POPULAR ADAPTATIONS TO CLIMATE CHANGE INDUCED WATER STRESSES IN MAJOR GLACIERIZED MOUNTAINOUS REGIONS OF THE WORLD

Aggarwal et. al. 2022
https://www.tandfonline.com/eprint/PFHN7SZ4RH6PIHNMTJWN/full?target=10.1080/17565529.2021.1971059

INTRODUCTION

- Mountains are an important source of water and are often called water towers.
- Fifteen percent of the world population live in mountain regions.
- Rough terrain, complex climatic patterns and data scarcity for assessment have limited the process understanding of mountain areas.
- Limited local adaptive capacity leads to difficulties in designing adaptation strategies.
- Thus, mountain regions and people are thought to be highly vulnerable to the impacts of climate change.

- There is a need to improve adaptive capacities of communities.
- Challenge - limited understanding of what adaptation action works well or not, where, and under what conditions.
- This study aims to synthesize popular adaptations and lessons learnt from these experiences in an effort to identify adaptation practices that can contribute to the improvement of climate resilience in mountain communities.

METHODOLOGY

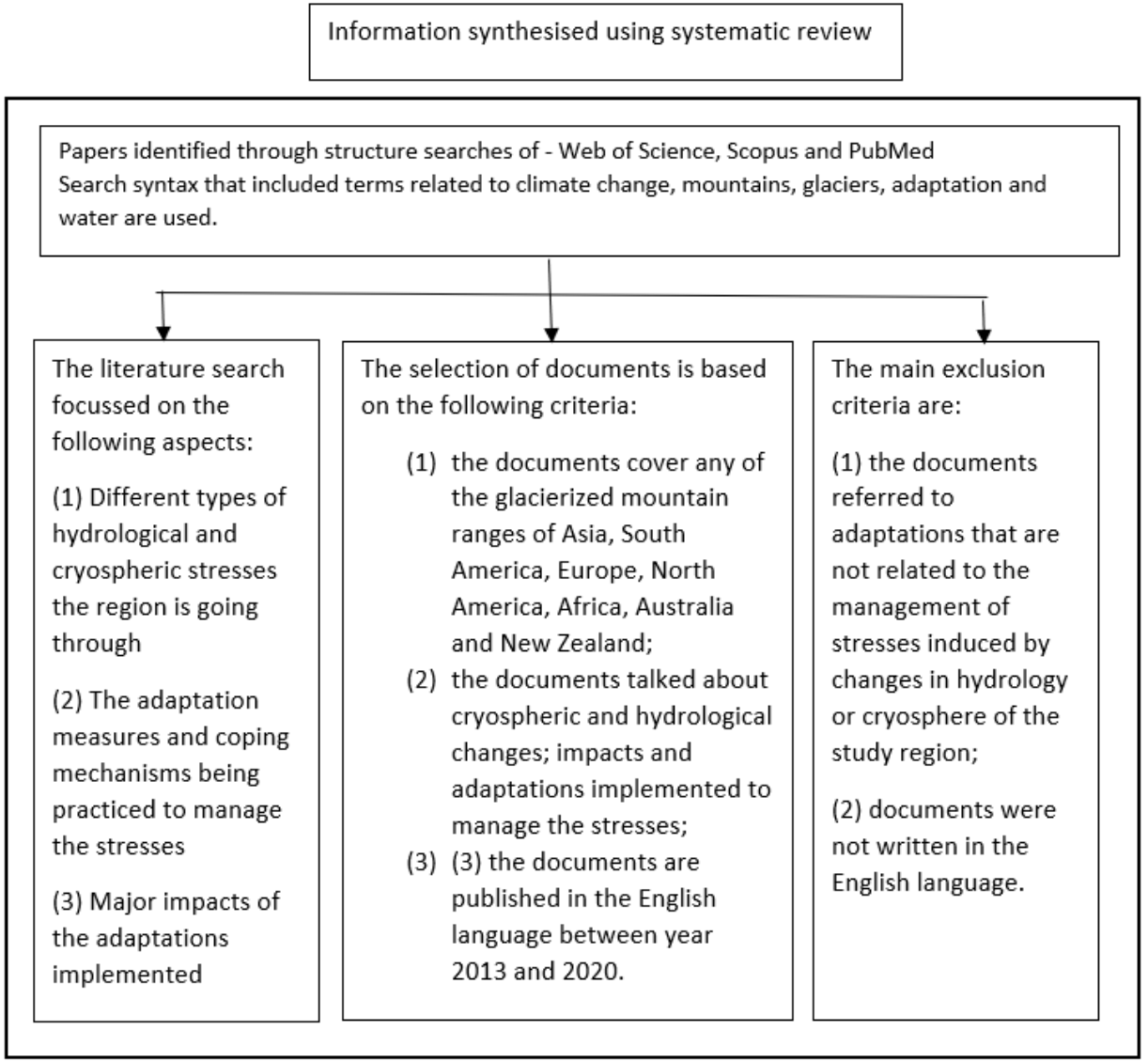
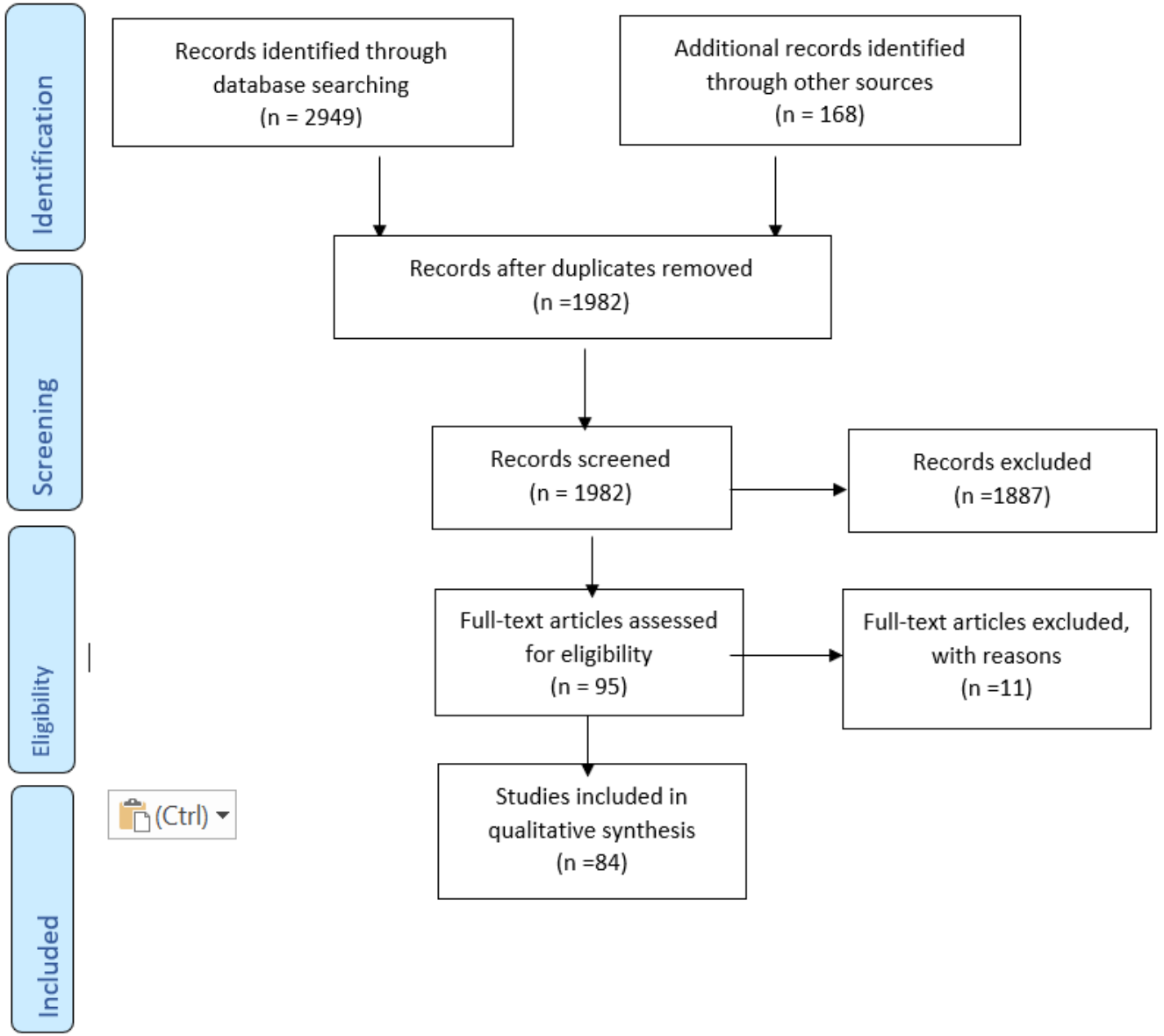


Fig. 1 Flow chart showing methodology used.

Fig. 2 **PRISMA 2009 Flow Diagram** (PRISMA flow chart from http://www.prisma-statement.org/PRISMAStatement/)



DATA

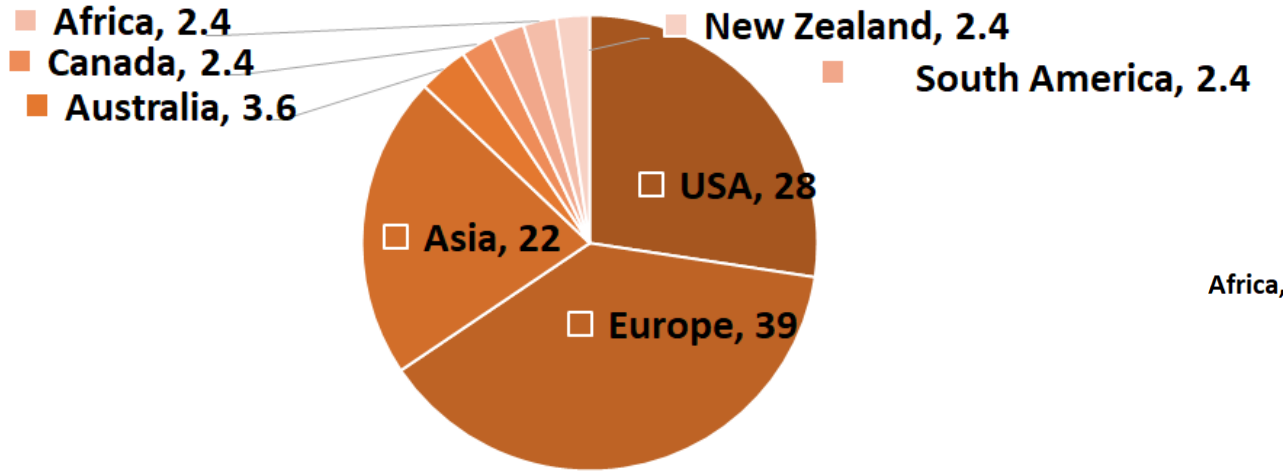


Fig. 3 Geographical distribution of authors of the reviewed papers (percentage)

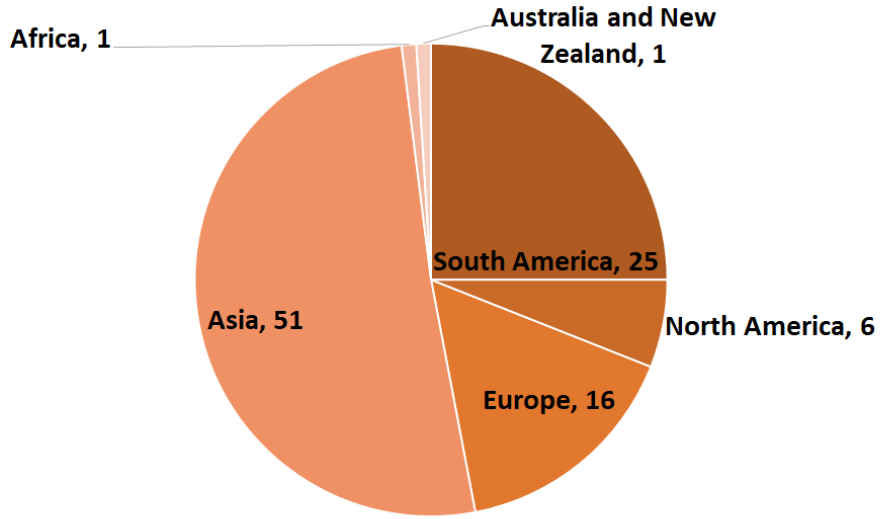


Fig. 4 Geographical distribution of study regions (percentage)

RESULTS

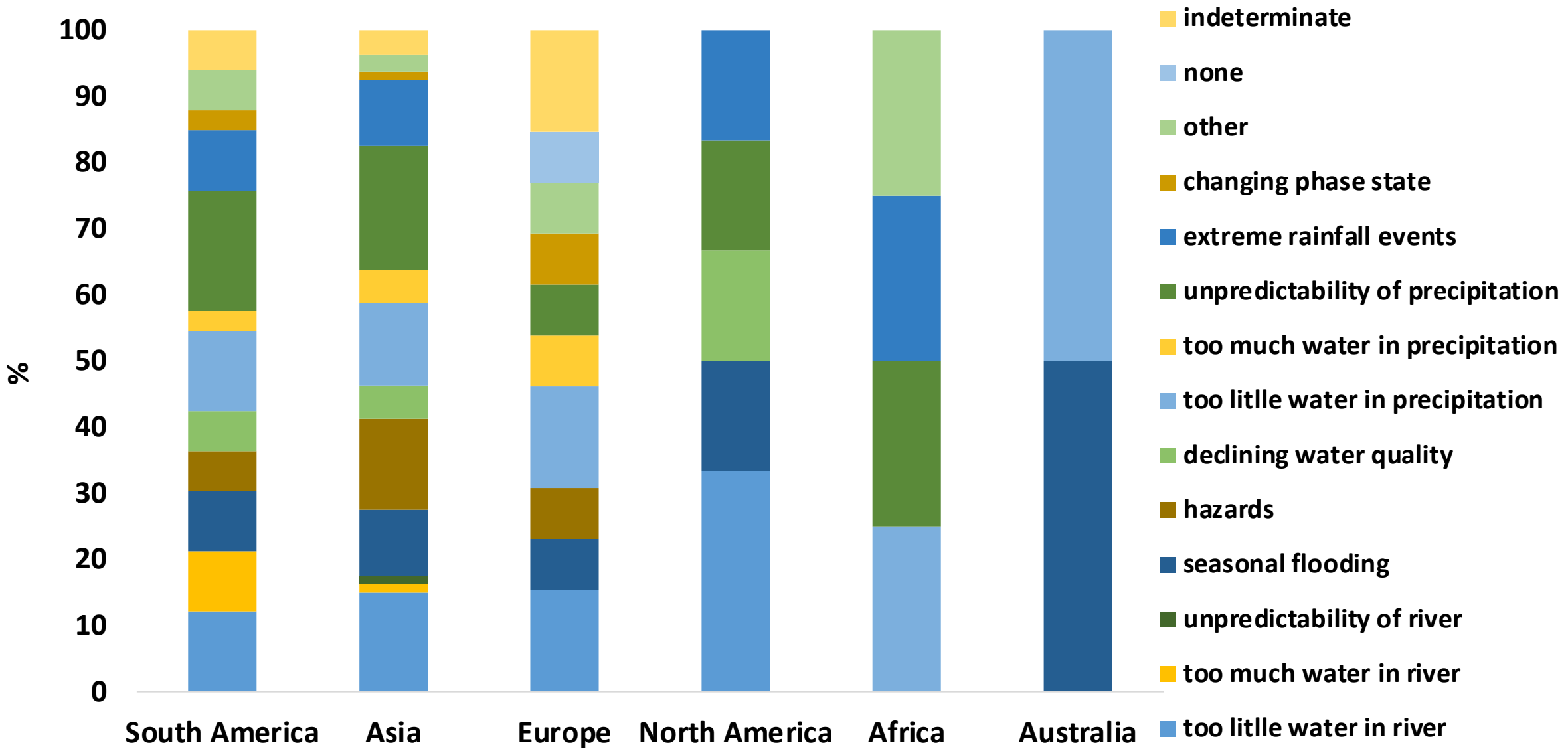


Fig. 5 Different water related issues

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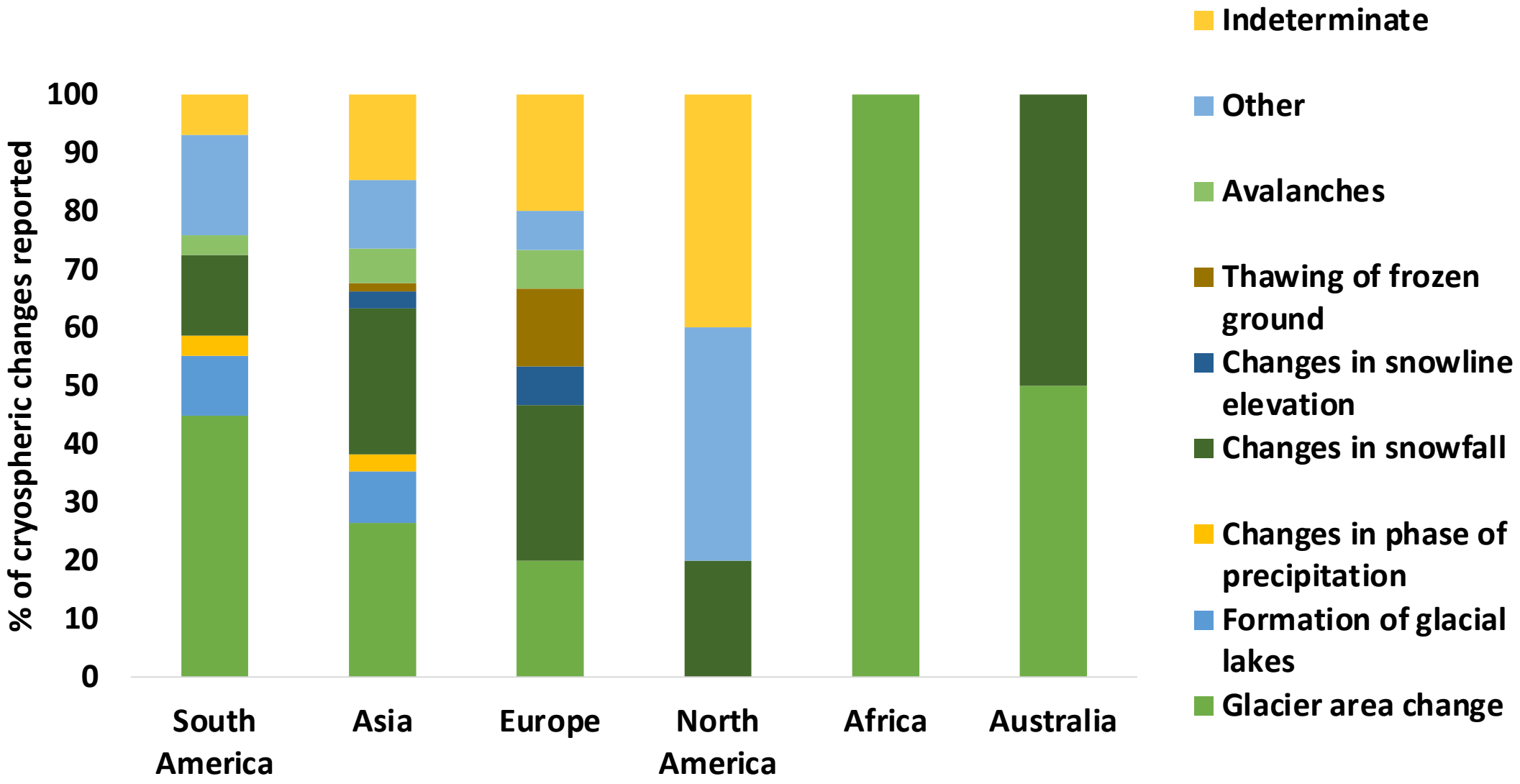

Fig. 6 Cryospheric changes

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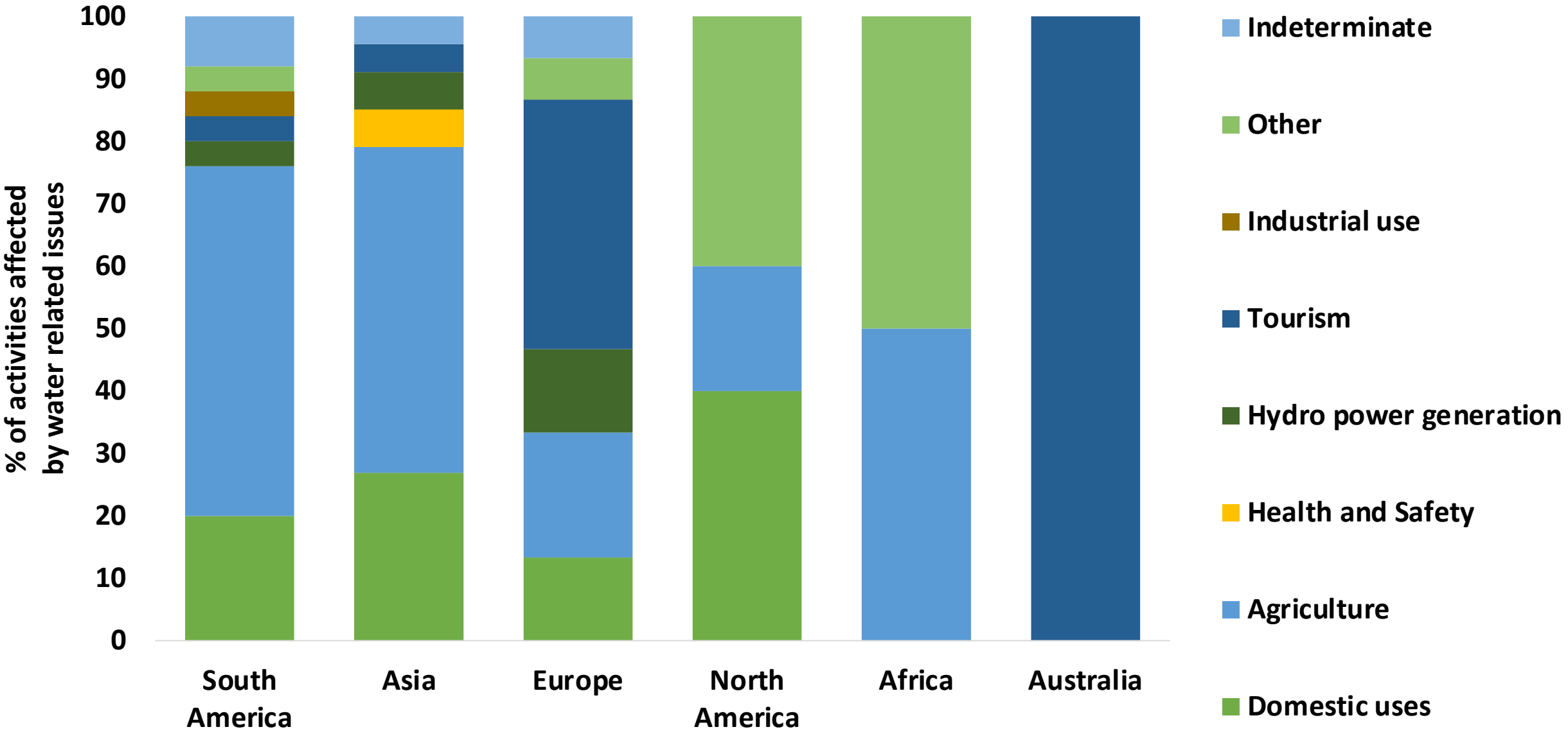

Fig. 7 Activities affected by water related issues

- It is observed that the government and local communities are leading the adaptations all around the world.
- The main limitation faced in adaptation implementation is due to the social conditions of a region.

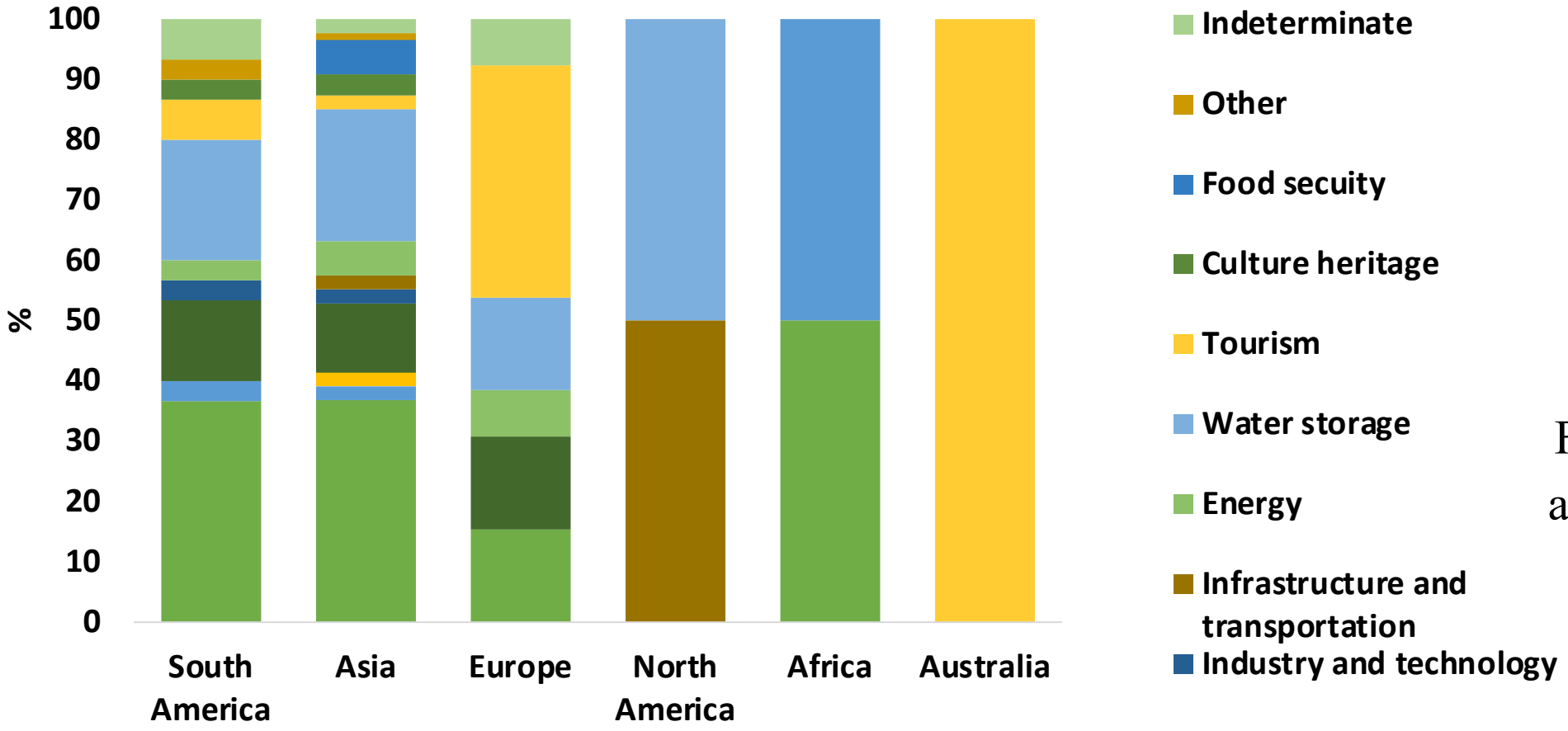

Fig. 8 Sectors where adaptations are being introduced

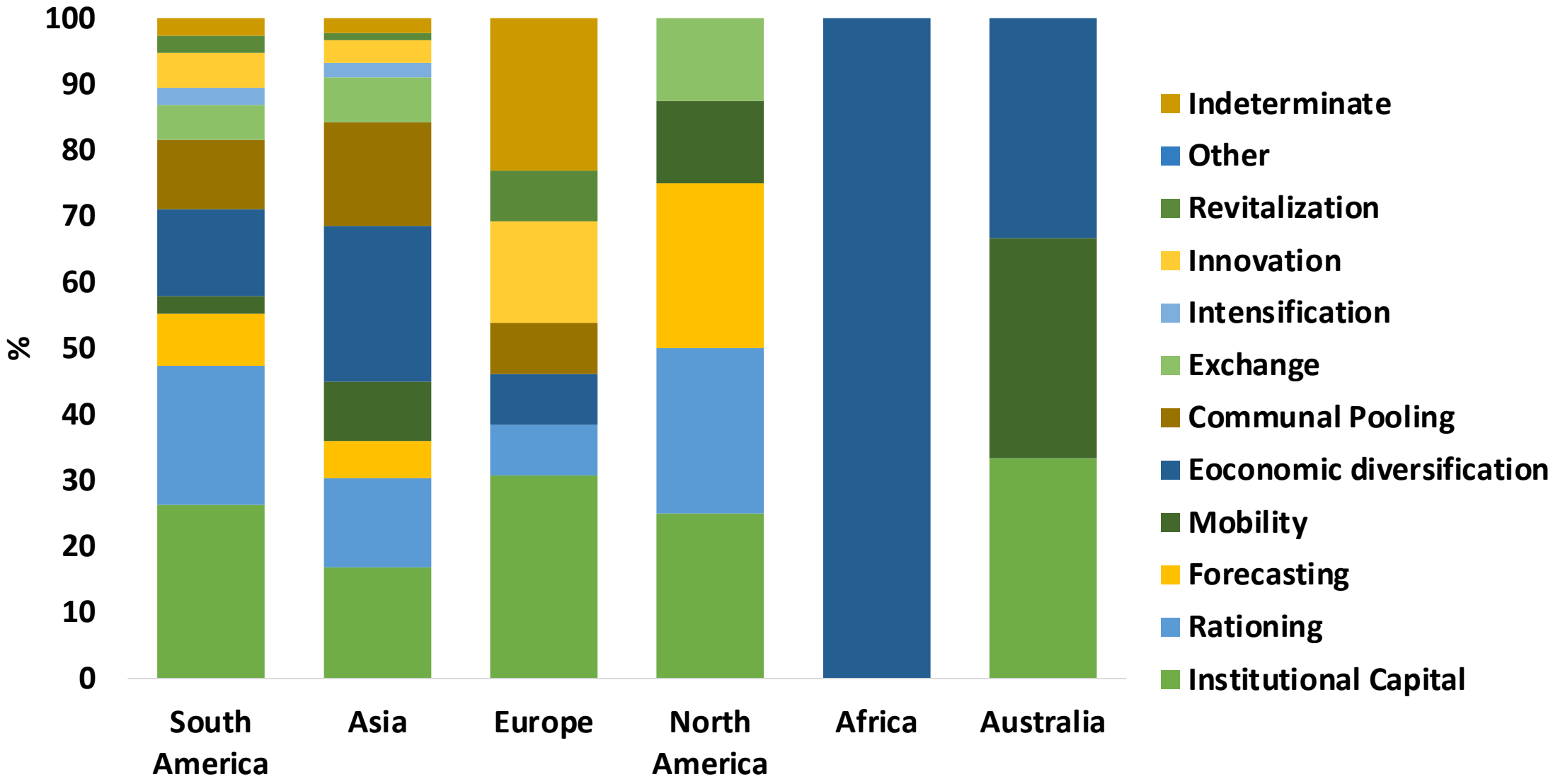

Fig. 9 Adaptation strategies implemented

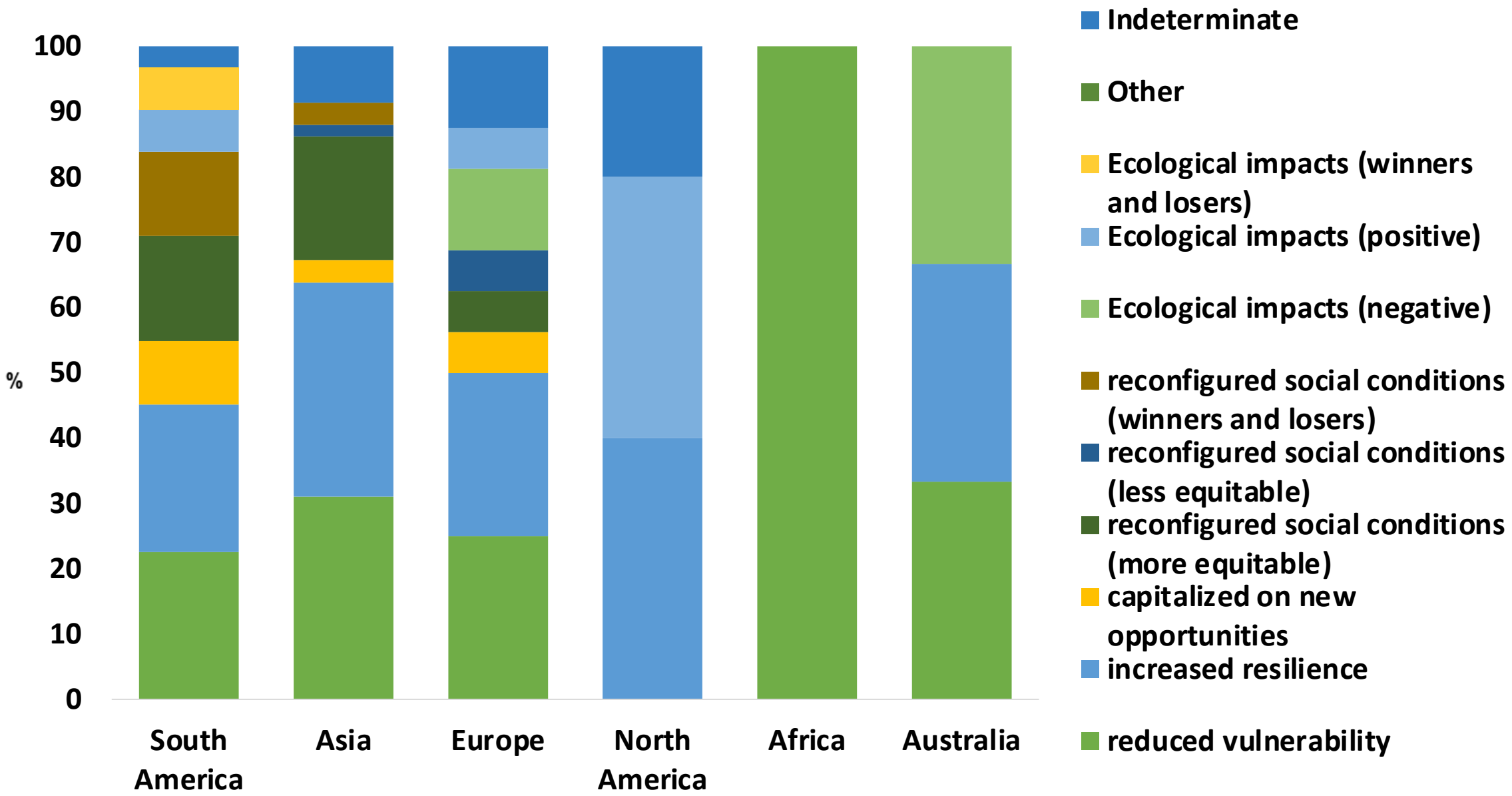

Fig. 10 Reported effects of adaptations

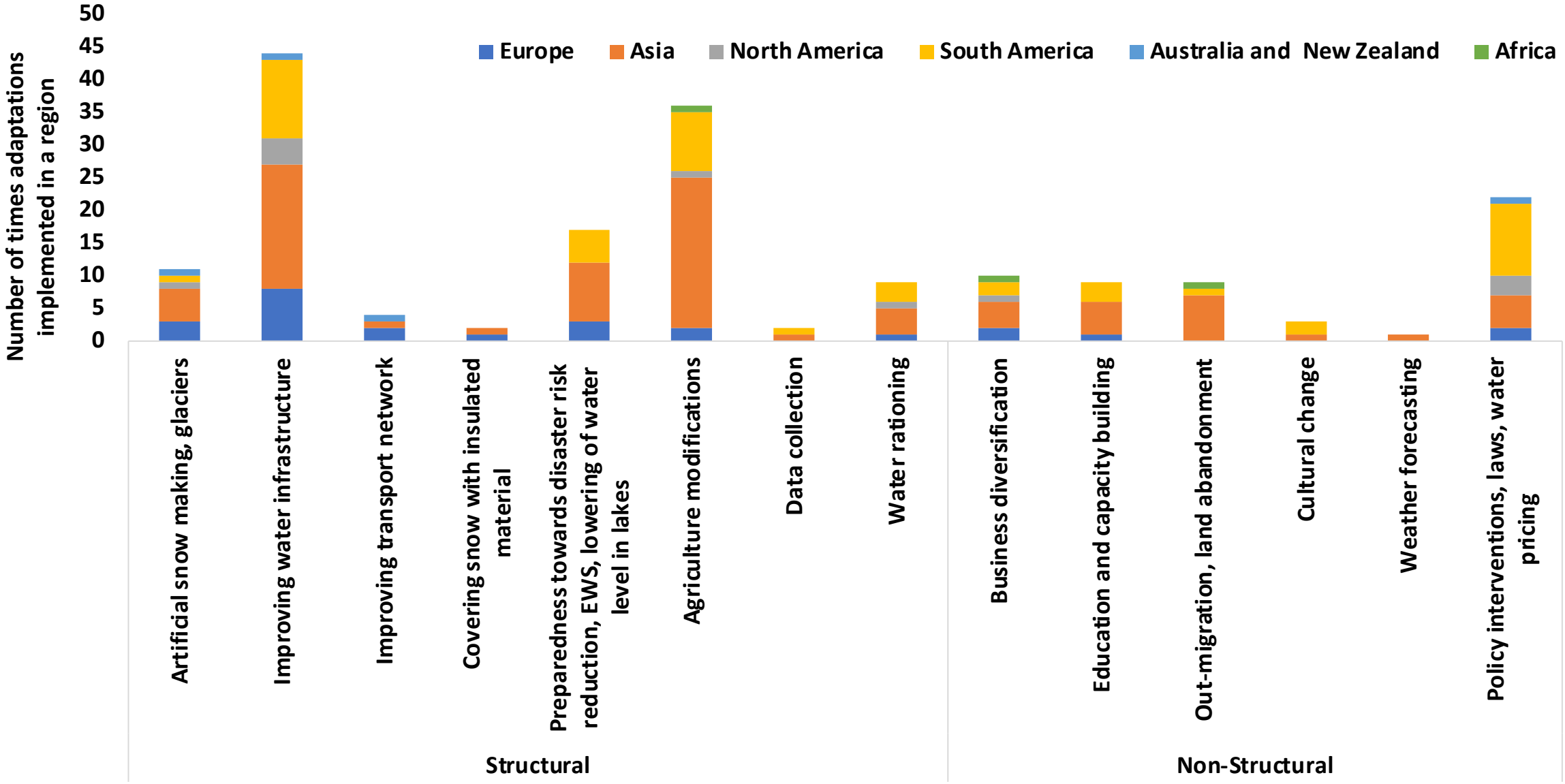

Fig. 11 Structural and non-structural adaptations implemented

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In Asia broadly ~15 types of adaptations are implemented like dam construction, snow and water harvesting and conservation programs, artificial glaciers, crop diversification, afforestation programs, new irrigation practices, legal water sharing system, pay for water services, hydro-meteorological data acquisition, disaster risk reduction and training, economic diversification, migration and reallocation for water.

In South America ~13 types of adaptations are implemented like crop diversification, afforestation programs, new irrigation practices, glacier protection laws, water laws and improved water governance, water storage infrastructure, Early Warning System (EWS), disaster risk reduction and training, hydro-meteorological monitoring, economic diversification and capacity building.

In Africa ~3 types of adaptations are implemented like crop diversification, economic diversification and new agriculture practices.

In Europe ~8 types of adaptations are implemented like artificial snow making, dam construction, cover snow with insulating material, making new hiking routes, economic diversification, improve water storage infrastructure, crop diversification and rising awareness.

In North America ~4 types of adaptations are implemented like increased funding in mountain adaptation programs, water storage infrastructure, agriculture modifications and non-snow tourism.

In Australia and New Zealand ~2 types of adaptations are implemented like economic diversification and motivating non-snow tourism.

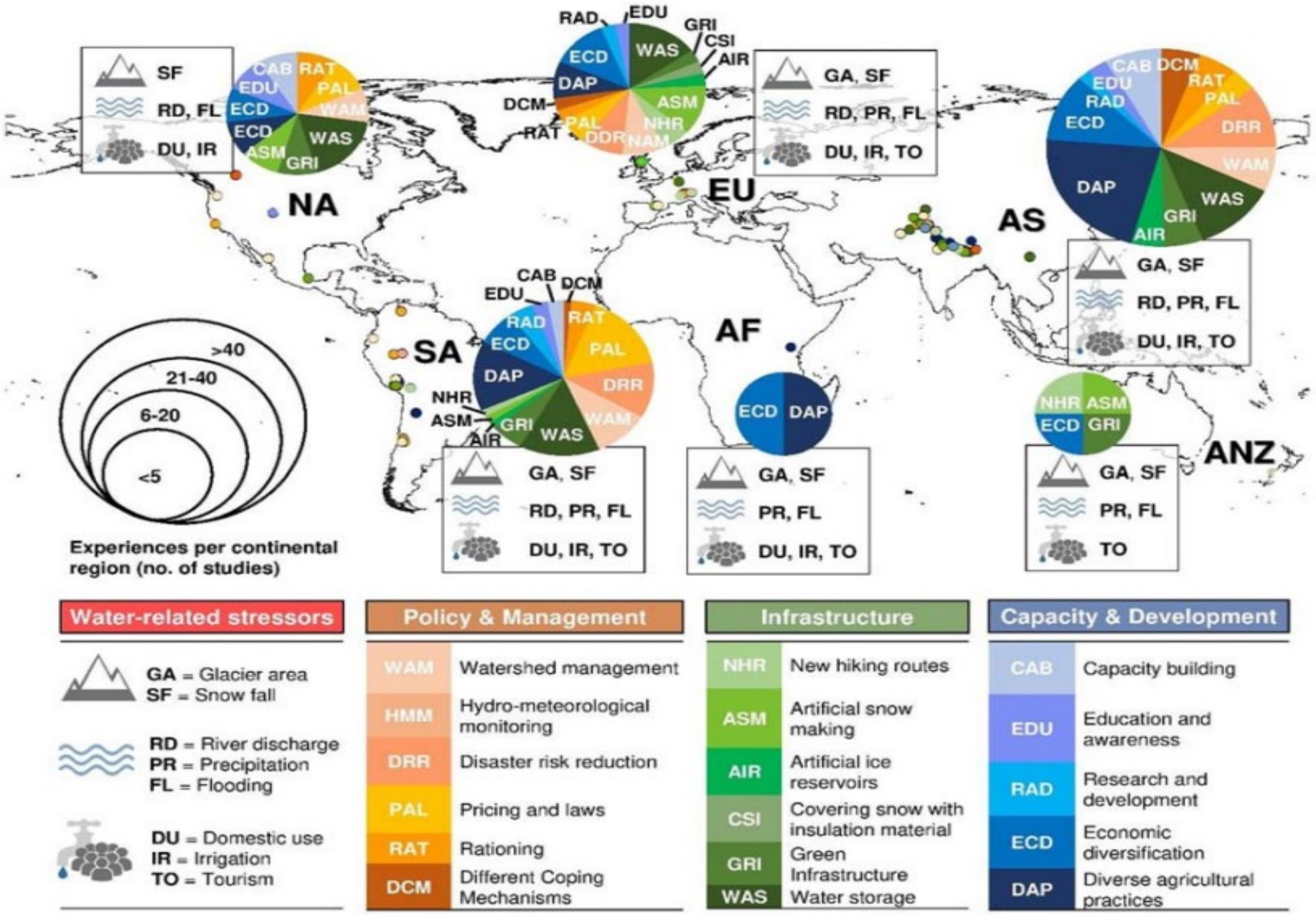

Fig. 12 Dominant types of adaptation (grouped into three main categories), and water related stressors (associated with cryospheric and hydrological changes, and socioeconomic activities) for the world's mountain regions. NA = North America, SA = South America, EU = Europe, AF = Africa, AS = Asia and ANZ = Australia and New Zealand.

Sources of Uncertainty

- The main sources of uncertainties involved in the formulation of the adaptation strategies are:
  - prediction of snow variability are uncertain due to the climate data used, unclear data quality
  - Modeling impacts of floods on downstream communities
  - erratic behaviour of climate has made local knowledge of inhabitants obsolete and it is difficult to take any decision related to adaptation interventions needed
  - Uncertainty about the cause of climate change, scientific uncertainty associated with climate change

CONCLUSIONS

- Mountains are facing water stress. To cope with the stresses a number of adaptation measures are being implemented all over the world in mountainous regions.
- In South America and Asia maximum adaptations are implemented in agriculture sector.
- In Europe and Australia maximum adaptations are implemented in tourism sector.
- In North America maximum adaptations are implemented in transport and water infrastructure building sectors.
- In Africa maximum adaptations are implemented in agriculture and forestry sectors.

- The main limits to adaptations
  - are misuse and lack of funds
  - difficulty in maintenance of infrastructure
  - delayed implementation of laws
  - resource conflict,
  - mistrust in government,
  - lack of resources, knowledge and labour
  - lack of investment in mountain programs
  - extreme events
  - uncertainty in future climate change impacts, discontinuity and errors in climate data
- Artificial snow making in Europe is putting pressure on the water resources of the region.
- In Asia overexploitation of water resources is leaving less water for downstream population.
- The popular adaptation practices observed from the review are improvement of water storage infrastructure, better agricultural and irrigation practices, economic diversification and improved water governance and laws.

THANK YOU