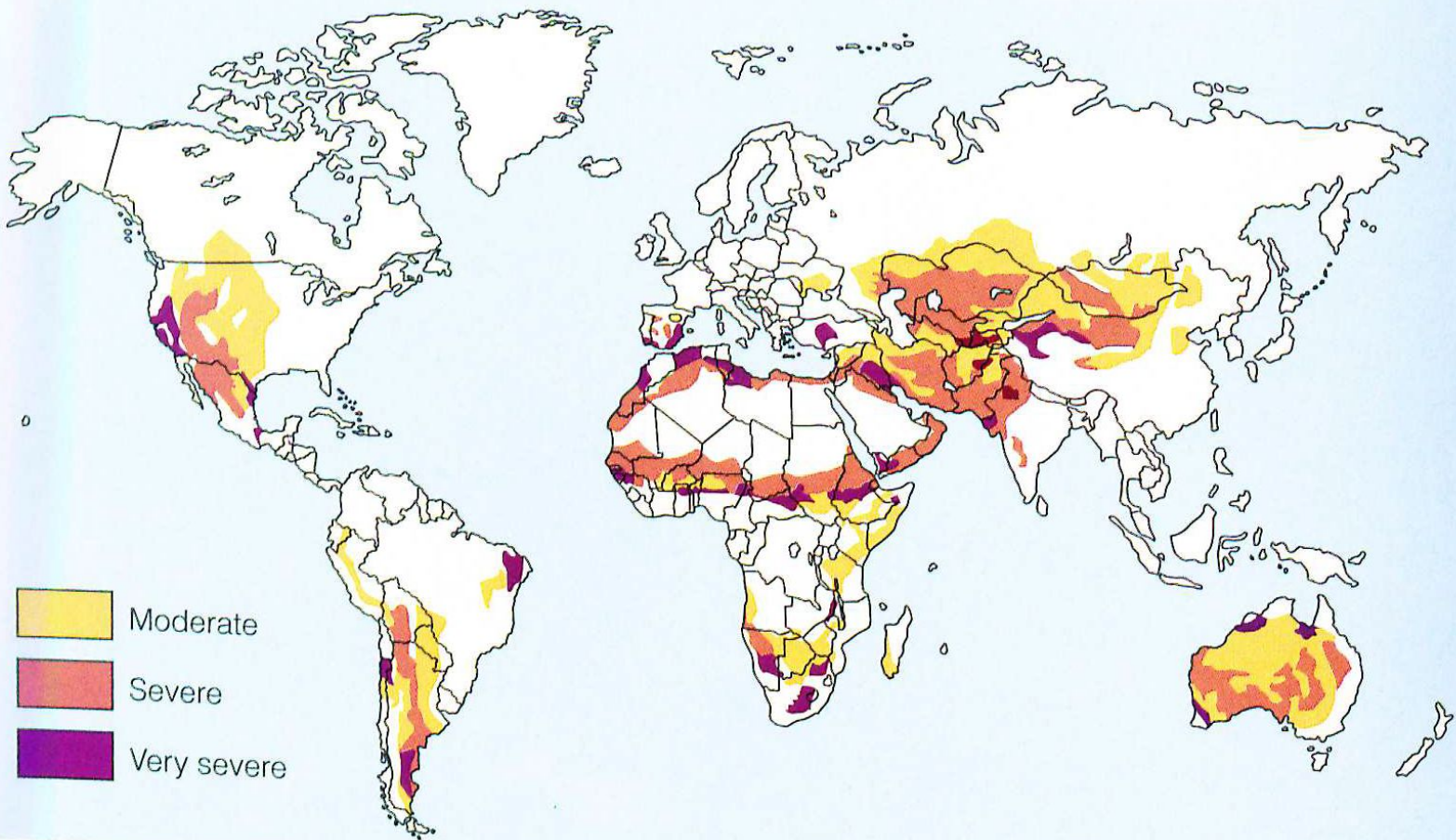
*Výskyt usazenin v Středozemním moři způsobený přenosem půdních částic z erodovaných polí ve vnitrozemí (Itálie)) (Zdroj: Agenzia per i Servizi nel Settore Agroalimentare delle Marche, Itálie)*



- Serious concern
- Some concern
- Stable or nonvegetative

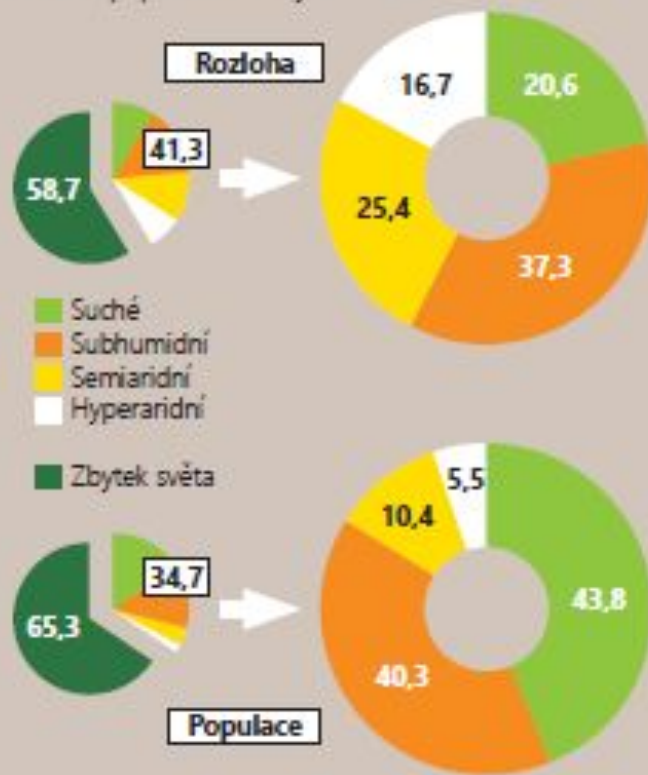
# Desertifikace

- ohroženo 70% suchých oblastí =  $\frac{1}{4}$  půd (Moldan 2015)
- Ekosystémy aridních a semiaridních oblastí –  $\frac{1}{3}$  zemského povrchu
- 90 % postižených oblastí leží v rozvojových zemích
- sociálně–ekonomické dopady – chudoba, hladomor (UNCCD udává 250 mil. ohrožených obyvatel)
- nejvíce ohrožená Afrika (pás Sahelu), problémy na všech kontinentech



## ČEKÁNÍ NA DĚŠŤ

Rozloha a populace v suchých oblastech na světě



# Přepásání

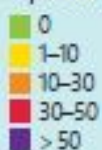
- Přímá příčina desertifikace
- Pastvina = obnovitelný zdroj X překročení kapacity pastviny
- Poškození pastviny
  - vodní a větrná eroze
  - zhutnění půdy
  - invaze určitých druhů
- Původně divoká zvířata; dnes dobytek na 42 % pastvin



## MIGRUJÍCÍ STÁDA NEJSOU PROBLÉMEM

Degradace půdy v suchých oblastech a pastevecký způsob chovu zvířat podle hlavních druhů, výběr

Ztráta úrodnosti  
půdy z důvodu  
lidských aktivit  
(odlesňování,  
kultivace, nadměrná  
pastva, sídla),  
v procentech



Skot   Ovce   Kozy   Velbloud jednohrbý   Velbloud dvouhrbý   Osli, koně   Jaci   Buvoli   Sobi   Lamy

# Zhutnění půdy (Kompakce)

- Vystavení povrchu půdy tlaku
  - využívání těžké techniky při hospodaření + orba za mokra
- Snížení pórovitosti, propusnosti a zvýšení objemové hmotnosti.
  - Nižší dostupnost vody a kyslíku → omezení kořenového růstu
- Zhutněná půda pojme méně vody → zrychluje se povrchový odtok
  - větší riziko povodní a záplav + zvýšení eroze.
- Snížená samočisticí schopnost půdy a její okyselování
- V takových půdách je potlačen život zhoršením vzdušného, vodního a teplotního režimu půdy.

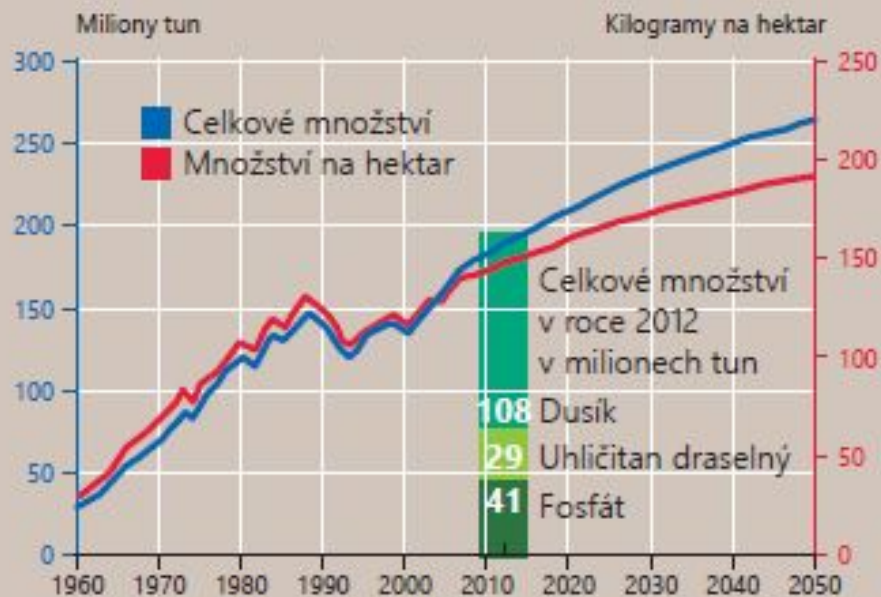


# Chemická degradace

- Ztráta živin a organického uhlíku, zasolování a znečištění půdy cizorodými škodlivými látkami (doprava, těžba)
- Zejména způsobena nadměrným hnojením, postřiky, pěstováním stále stejných plodin, atmosférická depozice
- Okyselování půd (kyselá dešť)
- Hromadění fosforu
- Pěstování bavlny
  - 10 % pesticidů + 25 % insekticidů
- Ohrožena převážná část půd světa - 3 mil. km<sup>2</sup> silně poškozeny

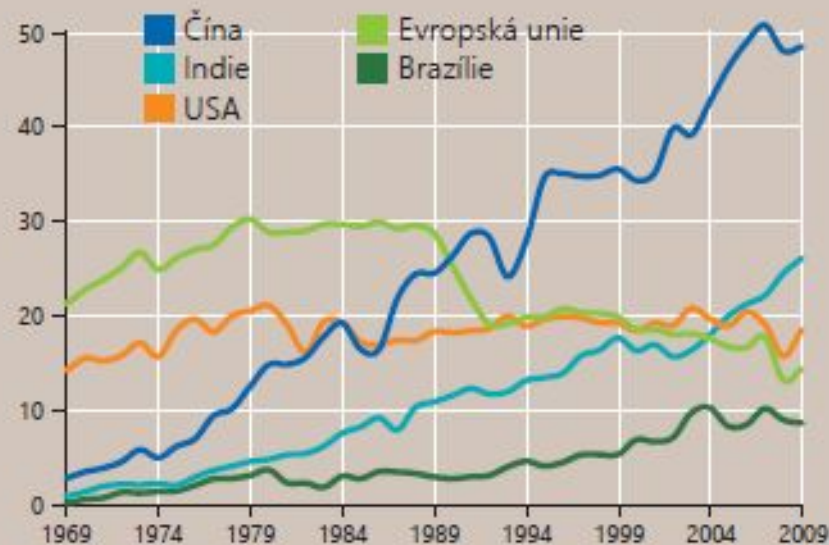
## NEUSTÁLÝ RŮST

Množství použitého hnojiva



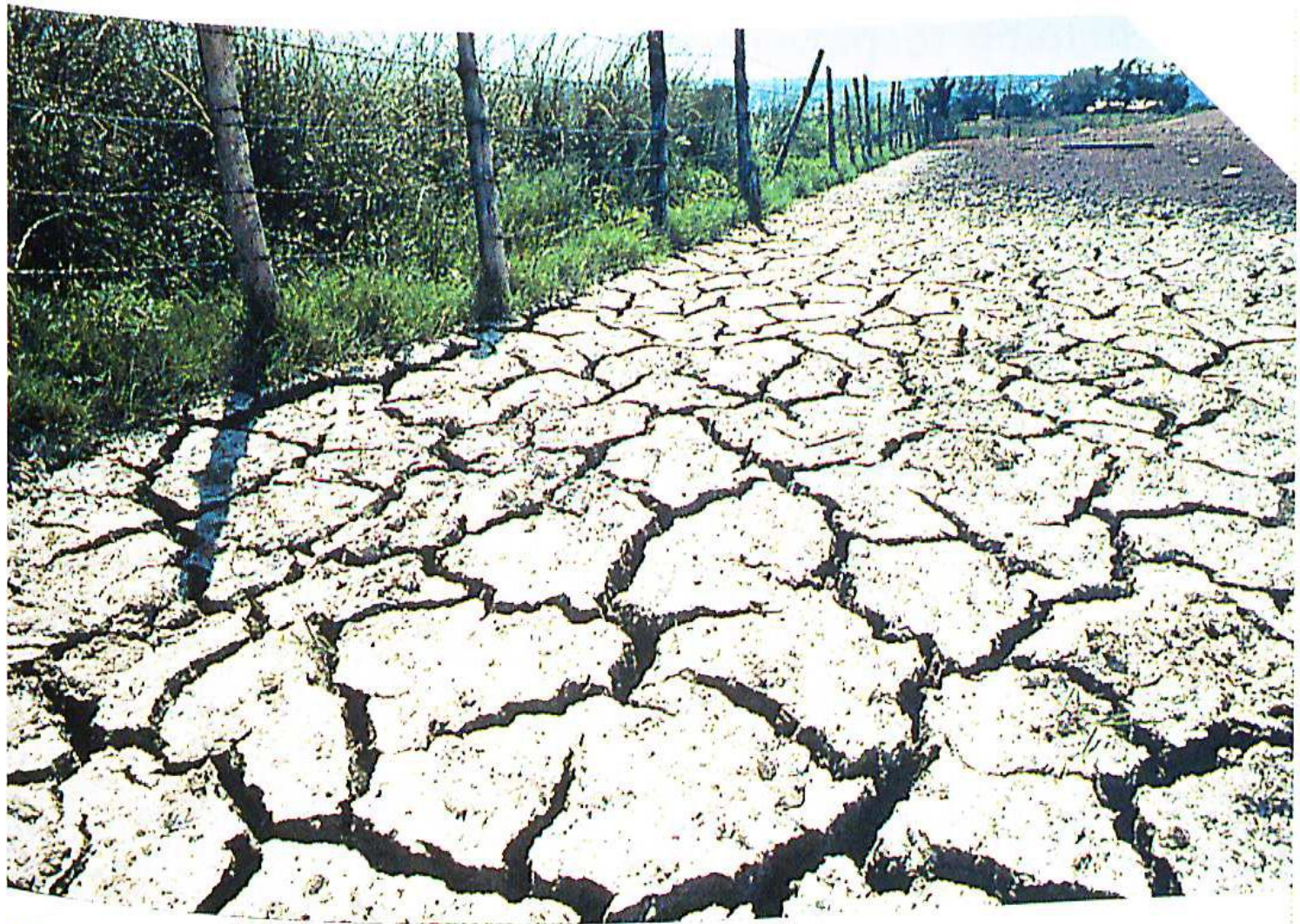
## BOOM HNOJIV POKRAČUJE

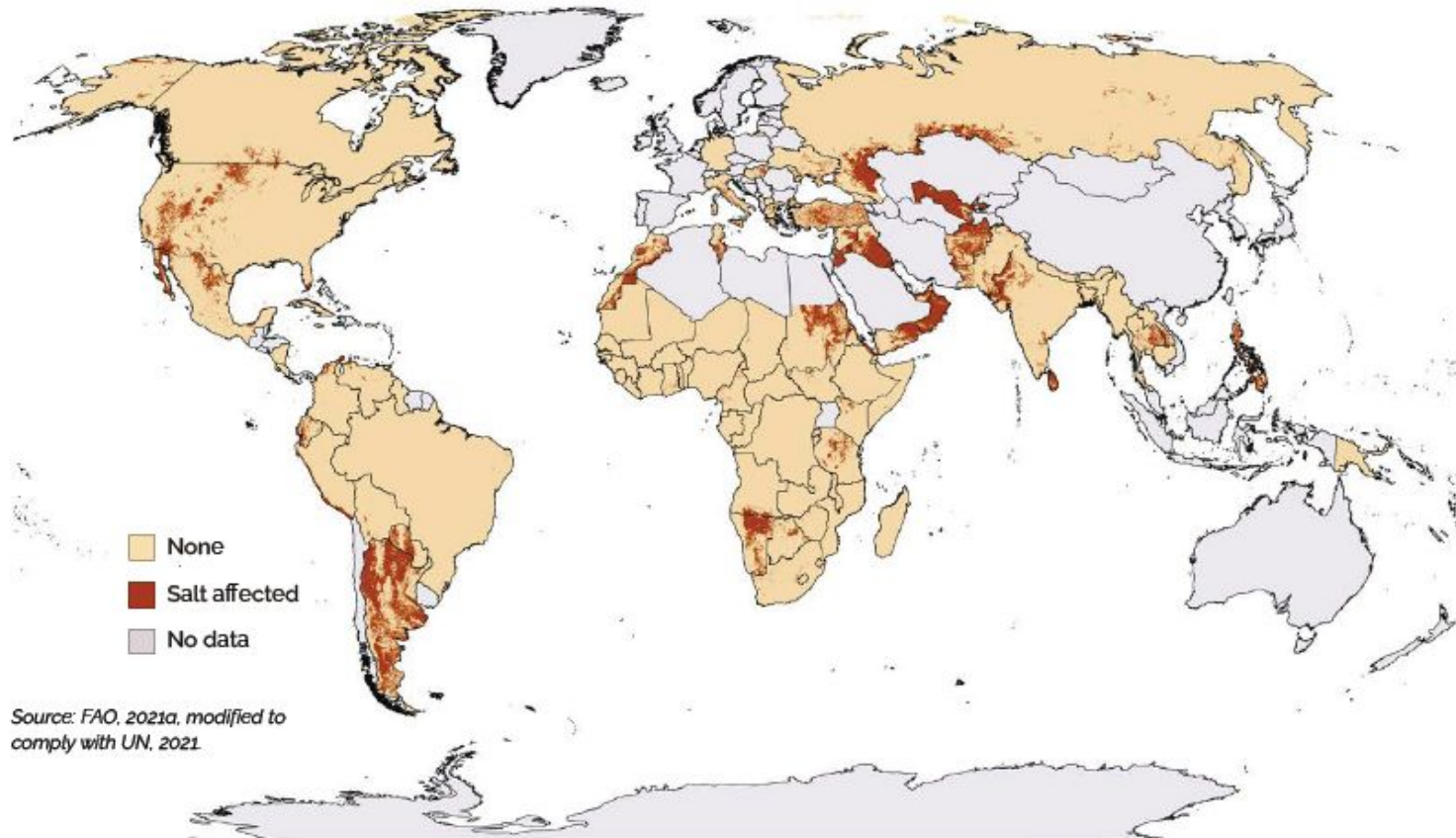
Použití minerálních hnojiv, miliony tun



# Zasolování a podmáčení půd

- při zavlažování zemědělsky využívaných ploch
  - 20% zem. půd je zavlažováno = 45 % světové produkce
  - po odpaření vody soli a jiné látky zůstávají v půdě
- zpomalení růstu rostlin, nižší výnosy, poškození půdy
- UN: do 2020  $\frac{1}{3}$  obdělávané půdy degradována zasolením
- Čína, Indie, Egypt, Pakistan, Mexiko, Austrálie, Irák
- Snahy sůl vypláchnout - problém podmáčení
  - slaná voda se akumuluje v podzemí + úhyn rostlin
- Snížení úrody - 10 % zasolování + 10 % podmáčení
- Salinita půdy každý rok vyřadí z produkce až 1,5 milionu ha orné půdy





Zdroj: FAO. 2021

Source: FAO, 2021a, modified to comply with UN, 2021.



# Těžba a degradace půdy

- Povrchová těžba X Podzemní (hlubinná) těžba
- Zamoření okolní půdy těžkými kovy a chemikáliemi skrze kontaminovanou vodu (např. Ajka)
- Těžební procesy → nesmírné množství vody k oddělení hodnotných kovů či nerostů od písku či kamene za vzniku hlušiny
- Úniky jedovatých látek a likvidace biotopů
  - vliv na kvalitu života obyvatel, krajiny i na druhovou rozmanitost. (např. těžba tantalové rudy vedla k obrovským propadům v populacích goril).
- Při těžbě může docházet k vystavení nezdravým dávkám radioaktivity (např. kontaminace pitné vody a půdy v Nigeru)

Figure 7.4 Global assessment of the four main threats to soil by FAO regions.

The first main threat is the most severe threat in a region, the second main threat is the second-most severe and so forth.  
Source: Montanarella *et al.* (2016).

1<sup>ST</sup> MAIN THREAT



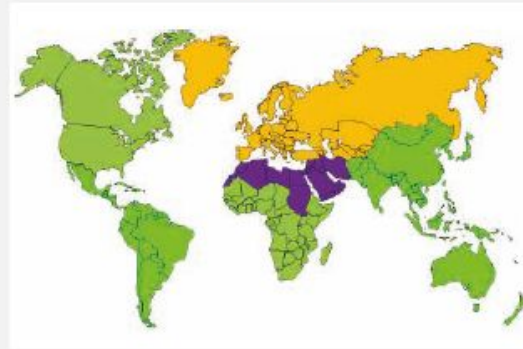
2<sup>ND</sup> MAIN THREAT



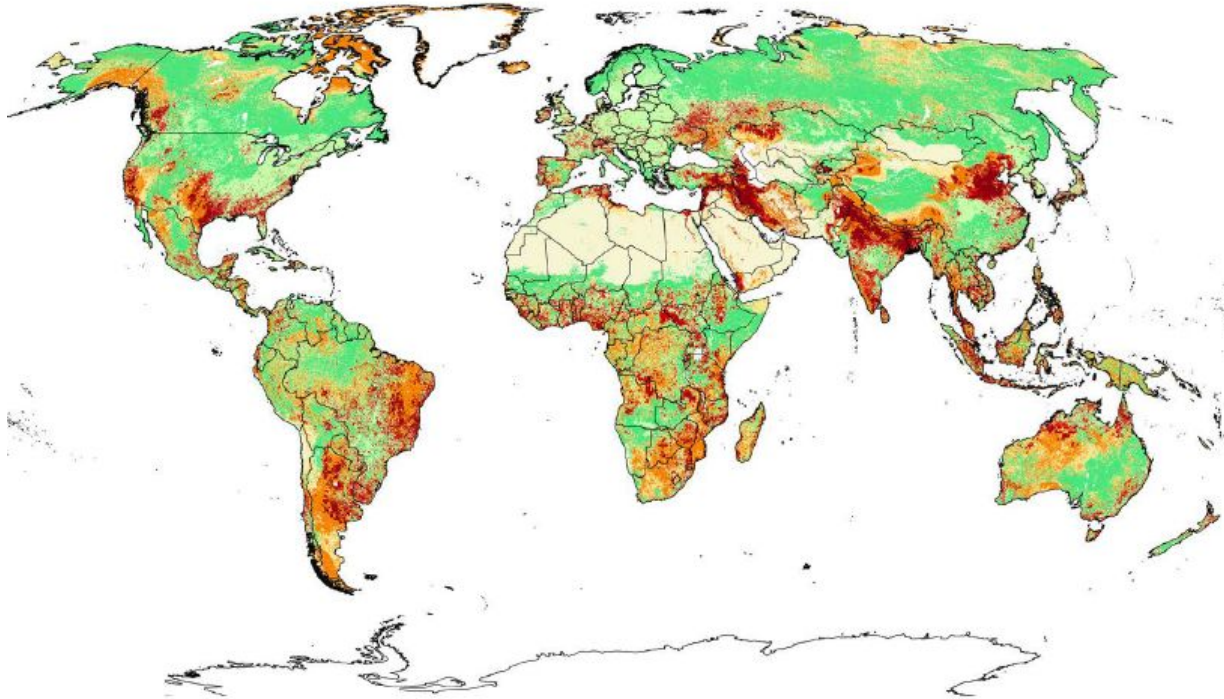
3<sup>RD</sup> MAIN THREAT



4<sup>TH</sup> MAIN THREAT



Zdroj: IPBES.  
*The assessment report on Land Degradation and Restoration.*  
2018.



*Note: Global distribution of land degradation. Overall trend combined with cumulative pressure by direct human drivers. Human-induced land degradation refers to a negative trend, which is caused by human activity. Deterioration refers to a negative trend caused by natural phenomena, or by human action where status is low.*

*Source: Coppus, forthcoming, modified to comply with UN, 2021.*

TABLE S.2

## EXTENT OF HUMAN-INDUCED LAND DEGRADATION, 2015 (MILLION ha)

DEGRADATION	GLOBAL	DRYLANDS	HUMID AREAS
<b>Total</b>	1 660	733	927
<b>Strong</b>	850	418	432
<b>Light</b>	810	315	495

*Note: Antarctica, Greenland and land with more than 90 percent bare cover (the great deserts) are excluded. For humid areas, the cold zone where potential evapotranspiration is greater than 400 is also excluded.*

*Source: Coppus, forthcoming.*

Zdroj: FAO. 2021

Table 7.1: People living on degraded agricultural land (DAL): Adapted from<sup>247</sup>

	share of rural population on DAL in 2000	change from 2000 to 2010 of rural population on DAL	share of rural population on remote DAL	change from 2000 to 2010 of rural population on remote DAL
Developed Countries	17.9%	-2.8%	0.8%	-1.8%
Developing Countries	32.4%	+13.3%	5.5%	+13.8%
East Asia & Pacific	50.8%	+8.4%	9.0%	+6.8%
Europe & Central Asia	38.5%	+1.0%	3.6%	+4.4%
Latin America & Caribbean	13.0%	+18.4%	1.9%	+17.1%
Middle East & North Africa	22.3%	+14.3%	2.8%	+5.9%
South Asia	26.2%	+17.8%	2.5%	+18.9%
Sub-Saharan Africa	20.6%	+37.8%	5.8%	+39.3%
<b>World</b>	<b>34.0%</b>	<b>12.4%</b>	<b>5.0%</b>	<b>+13.6%</b>

Zdroj:  
UNCCD.  
*Global Land  
Outlook.*  
2017

LAND COVER	TOTAL AREA (MILLION ha)	DEGRADATION (MILLION ha)	DETERIORATION (MILLION ha)	STABLE (MILLION ha)	DEGRADED (%)	DETERIORATED (%)	STABLE (%)
<b>Cropland</b>	1 527	479	268	780	31	18	51
<b>Rainfed</b>	1 212	340	212	660	28	17	54
<b>Irrigated</b>	315	139	57	120	44	18	38
<b>Grassland</b>	1 910	246	642	1 022	13	34	54
<b>Trees</b>	4 335	485	1 462	2 388	11	34	55
<b>Shrubs</b>	1 438	218	584	636	15	41	44
<b>Herbs</b>	203	16	51	136	8	25	67
<b>Sparse vegetation</b>	1 034	85	499	450	8	48	44
<b>Protected area</b>	880	76	361	443	9	41	50

Note: The term degradation refers to high pressures from anthropogenic drivers. All other declines in biophysical status are defined as deterioration.

Source: Coppus, forthcoming.

TABLE S.3	EXTENT OF HUMAN-INDUCED LAND DEGRADATION BY REGION, 2015					
CONTINENT/ REGION	AREA AFFECTED BY HUMAN- INDUCED DEGRADATION (MILLION ha)	TOTAL LAND AREA OF REGION (MILLION ha)	PERCENTAGE OF REGION AFFECTED (%)	STRONGLY DEGRADED (MILLION ha)	SLIGHTLY DEGRADED (MILLION ha)	
<b>Sub-Saharan Africa</b>	330	2 413	14	149	181	
<b>Southern America</b>	281	1 778	16	153	128	
<b>South Asia</b>	180	439	41	126	54	
<b>Northern America</b>	177	2 083	8	82	95	
<b>East Asia</b>	156	1 185	13	84	72	
<b>Western Asia</b>	123	615	20	92	31	
<b>Southeast Asia</b>	122	501	24	74	48	
<b>Australia and New Zealand</b>	94	796	12	34	59	
<b>Eastern Europe and Russian Federation</b>	83	1 763	5	21	62	
<b>Western and Central Europe</b>	56	489	11	12	44	
<b>Central Asia</b>	31	456	7	12	19	
<b>Northern Africa</b>	22	579	4	9	13	
<b>Central America and Caribbean</b>	11	76	14	5	5	
<b>Pacific Islands</b>	0.14	7	2	0.11	0.03	
<b>World</b>	<b>1 660</b>	<b>13 178</b>	<b>13</b>	<b>850</b>	<b>810</b>	
<b>High income</b>	393	3 817	10	175	218	
<b>Upper middle income</b>	621	5 604	11	326	295	
<b>Lower middle income</b>	428	2 207	19	241	187	
<b>Low income</b>	220	1 520	14	107	112	
<b>Low income and food deficit</b>	283	2 062	14	133	149	
<b>Least developed</b>	288	2 097	14	134	154	

Note: Percentage of region affected refers to the portion of the total regional extent that is degraded. Antarctica, Greenland and land with more than 90 percent bare cover (the great deserts) are excluded.

Source: Coppus, forthcoming.

# Aktivita

## Řešení problémů s degradací půdy

- Eroze
- Desertifikace a přepásání
- Zhutnění půd (Kompakce)
- Zasolování a podmáčení půd
- Chemická degradace



c



a



d

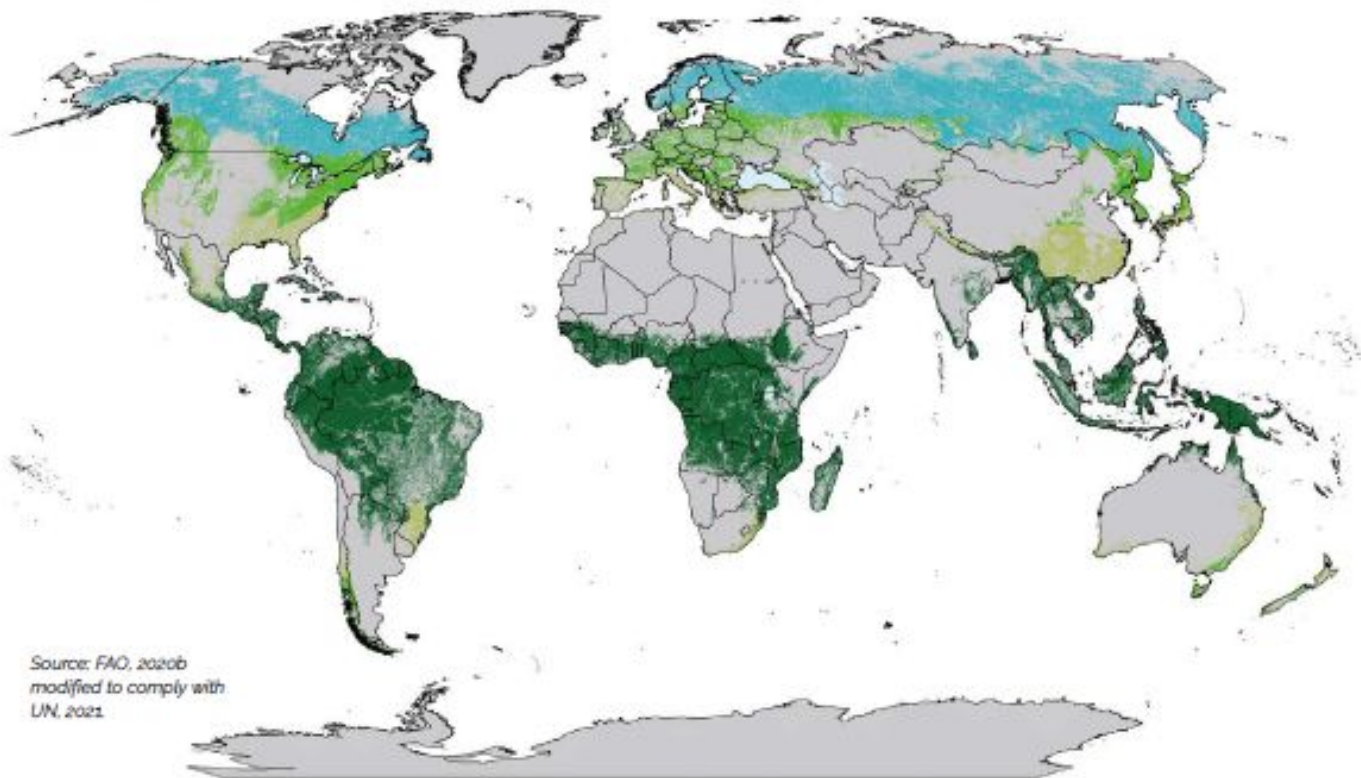


b

# Lesy a jejich využití. Deforestace

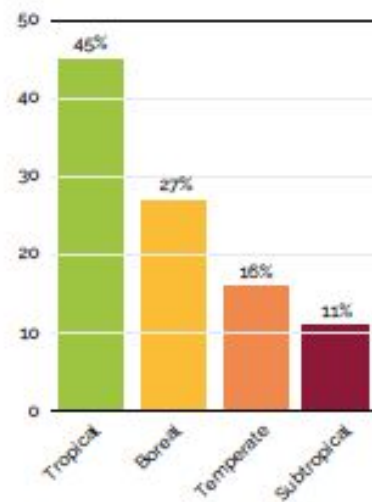


■ Boreal ■ Temperate ■ Subtropical ■ Tropical



Source: FAO, 2020b  
modified to comply with  
UN, 2021

Proportion and distribution of  
global forest area by climatic  
domain, 2020 (%)

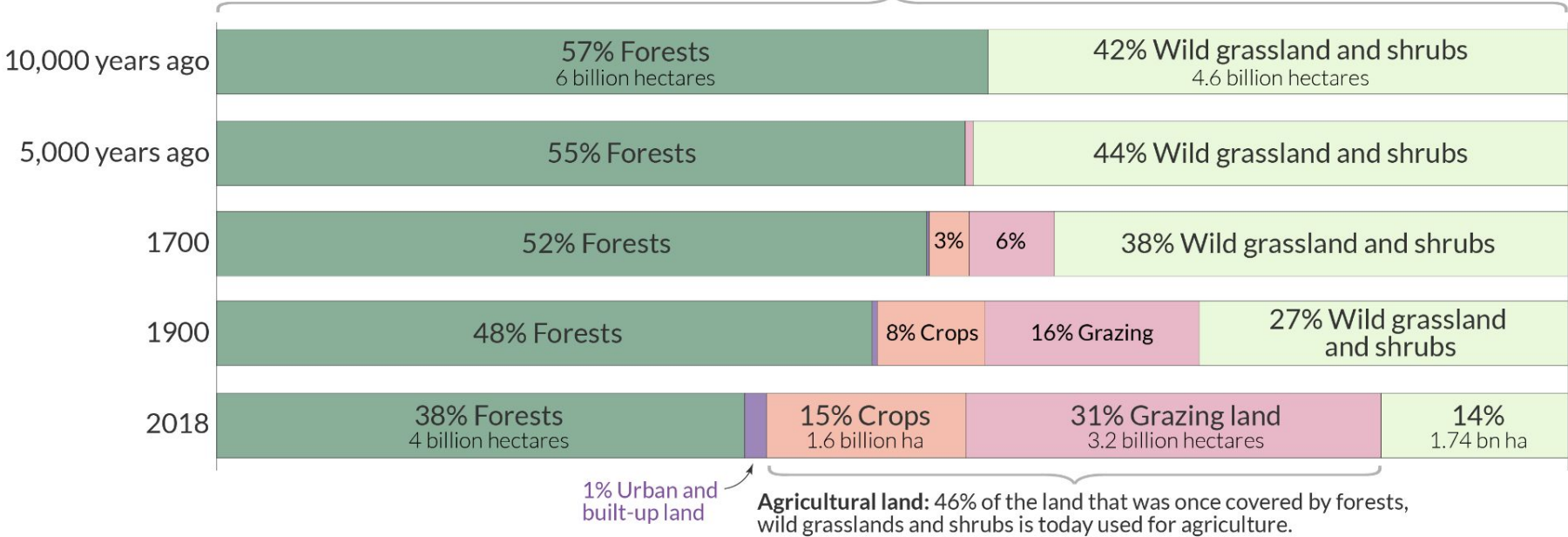


Zdroj: FAO. 2021.

# Humanity destroyed one third of the world's forests by expanding agricultural land

Agriculture is by far the largest driver of deforestation. To bring deforestation to an end humanity has to find ways to produce more food on less land.

10,000 years ago, 10.6 billion hectares — 71% of the earth's land surface — were covered by forests, shrubs, and grasslands. The remaining 29% are covered by deserts, glaciers, rocky terrain and other barren land.



Data: Historical data on forests from Williams (2003) - Deforesting the Earth. Historical data on agriculture from The History Database of Global Environment (HYDE). Modern data from the FAO.

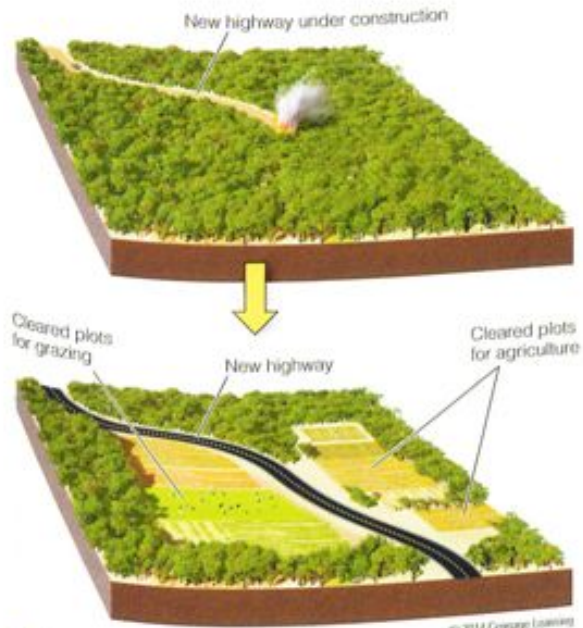
## LAND AREA BY MAJOR LAND-USE CLASS, 2010



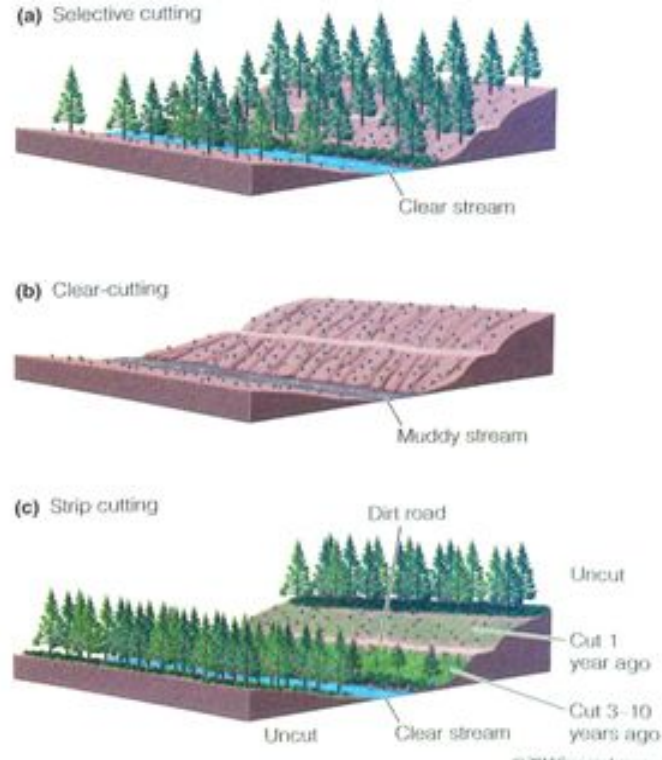
Note: "Other land" is all land not categorized as agricultural or forest land.

SOURCE: FAO, 2015a, 2016a.

# Degradace lesů *(Spoolman, Myers)*



**FIGURE 9.25** Building a road into a previously inaccessible forest can harm the forest ecosystem.



# Deforestation *(Spoolman, Myers)*

- Extenzivní kácení a vypalování lesů za účelem vytvoření ploch pro pěstování plodin, chov dobytka, pro dopravu a rozšiřování sídel a pro těžbu surovin
- Důsledky:
  - Eroze svrchní lesní půdy - zamezuje obnovení lesů
  - Znečištění ovzduší a vod
  - Růst rizika povodní, požárů
  - Ničení a degradace (na nižší úroveň) habitatů pro stovky a tisíce druhů
  - Fragmentace habitatů - snižuje možnosti migrace, obživy či péče o mláďata pro mnohé druhy, “rozplétá” propojené ekosystémové služby.

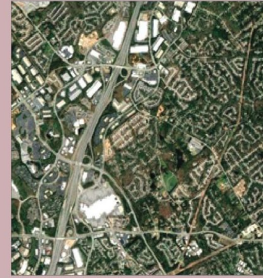
## Deforestation

Complete removal of trees for the conversion of forest to another land use such as agriculture, mining, or towns and cities. It results in a permanent conversion of forest into an alternative land use. The trees are not expected to regrow.



### Commodity-driven deforestation

Conversion of forests to other land uses such as agriculture (including oil palm and cattle ranching), mining, or energy infrastructure.



### Urbanization

Conversion of forests to towns, cities and urban infrastructure such as roads.

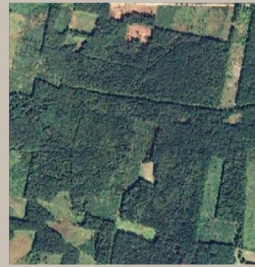
## Forest Degradation

Thinning of the canopy - a reduction in the density of trees in the area - but without a change in land use. The changes to the forest are often temporary and it's expected that they will regrow.



### Shifting agriculture

Small-scale clearance of forest for subsistence, slash-and-burn farming.



### Forestry products

Logging and management of forests for products such as timber, paper and pulp.



### Wildfires

Natural fires, or management through deliberate burning.

# Deforestation

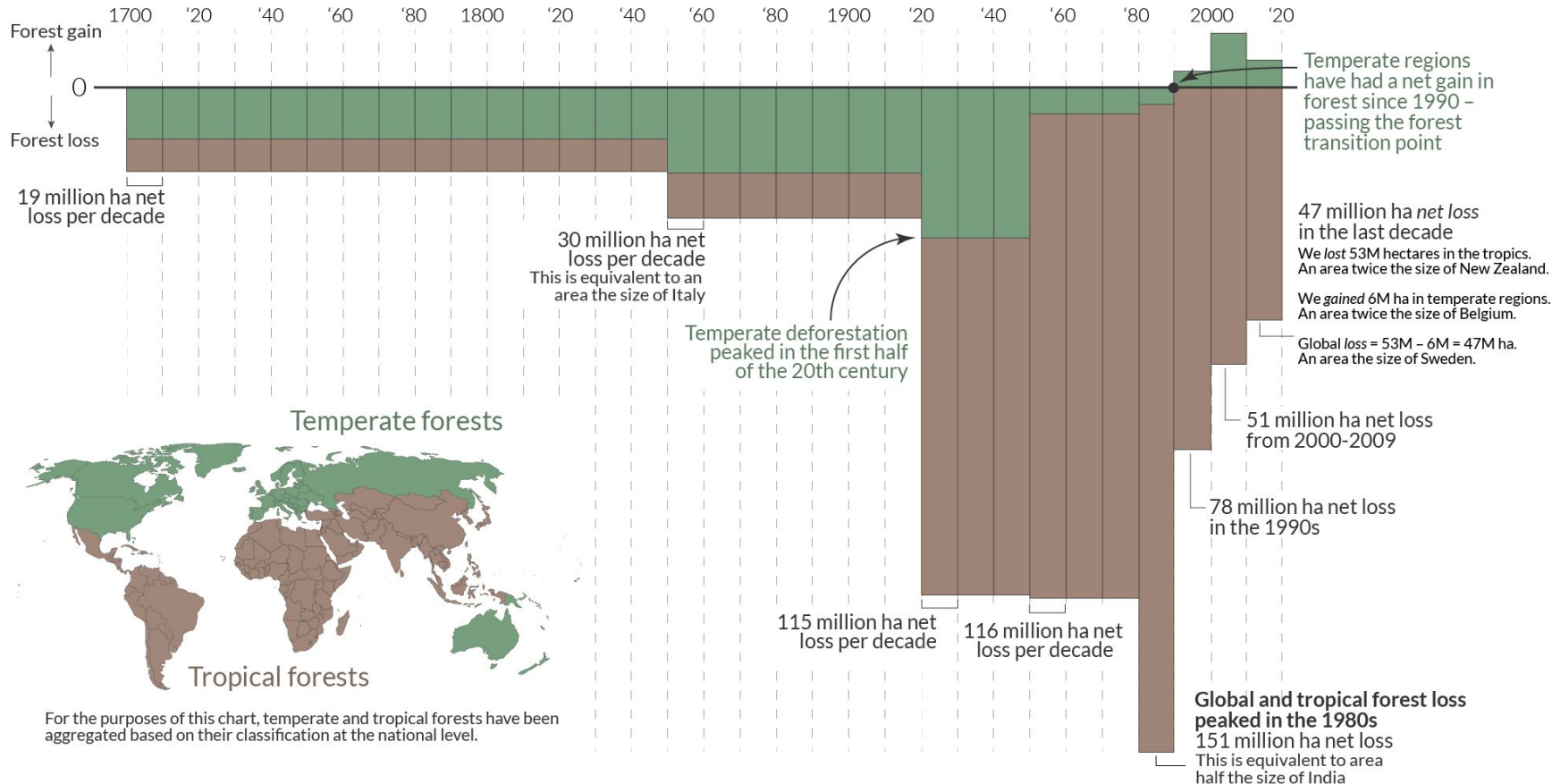
- Historie lidstva - zmenšení rozlohy o 40 % (antropocén =  $\frac{3}{4}$ )
- Dlouhodobý vliv lidí
  - za 8000 let člověkem odstraněna  $\frac{1}{2}$  původních lesů
- 70 % lesů - ohroženo degradací
- Změna tempa a lokality deforestation
  - před 20. stol. lesy mírného pásma (Asie, Sev. Ame., Evropa)
  - od pol. 20. stol. tropické země (Brazílie, Indonesie)
  - Problém biodiverzity

# Decadal losses in global forest over the last three centuries

Decadal forest loss is measured as the average net loss of forest area every ten years, in hectares.

This equals deforestation minus any increases in forest area through afforestation.

1.5 billion hectares of global forest was lost between 1700 and 2020 – this is equal to an area 1.5-times the size of the USA.



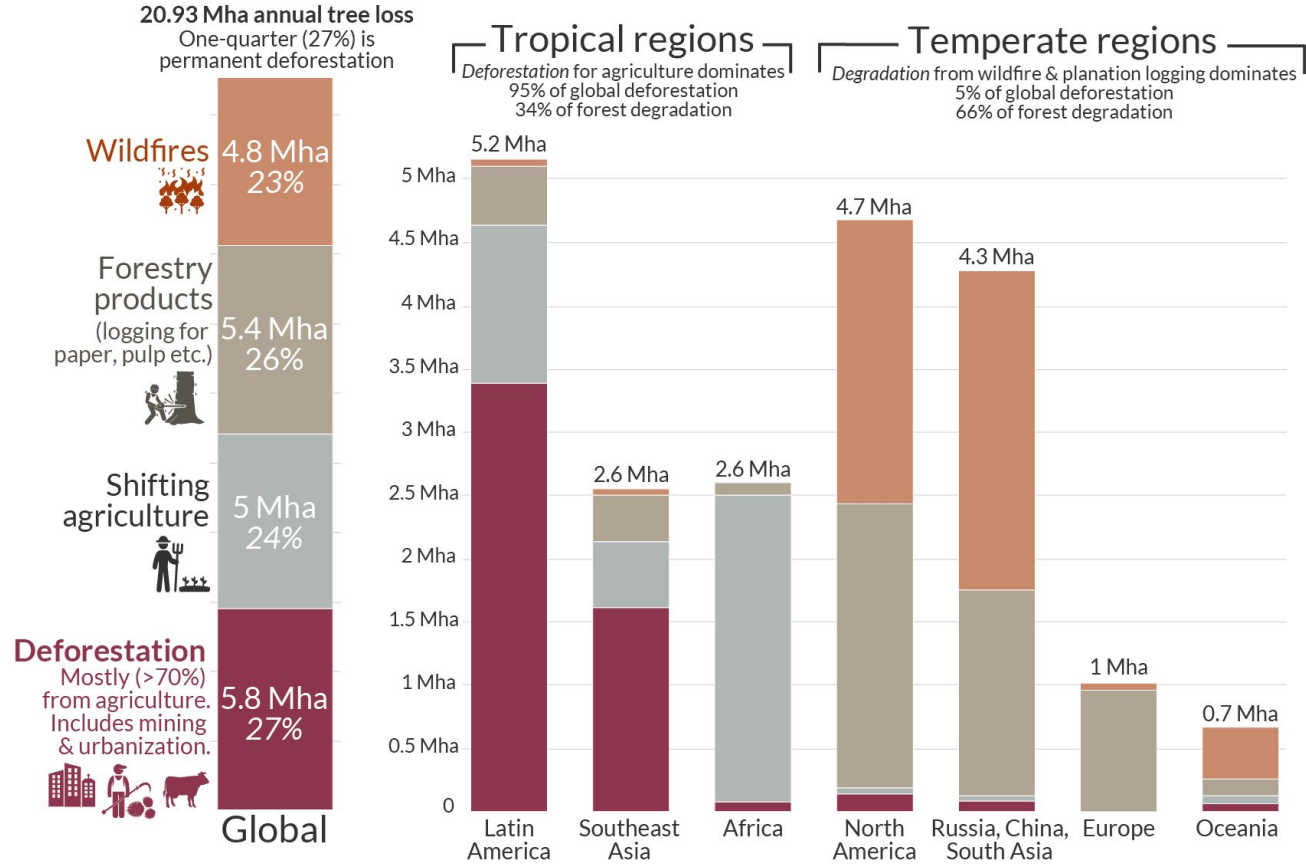


# Global forest loss: deforestation vs. forest degradation

Forest loss is defined as the combination of deforestation and forest degradation.

*Deforestation* involves the abrupt transition from land with trees to land without trees with no subsequent regrowth.

*Forest degradation* refers to thinning of the canopy and loss of carbon without a change in land use. Forest is expected to regrow.



Data source: Philip Curtis et al. (2018). Classifying drivers of global forest loss. *Science*.  
OurWorldinData.org – Research and data to make progress against the world’s largest problems.

Licensed under CC-BY by the author Hannah Ritchie.

**FIGURE 4**  
**GLOBAL FOREST EXPANSION AND DEFORESTATION, 1990–2020 (MILLION HECTARES PER YEAR)**



SOURCE: FAO, 2020.

**TABLE 1**  
**ANNUAL RATE OF FOREST AREA CHANGE**

Period	Net change (million ha/year)	Net change rate (%/year)
1990–2000	-7.84	-0.19
2000–2010	-5.17	-0.13
2010–2020	-4.74	-0.12

SOURCE: FAO, 2020.

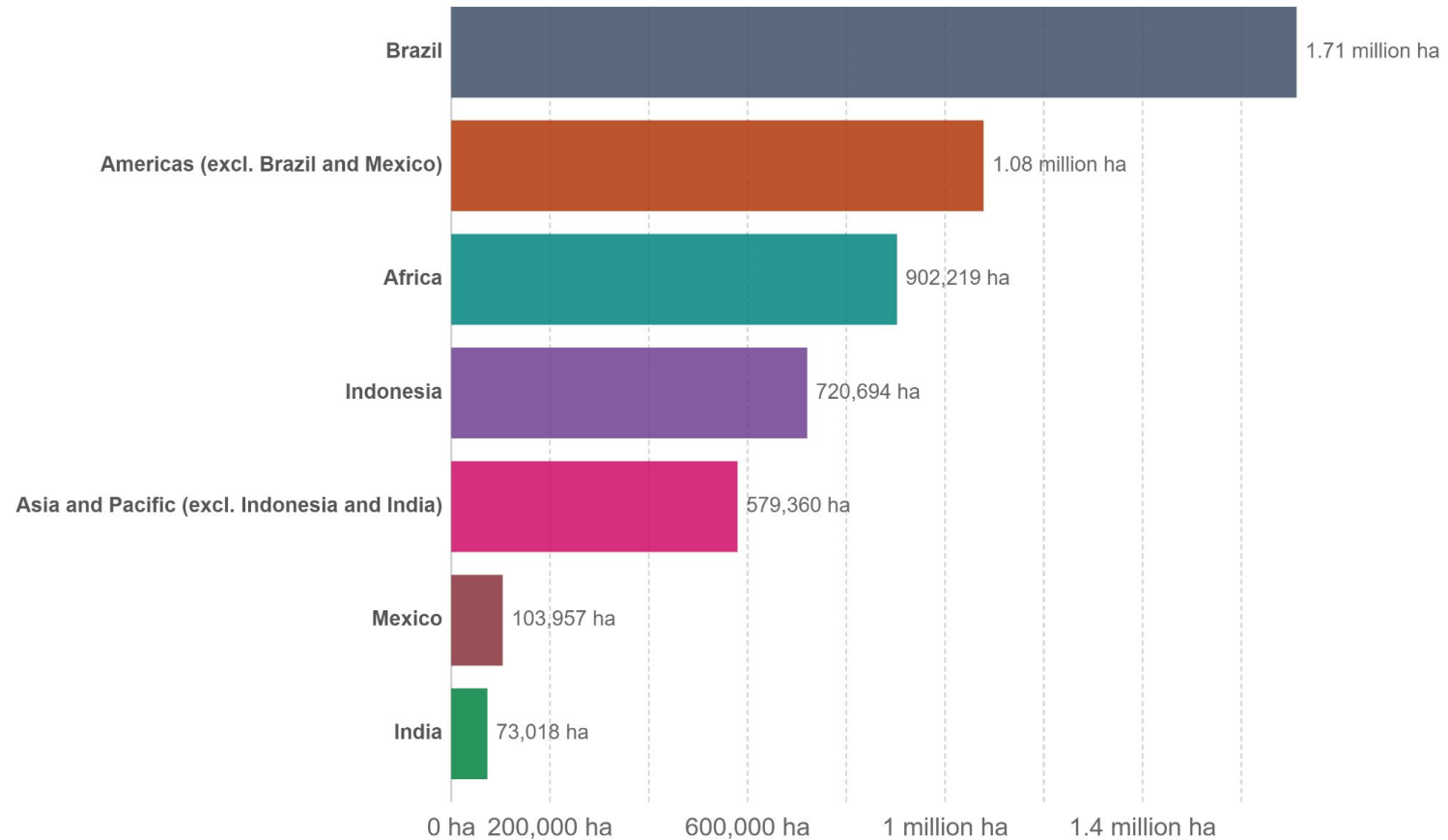
FIGURE 2  
NET FOREST AREA CHANGE BY REGION, 1990–2020 (MILLION HECTARES PER YEAR)



SOURCE: FAO, 2020.

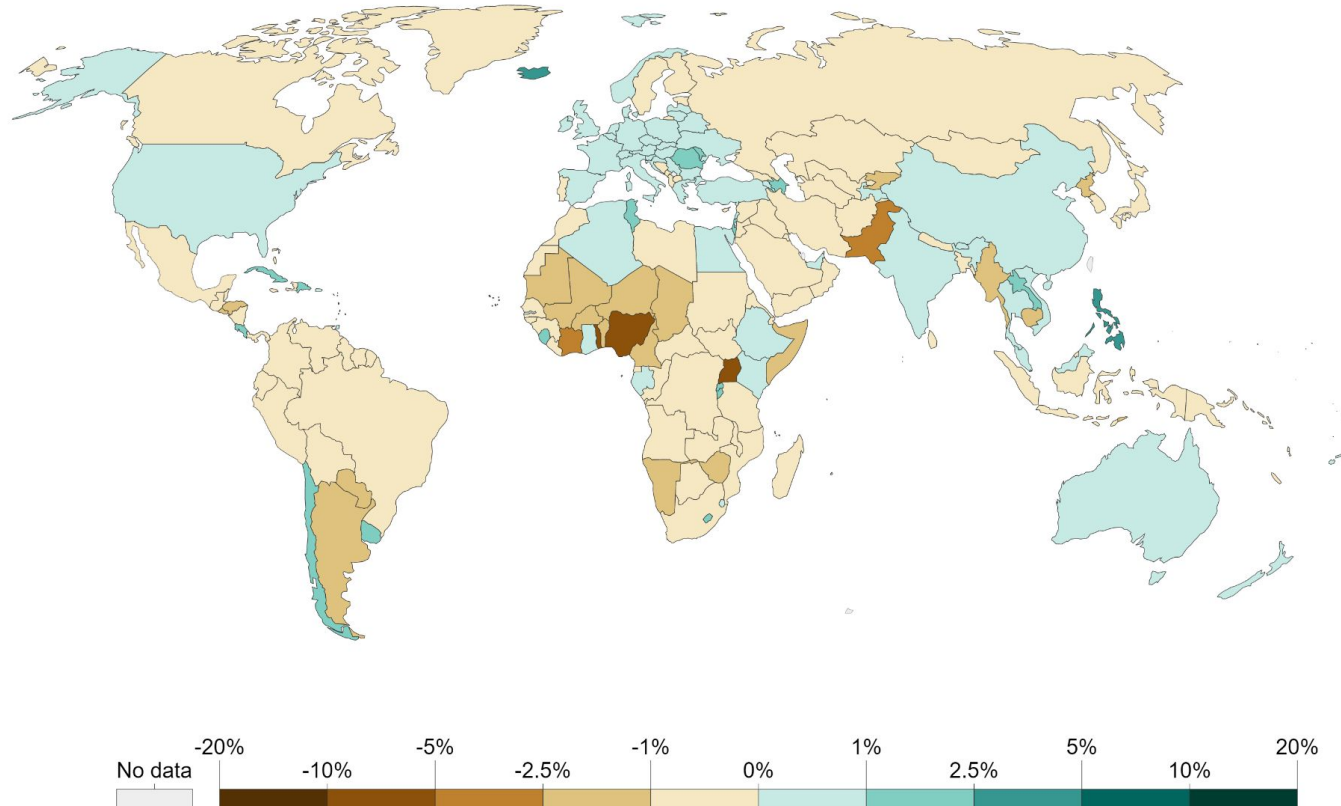
# Annual deforestation by region

Annual deforestation is measured as the average between 2010 and 2014, and is measured in hectares.



# Annual change in forest area, 2015

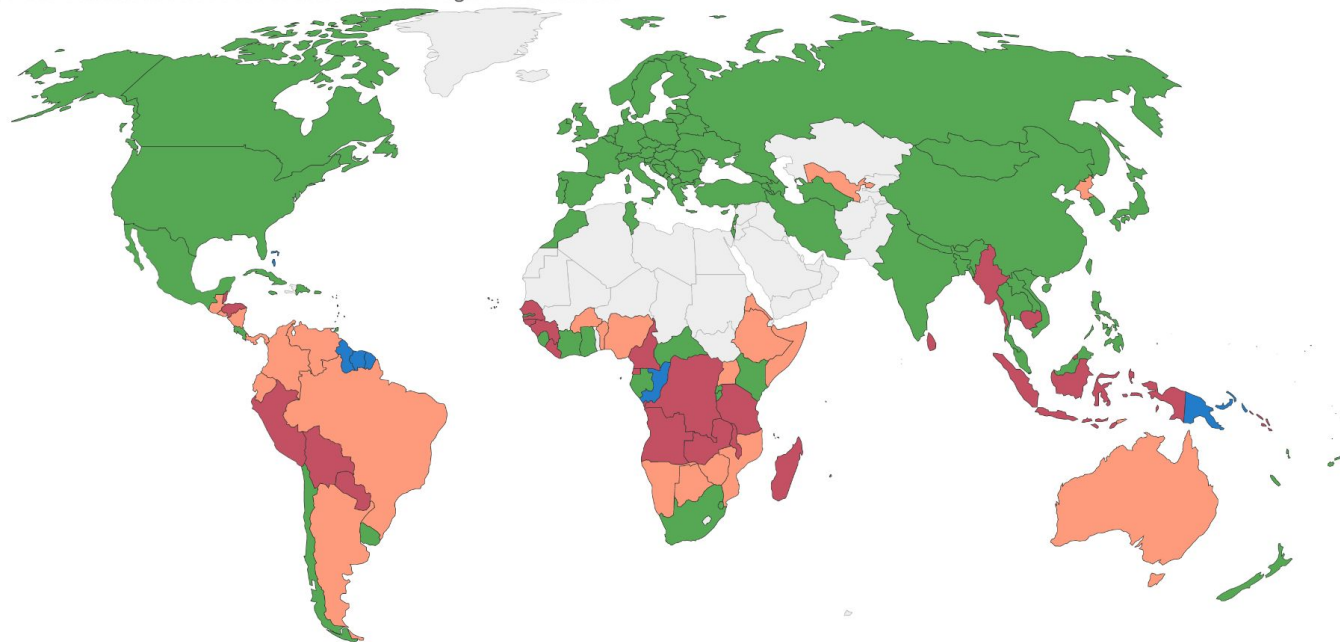
Forest area net change rate measures the annual net change in forested area, as a percentage of total forest area. Negative values indicate a net loss of forest, and positive values a net gain.



# Forest Transition Phase, 2013

Countries are grouped into four forest transition phases which tend to represent a sequence of development.

- (1) Pre-transition: high forest cover and low deforestation rates;
- (2) Early-transition: forests lost at an increasingly rapid rate;
- (3) Late-transition: small fraction of remaining forest but slowing of deforestation;
- (4) Post-transition: forest cover increases through reforestation.



■ Early Transition ■ Late Transition ■ Post-Transition ■ Pre-transition ■ No data

Source: Pendrill, F., Persson, U. M., Godar, J., & Kastner, T. (2019). Deforestation displaced: trade in forest-risk commodities and the prospects for a global forest transition. *Environmental Research Letters*, 14(5), 055003.

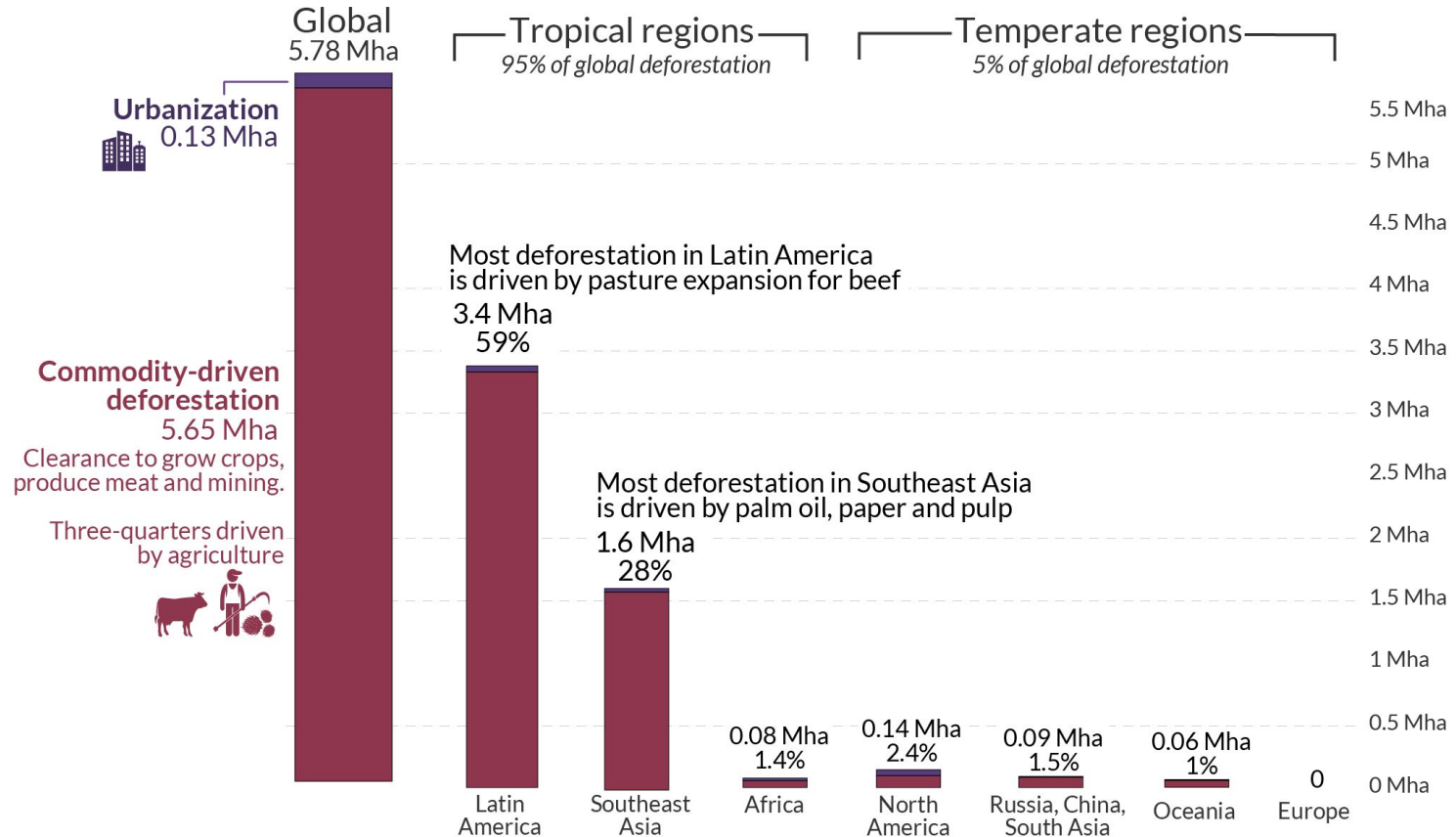
OurWorldInData.org/forests • CC BY

# Důsledky lidské činnosti

- Při současném tempu deforestace bude do roku 2030 odlesněno dalších 40 % zůstávajících nedotknutých lesů !
- Původní tropické lesy mizí nejrychleji, ročně ubývá 10-15 mil. ha.
  - Většina tropických deštných pralesů zmizne nebo bude zásadně poškozena v průběhu 20 - 40 let
- 25 zemí - lesy úplně zmizely, v 29 dalších až 90 %
- SAm a Evropa – zvětšují se lesní plochy, ale v minulosti byl velký úbytek. Nové lesy často jen málo připomínají původní lesy.
- Zhoršení kvality lesních ekosystémů
  - fragmentace, imise, eutrofizace, změna klimatu

# Nearly all of global deforestation occurs in the tropics

Deforestation is the permanent conversion of forest to another land use (such as agriculture or urban land). This is distinct from forest degradation – the logging of managed tree plantations, or wildfires – which is a temporary thinning of the canopy, and forests are expected to regrow.





# Tropické deštné lesy

- 2 % plochy Země, 50 % ze všech druhů rostlin a zvířat pevniny
- Polovina je již odlesněná či zničena (většina po 1950)
- Až ¼ druhů zde může vyhynout do konce 21. stol.
- Kromě přímého odlesňování jsou ovlivněny i klimatickými procesy. Např. [Amazonský prales](#) se díky postupnému vysychání (méně lesa = méně srážek) a oteplování půdy postupně mění na savanu → tou se většinově může stát již v roce 2080.
- Odlesňování vysušuje půdu a vrchní vrstva tak může být odplavena, nebo → odfouknutá stává se tropickou savanou, nebo pouští
- Ztráta ekosystémových služeb

# 80% of deforestation between 2010 and 2030 is likely to happen in just 11 places. These are the "deforestation fronts." (WWF)

Figure 4 37 Areas where the bulk of global deforestation is expected to take place from 2010 to 2030, under business-as-usual scenarios (see Section 4.1.3) and without interventions to prevent losses.

The 11 regions where the losses are expected to be greatest are circled. Source: WWF (2015).



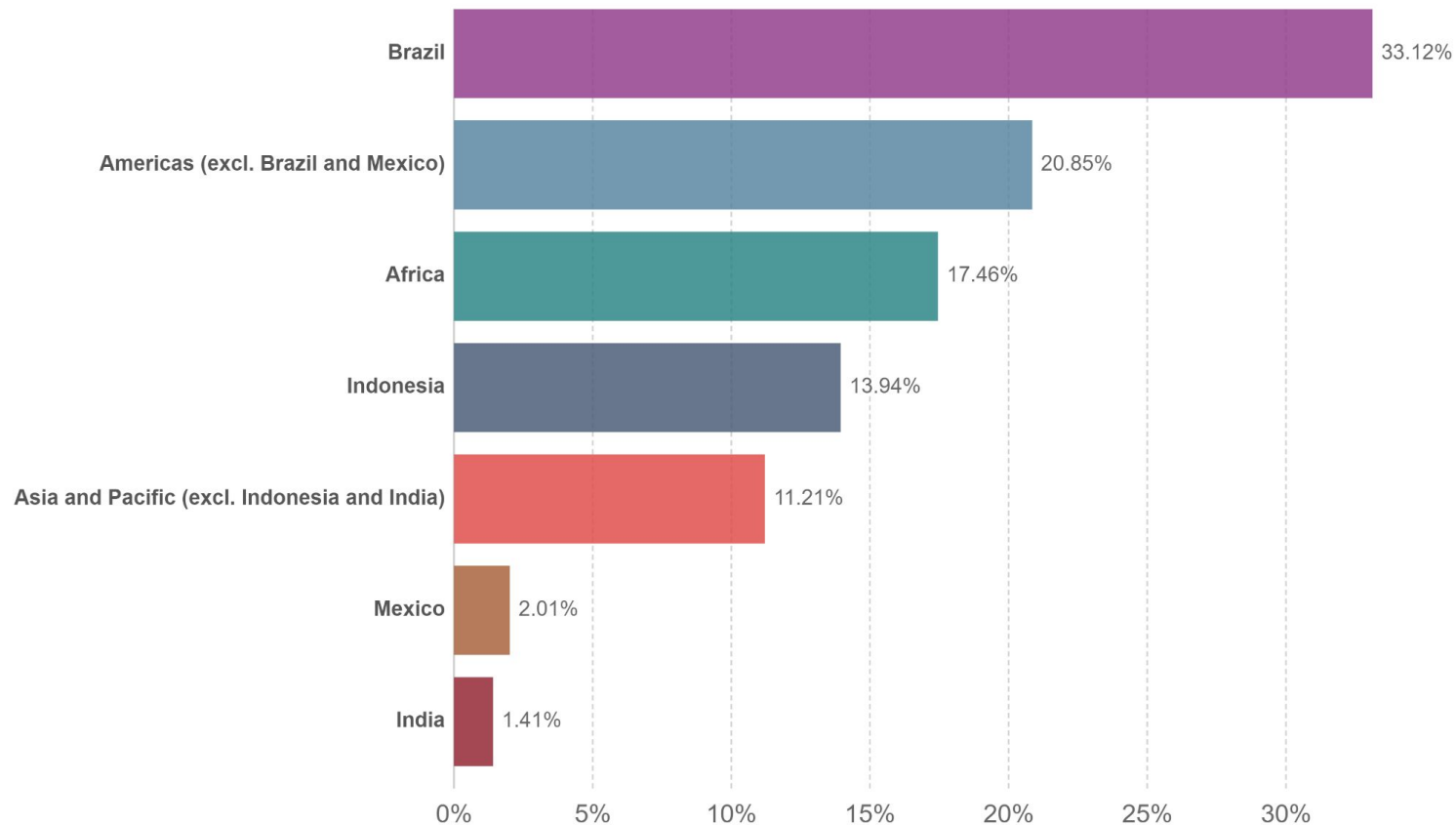
Deforestation Front	Projected loss in millions of hectares by 2030
Amazon	23-48
Chocó-Darién	3
Cerrado	11
Atlantic Forest/Gran Chaco	-10
Congo Basin	12
Coastal forest of East Africa	12
Borneo	21.5
Sumatra	5
New Guinea	7
Greater Mekong	15-30
Australia	6
<b>Total from 11 deforestation fronts</b>	<b>136.5-176.5</b>

FOREST

DEFORESTATION FRONTS + PROJECTED DEFORESTATION, 2010-2030

# Share of tropical deforestation

Share of tropical deforestation from commodity production – this includes forest clearance for croplands, pasture and tree plantations for logging. It's measured as the annual average between 2010 and 2014.



# Příčiny deforestace

- **5F** Food, Feed, Fibre, Fuel, Forest Products
- Do 2050 - potřeba o 70 % více jídla (živočišné produkty)
- Přímé příčiny
  - Rozvoj infrastruktury; Expanze zemědělství; Těžba dřeva
- Základní příčiny
  - Demografická změna; Ekonomický rozvoj; Technologické změny; Politiky a instituce; Kulturní změny
- Před 1990 - státem řízená deforestace (vnitřní kolonizační programy)
- Po 1990 - podnikově řízená deforestace (dopyt po komoditách)

# Příčiny deforestace

## Typický průběh odlesnění:

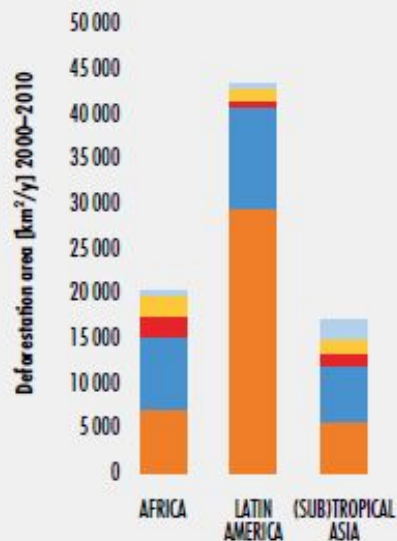
- Těžba dřeva → Pasterectví → Zemědělství a produkce biopaliv → přesun dál
- Těžba dřeva - zahraniční společnosti + dotace
- Pasterectví - odstranění vegetace + spasení
- Zemědělství - pár let - málo živin
- Latinská Amerika (Amazonie) - dobytek, pěstování sóje
- Juhovýchodní Asie (Indonésie, Malajsie) - palma olejná, kaučuk, kokos
- Afrika- ilegální těžba, zemědělství, dřevěné uhlí

# DRIVERS OF DEFORESTATION AND FOREST DEGRADATION BY REGION, 2000–2010

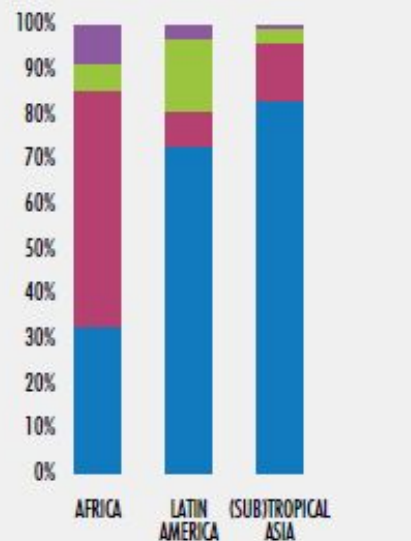
A) Proportion of deforestation drivers



B) Area proportion of deforestation drivers



C) Proportion of forest degradation drivers



■ Urban expansion   
 ■ Infrastructure   
 ■ Mining  
■ Agriculture (local/subsistence)   
 ■ Agriculture (commercial)

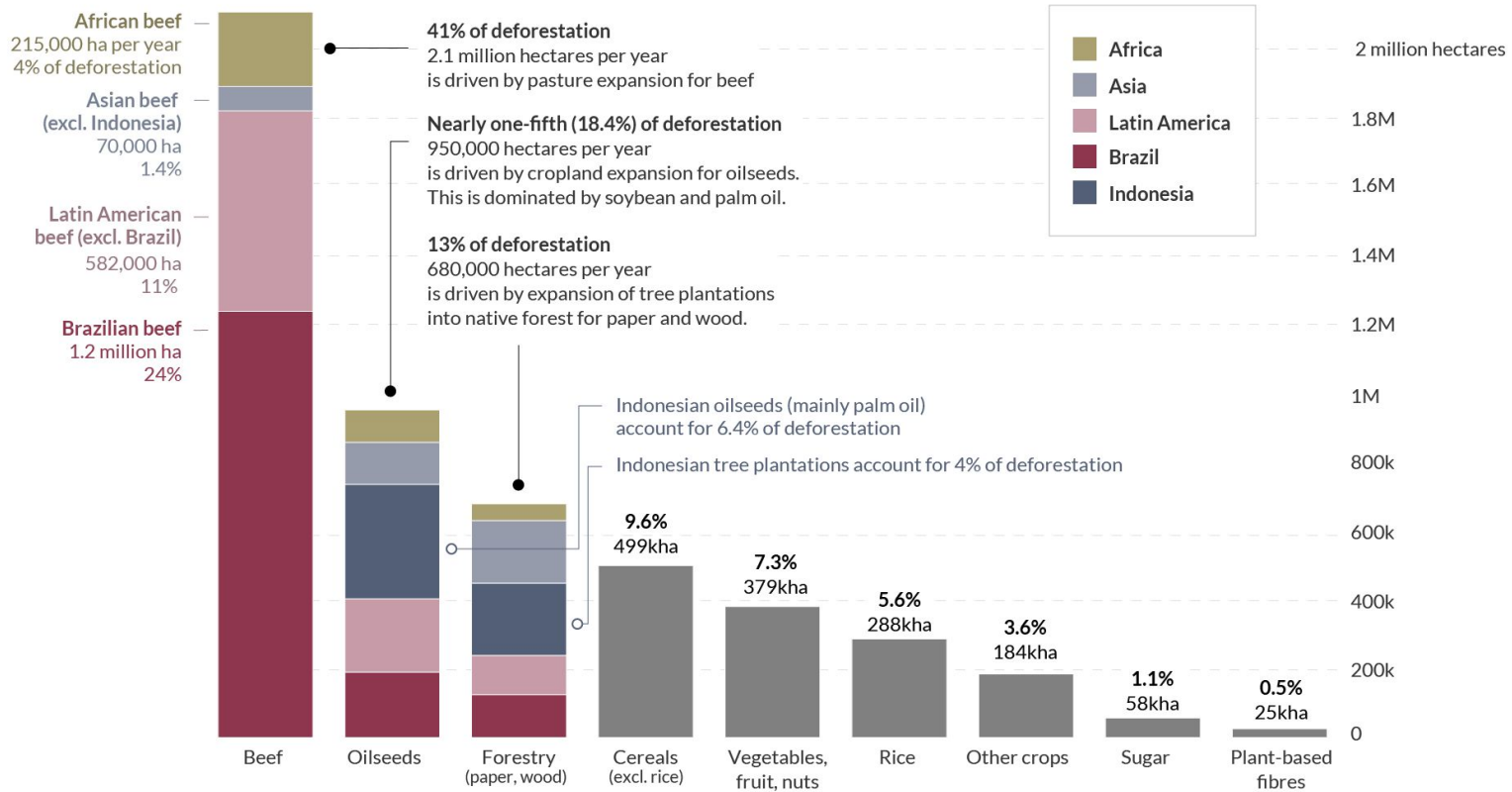
■ Livestock grazing in forest   
 ■ Uncontrolled fires  
■ Fuelwood charcoal   
 ■ Timber logging

NOTE: Continental-level estimations of the relative area proportion (A) and absolute net forest area change (km<sup>2</sup>/year; FAO, 2010b) for the period 2000–2010 (B) of deforestation drivers; and of the relative disturbed forest area fraction of degradation drivers (C), based on data from 46 tropical and subtropical countries.

SOURCE: Hosonuma *et al.*, 2012.

# What are the drivers of tropical deforestation?

Nearly all of global deforestation occurs in tropical and subtropical countries. 70% to 80% is driven by conversion of primary forest to agriculture or tree plantations. Shown is the breakdown of these drivers averaged over the years 2005 to 2013. Further observations since 2013 suggest that drivers have not changed substantially over this period.

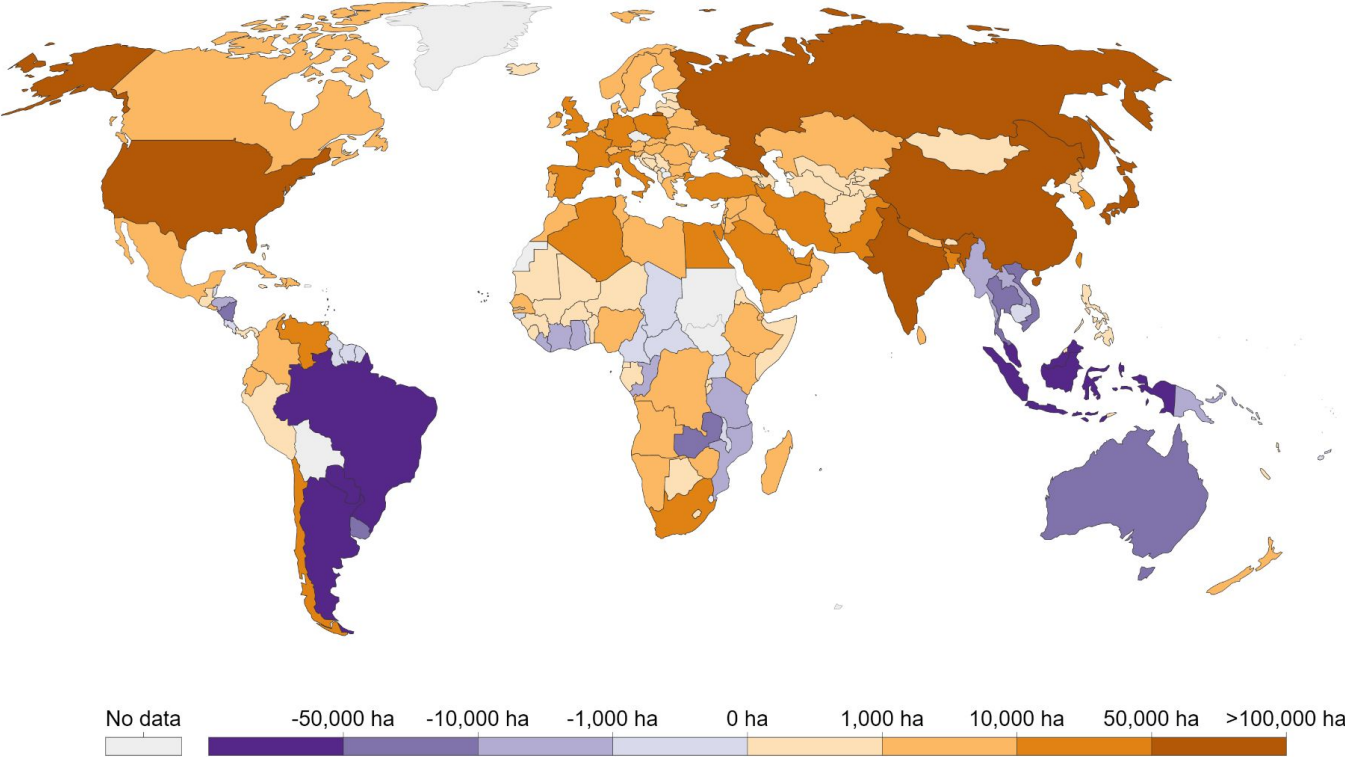


Data source: Florence Pendrill et al. (2019). Deforestation displaced: trade in forest-risk commodities and the prospects for a global forest transition.

# Who is contributing to deforestation abroad?, 2013

Net deforestation embedded in trade is deforestation driven by imported goods minus exported goods.

Net importers of deforestation are countries who contribute to net deforestation in other countries – the deforestation that they cause in other countries is given as a positive value.



Source: Pendrill, F., Persson, U. M., Godar, J., & Kastner, T. (2019). Deforestation displaced: trade in forest-risk commodities and the prospects for a global forest transition. OurWorldInData.org/forests • CC BY



# Lesy a změna klimatu

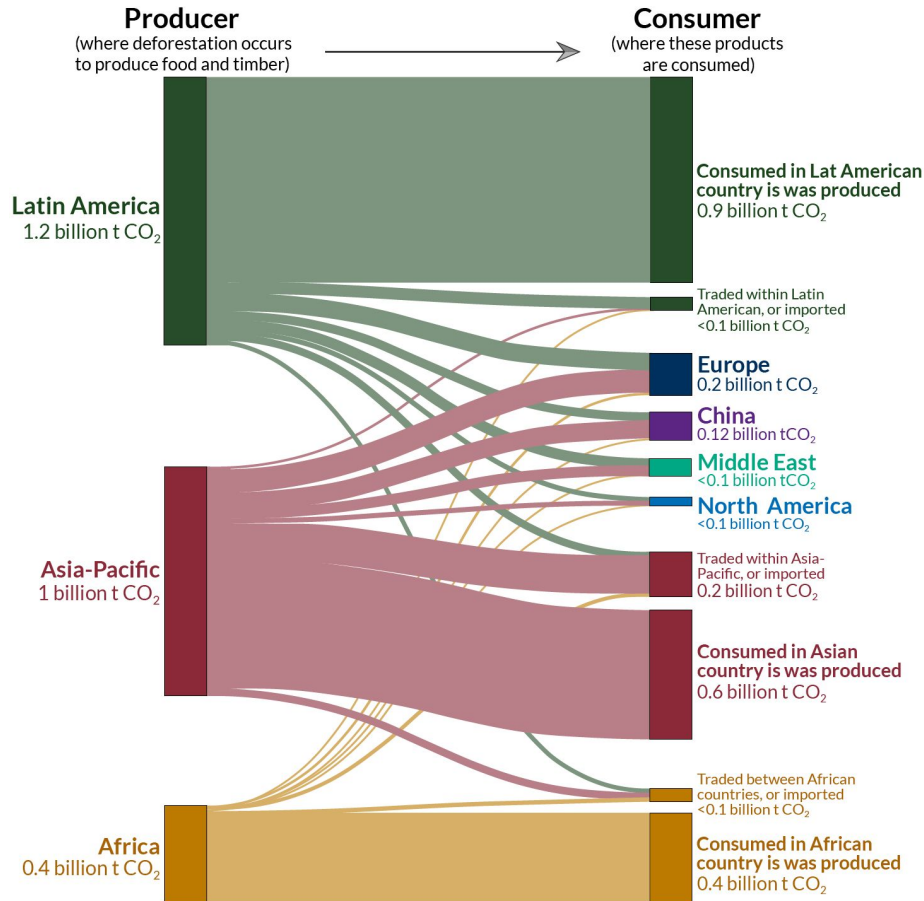
## Sekvestrace (vázáni) skleníkových plynů

- v klimaxovém stadiu ekosystému (lesy nerostou ani se nijak významně nemění) jsou emisně neutrální
- Při odlesňování nastávají emise a po zalesnění rostoucí lesy vážou CO<sub>2</sub> - tzv. propad CO<sub>2</sub>.
- Problém - odlesňování je rychlejší než zalesňování !!! - akcelerace klimatických změn
- Principy omezování emisí REDD+ (*Reduction of emissions from deforestation and forest degradation*).

**Poškození lesů změnou klimatu** - např. jehličnaté severské lesy

# Deforestation carbon emissions in international trade: who are the producers and who are the consumers?

Shown are CO<sub>2</sub> emissions produced from tropical deforestation for agricultural products, and where the products driving this deforestation are finally consumed. This is measured as the annual average from 2011 to 2014.



# Řešení problémů

- Ochrana území → nárazníkové zóny
- Selektivní těžba, Zákaz holosečí ve svazích
- Plantáže na odlesněných nebo degradovaných plochách
- Certifikace produktů
- Řízené požáry
- Kostarika - od 80. let - zdvojnásobení plochy lesů
  - ochrana s nárazníkovými zónami + dotace
- Green Belt movement - Wangari Maathai (Kenya)

# INFOGRAPHIC

## THE NEED FOR URGENT ACTION

This figure shows cumulative deforestation between 2010 and 2050. Under the Do Nothing Scenario, the area deforested is greater than the current total forest area of the Democratic Republic of Congo, Peru and Papua New Guinea combined.

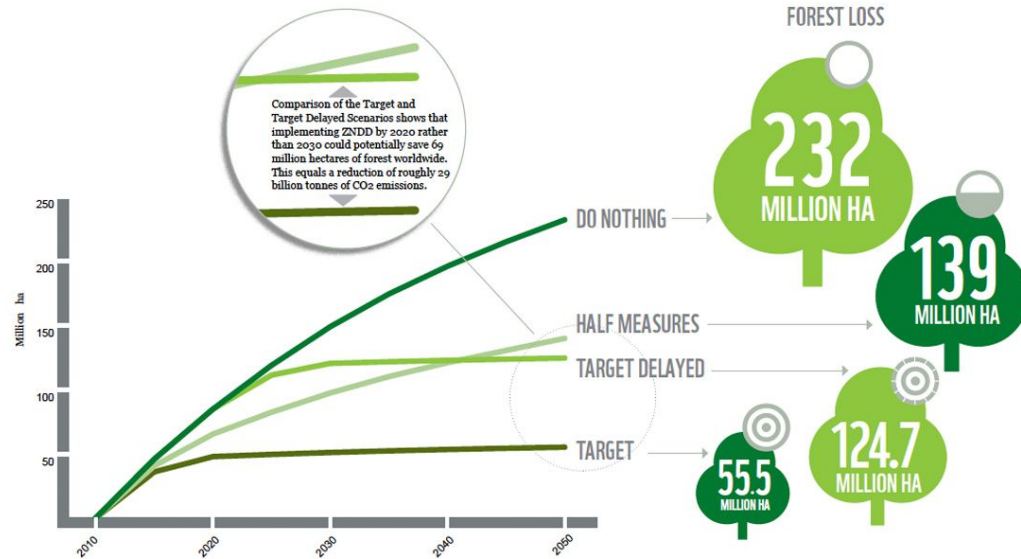
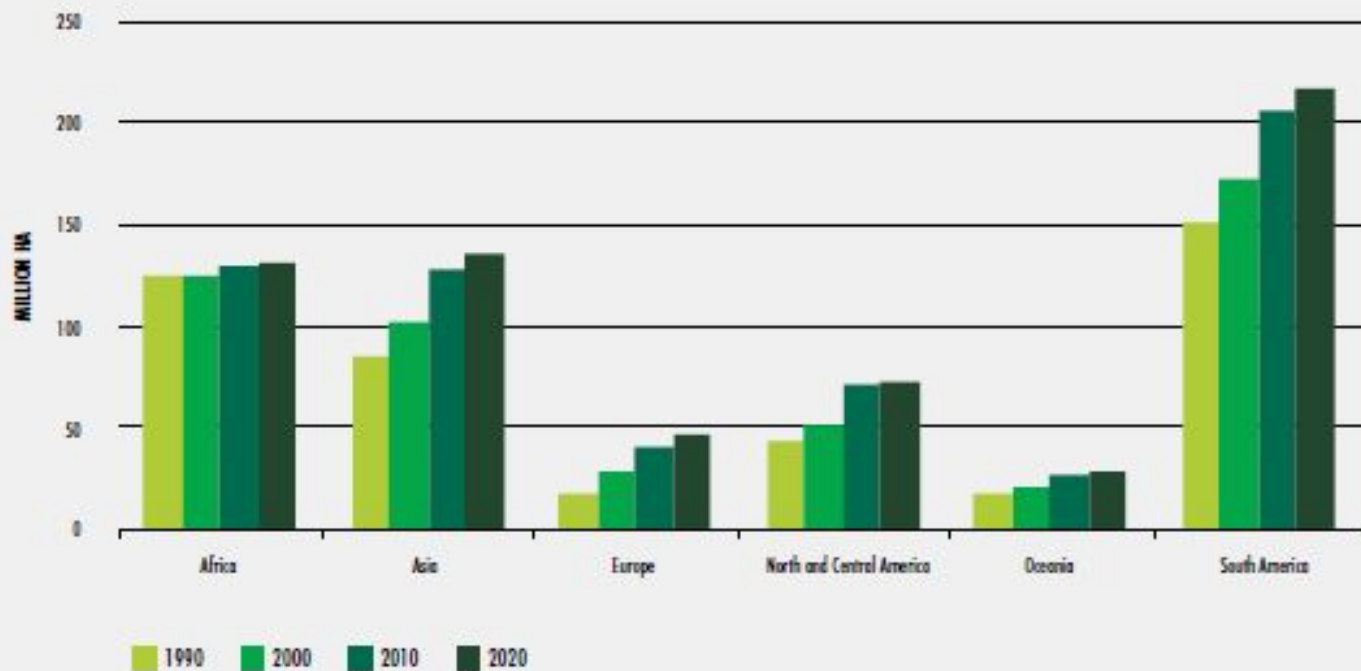


FIGURE 38

TRENDS IN AREA OF FOREST WITHIN PROTECTED AREAS BY REGION, 1990–2020 (MILLION HECTARES)



NOTE: Data for Europe include the Russian Federation.  
 SOURCE: Study prepared by UNEP-WCMC for this publication.

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