

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

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‘Changing India’s agricultural patterns can solve water challenges’

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My research focuses primarily on understanding global water sustainability. That covers infrastructure and access on the one side, and the role of climate in determining floods and droughts on the other. Studies show we are already in a water crisis — we simply haven’t elevated this to the status of climate change. In the early 2000s, I began researching hotspots of water crises globally — India jumped to the top of the list very quickly.

Most people talk of shortages of water when they refer to the water crisis in India, it’s more. There is a serious problem with the *excess* of water in agriculture, the unchecked pollution of water resources and flooding which costs almost a billion dollars a year in damages. No other country faces water challenges like this.

Of course, other nations have problems too. In America, Europe and Japan, for instance, most water infrastructure, including dams and urban infrastructure, was built 50 to 100 years ago. It’s beyond its design life now — the US needs two to three billion dollars just to bring things back to grade. Rural areas and smaller cities in the US and Europe already have endemic failures of water systems.

But the world has enough water for everyone to use. Yet, we’re in this

AT THE ROOT

situation, mostly because those in decision making roles generally think only of drinking water supplies. But the majority of water use on the planet is consumptive water use, which is removed from the system and is no longer available until it rains again — is it agriculture. Globally around 70% of freshwater is used for agriculture — in India, it’s over 80%.

Such water use efficiency is very low in India because we practice flood irrigation for crops. We’re mostly in semi-arid to semi-arid climate. So, if a farmer in Punjab maintains 33 inches of water in the fields all the time for growing paddy, that water is continuously evaporating. The water evaporation is as much as 2.2 metres during the season per unit area — but the plant itself needs only 60 to 70 cm. Most of that water just evaporates.

This has effects in all. Most Indian cities use groundwater. With heavy agricultural use, as this drops in level, it becomes more expensive to pump. Farmers get free electricity for

A FLOOD FIELD: Growing paddy is water-intensive. Doing so in dryer states is draining India’s groundwater.

pumping but often don’t let, they pump water only twice a day to save money. The middle class manages because it’s built its own water storage systems. But the poor suffer from the lack of water. This situation arises from the excessive use of water in agriculture. Therefore, we’ve examined solutions to help farmers improve their water use efficiency in Gujarat, Punjab and Andhra Pradesh; we did pilot projects with local universities involving over 10,000 farmers over five years. We found technologies which helped even highly water consuming crops achieve significant reductions in water use without losing productivity — you could have 50% water without much expenditure. But other issues impeded their widespread adoption — in Punjab, for example, over 90% farmers installed those moisture sensor technology which indicates when there’s a water shortage in the soil, so flood irrigation can be used just then. But that dropped to 20% farmers eventually — the reason was this required extra labour as they had to go in physically to the fields to check the moisture status. Since electricity also came on randomly farmers preferred to simply leave their pumps on. This means they were perpetually flooding their fields, wherever electricity was supplied.

Significantly, we found around two-thirds of farmers were interested in paying for regular electricity. The richer farmers weren’t — the poorer farmers were. That seemed paradoxical but this was because the richer farmers receive electricity through connections and money. Poorer farmers were spending more on diesel and therefore, they were willing to pay for a reliable electricity supply — which would help save a large amount of water.

We also researched crop choices — in India, government procurement of staples happens only in some states like Punjab, Haryana, Telangana, etc. Surprisingly, some of the most arid states contribute to raw-stone procurement — we studied if water could be saved by growing different crop items. We found that if you continued irrigation at the same level, farm incomes would

WHY IT’S FLOWING AWAY: Both free and irregular electricity supply has caused increased water pumping in Indian agriculture.

actually increase by 30% on shifting certain crops around — rice used shift to Bihar, Odisha, Bengali, some Himalayan areas and the Ghats while Punjab could return to growing corn, lentils and winter wheat.

Amazingly, the most expensive cropping pattern from a water point of view turned out to be similar to the crop patterns that existed across India before the Green Revolution. By simply changing the crop system, the water situation in the entire country could be significantly improved. This wouldn’t need much technology — it would yield a rich harvest of water for all.




Because water is essential for life.
And water scarcity is life threatening

INTRODUCTION

- An important source of water are mountains. They provide fresh water to a substantial portion of the world population (Viviroli et al. 2020). They are often called water towers (Immerzeel et al. 2019).
- To conserve the water resources of mountain regions and help communities cope up with stresses induced by climate change, it is important to improve adaptive capacities of communities living in harsh environments by providing social, economic and ecological security to them (Ingty 2017, Xenarios et al. 2019).
- An important challenge to date is 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.

- The information is synthesized using systematic review approach (McDowell et al. 2019, Rasul et al. 2019, Mukherji et al. 2019).
- 83 peer-reviewed articles are selected. The geographical distribution of the studies can be seen in the figure below.

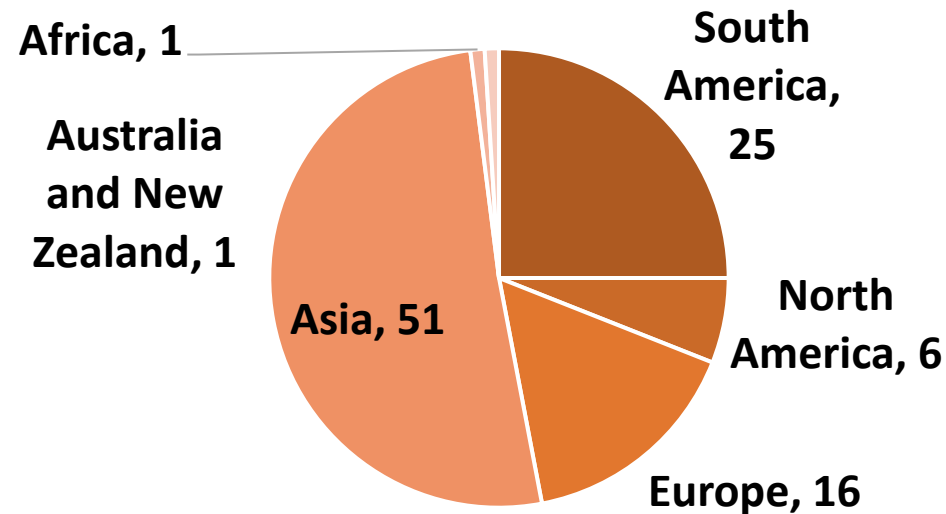


Fig. 1 Geographical distribution of study regions (percentage)

RESULTS

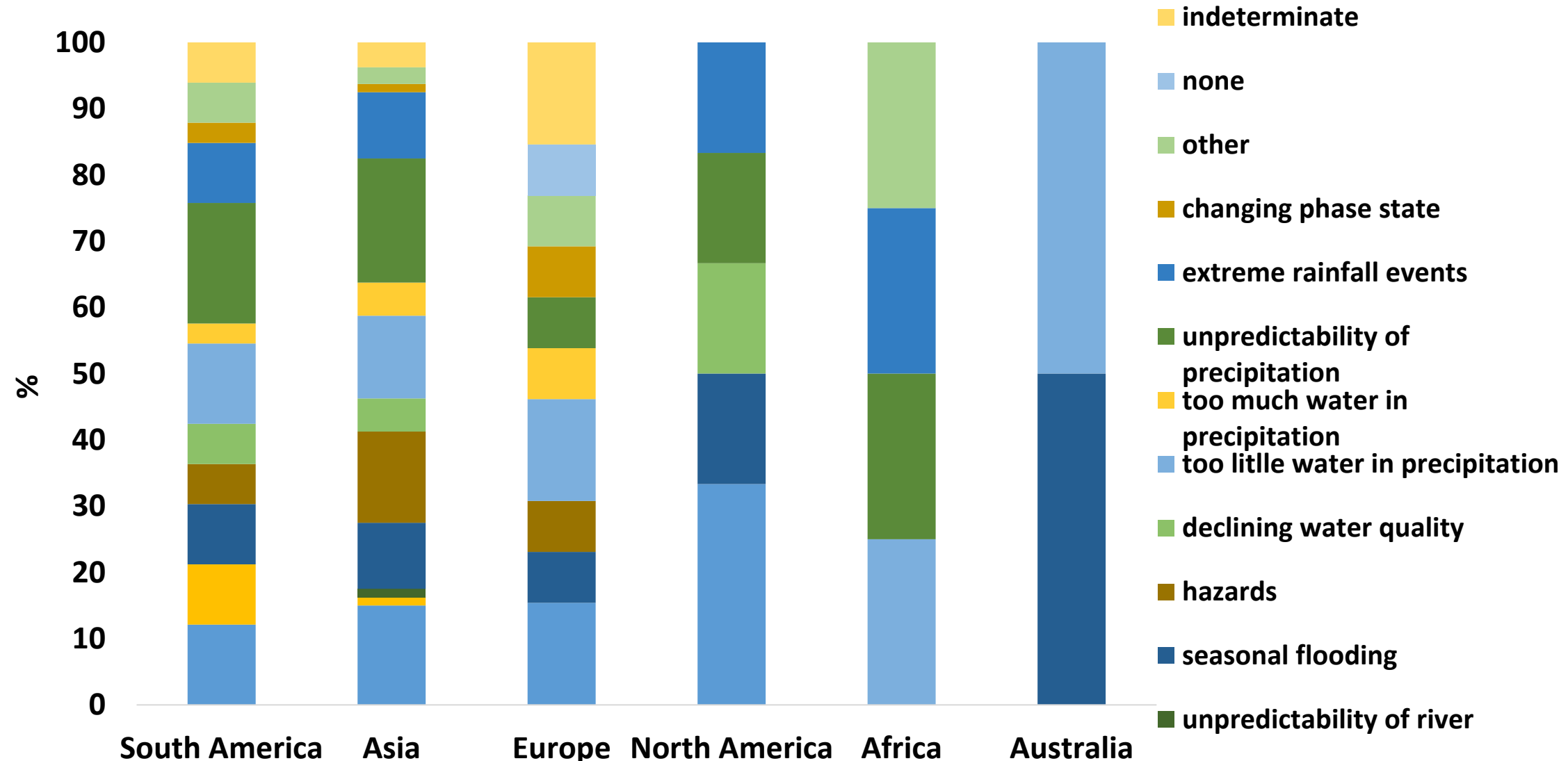


Fig. 2 Different water related issues

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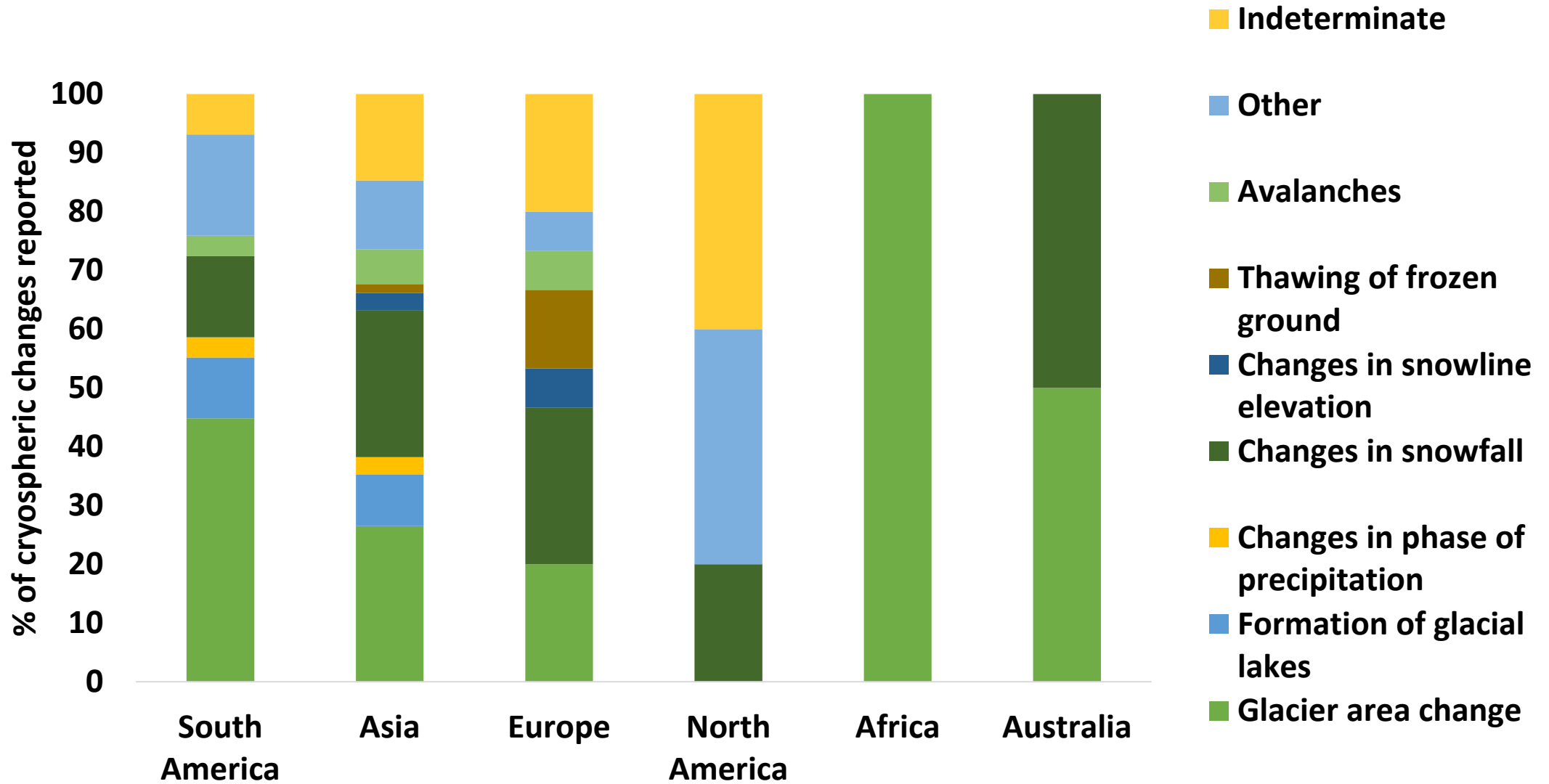


Fig. 3 Cryospheric changes

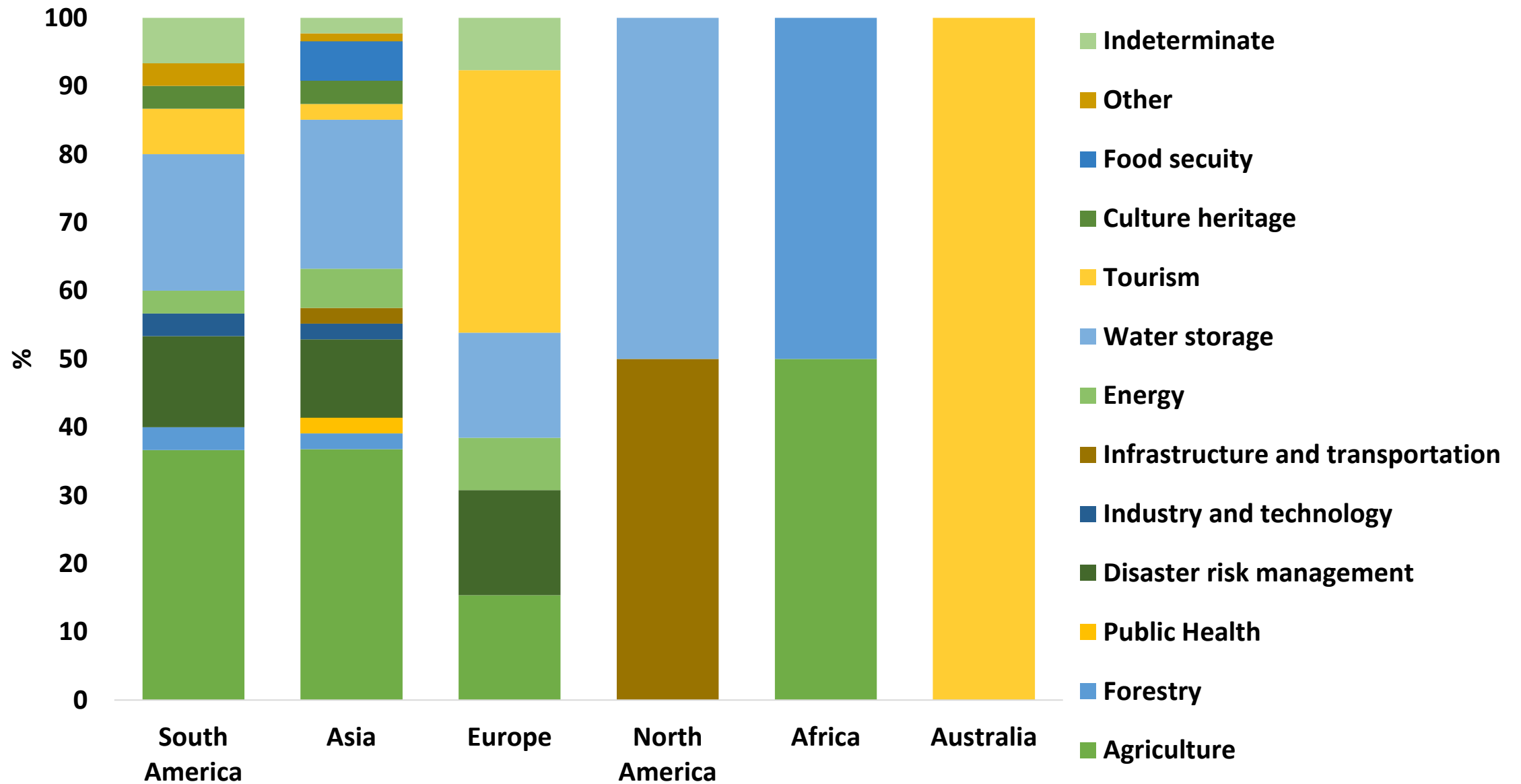


Fig. 4 Sectors where adaptations are being introduced

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and mountains under global change

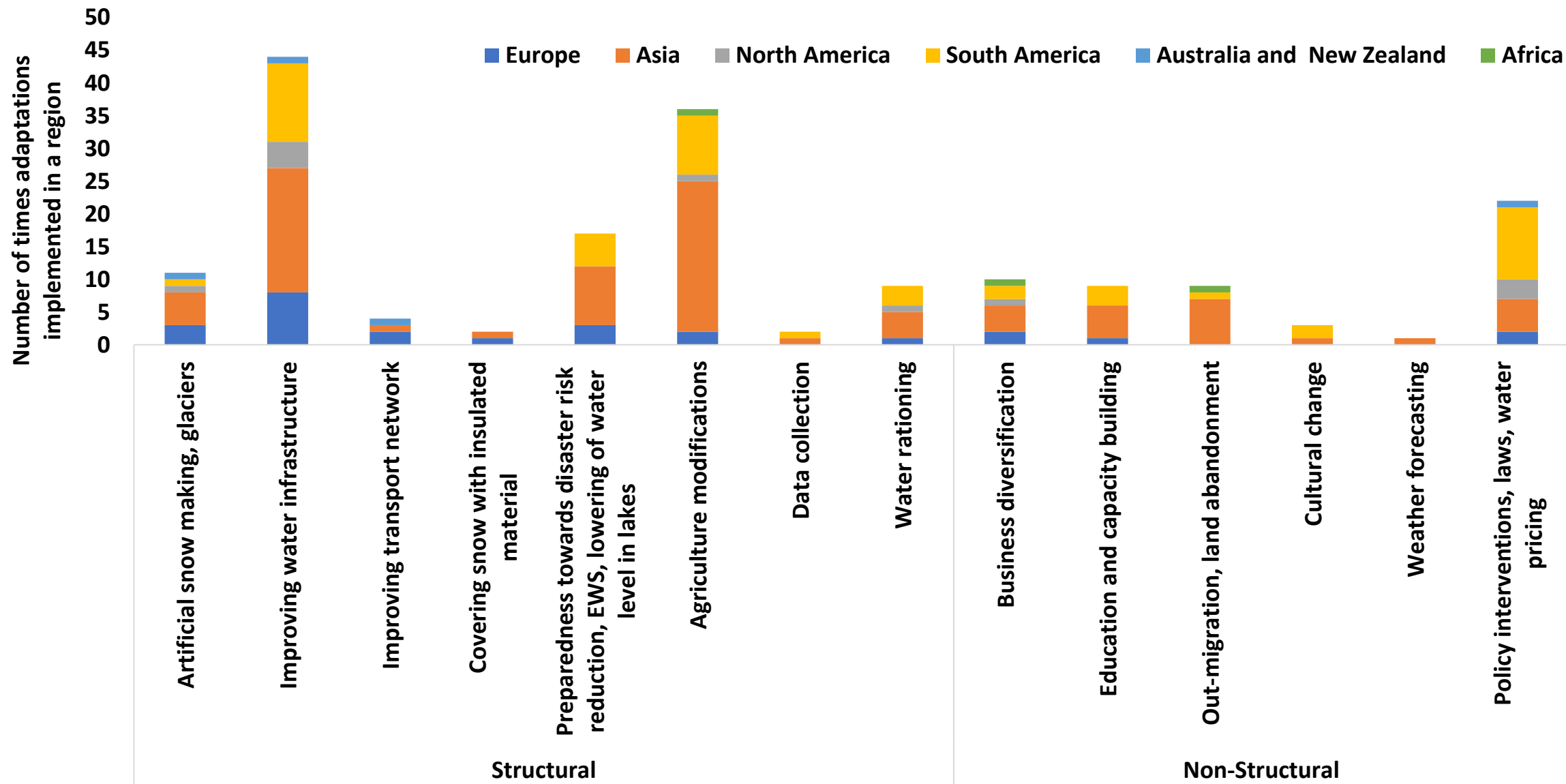


Fig. 5 Structural and non-structural adaptations implemented

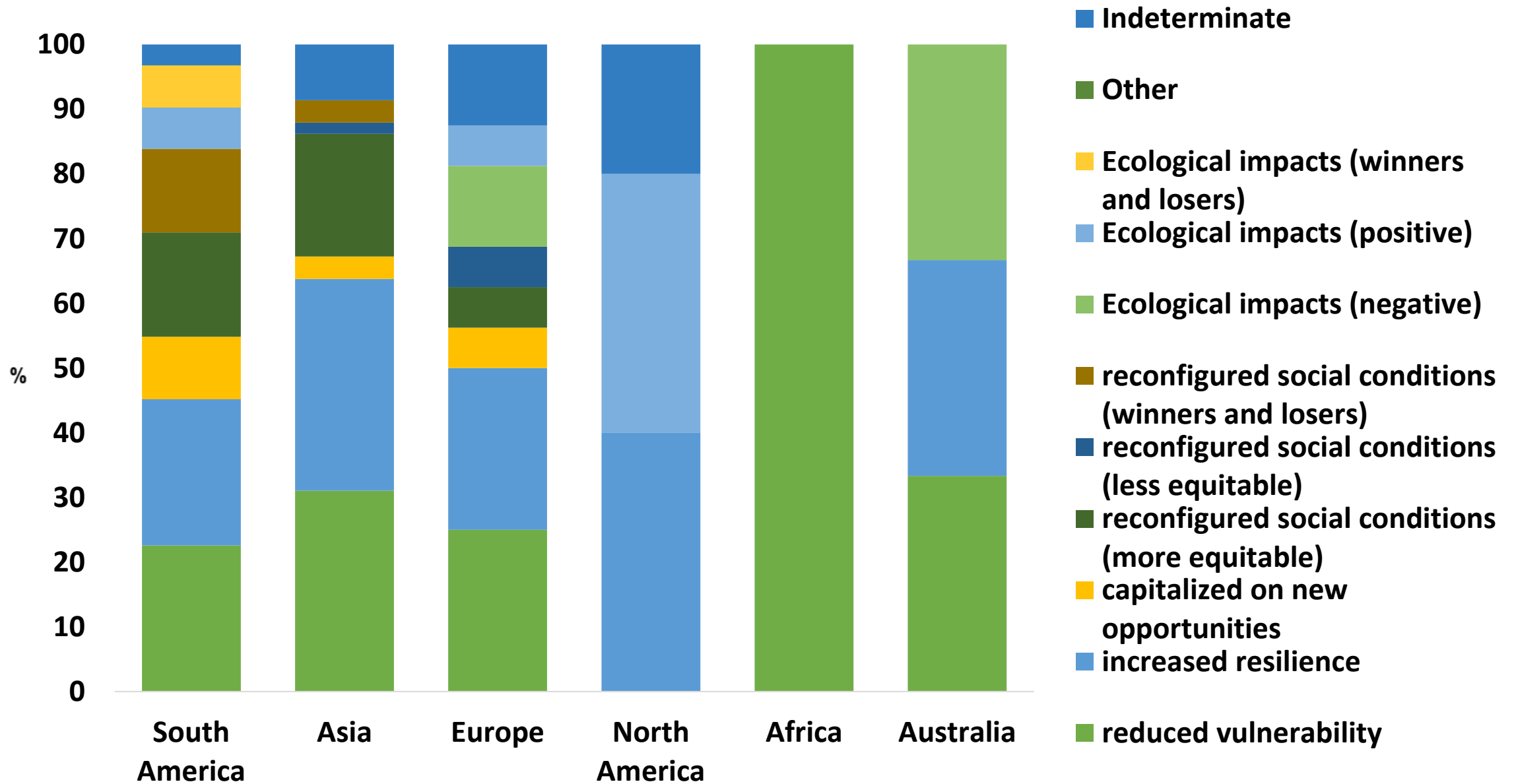


Fig. 6 Reported effects of adaptations

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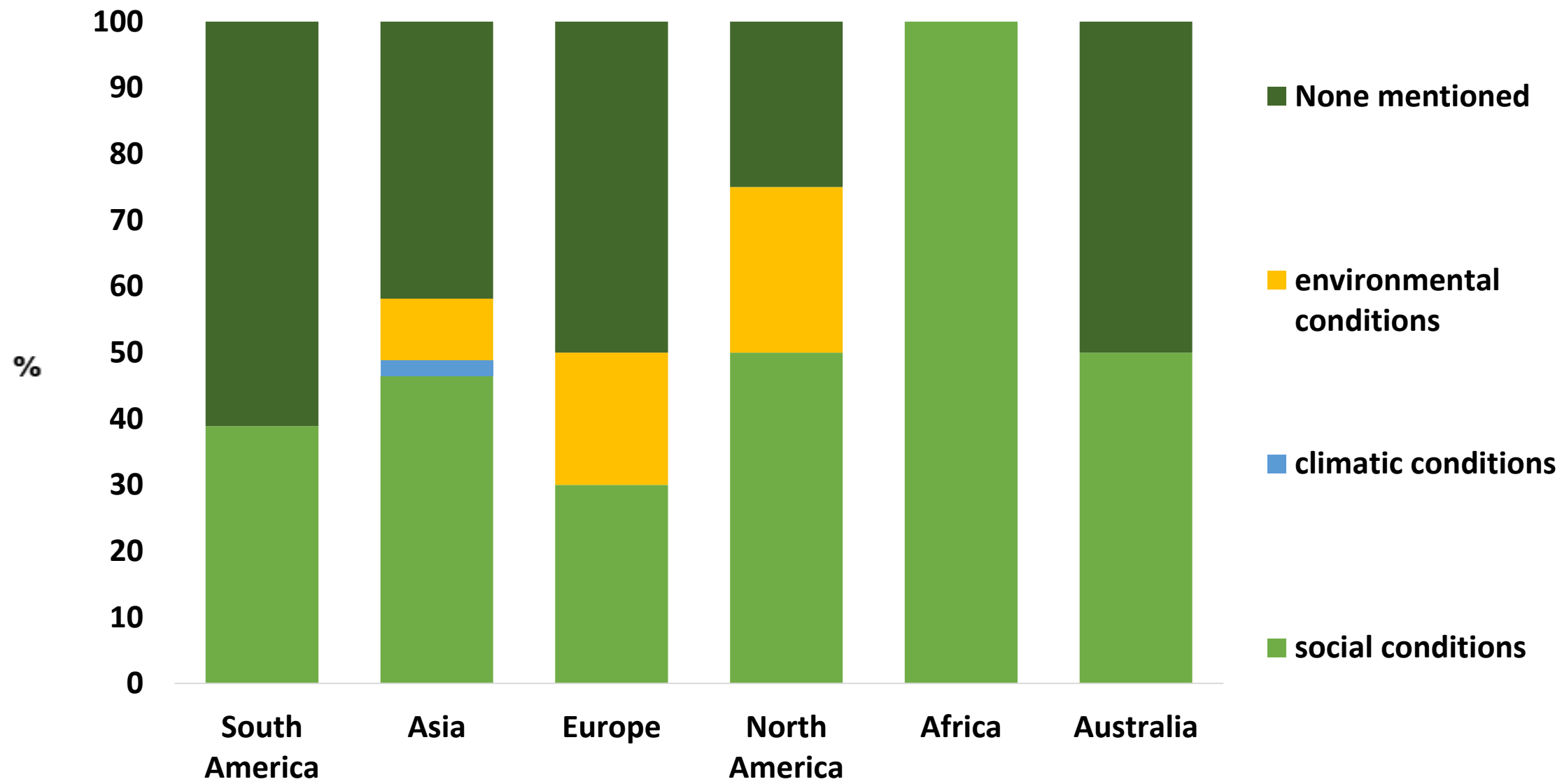


Fig. 7 Types of limits to adaptations

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and mountains under global change

CONCLUSIONS

- 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.
- The main limits to adaptations are misuse and lack of funds and 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, uncertainty in future climate change impacts etc. Even though adaptations have limitations, adaptations have both positive and negative impacts on their environment.
- 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. Also a number of failed adaptation programs have left people more vulnerable towards the induced stresses.