CLIMATE CHANGE IN AFGHANISTAN

WHAT DOES IT MEAN FOR RURAL LIVELIHOODS AND FOOD SECURITY?

FORWARD

Climate change is real. I invite anyone who may still doubt this to visit Afghanistan, and witness first-hand the alarming melting of the Pamir/Hindu Kush glaciers in the country's north-east. Afghanistan has already been, and will continue to be, heavily affected by the negative impacts of climate change. And it is the most vulnerable people—particularly subsistence farmers and pastoralists who depend on natural resources for their survival – who are suffering most.

Recognizing this, the Islamic Republic of Afghanistan has made many notable achievements towards addressing climate change over the past decade. At the national level, Afghanistan has successfully developed a number of policies and plans that target its most urgent climate change priorities and needs, including the National Adaptation Programme of Action (NAPA), as well as effectively mainstreamed climate change issues into a number of existing governance mechanisms. And, at the local level, Afghanistan's many institutions and partners are working directly with communities and civil society groups to build grassroots adaptive capacity.

More recently, at the Paris Climate Conference (COP21) held in December 2015, the Islamic Republic of Afghanistan committed to pursuing a Low Emission Development (LED) path as part of its global commitment to limiting greenhouse gas emissions. This commitment is all the more noteworthy considering the many competing development needs and challenges facing Afghanistan today, as well as the country's high level of vulnerability to the adverse impacts of climate change.

In the lead up to the 22nd session of the Conference of Parties to the United Nations Framework Convention on Climate Change (UNFCCC), the Islamic Republic of Afghanistan together with the World Food Programme (WFP) and the UN Environment Programme (UNEP) has prepared this technical report, *"Climate Change in Afghanistan: What Does it Mean For Rural Livelihoods and Food Security?"*

It is my great pleasure to launch this report and I look forward to seeing it being used, and referenced in the coming years. There is a lot of work to do for Afghanistan to be able to adapt and respond on climate action, and these technical reports and detailed scientific analyses help immensely in enabling better responses, and ultimately providing support to our people for a better life.

Mostapha Zaher

Director General

Member of the Cabinet

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Photo: NEPA/ Mostapha Zaher/ Wakhan District, Badakhshan

EXECUTIVE SUMMARY

Climate change in Afghanistan is not an uncertain, "potential" future risk but a very real, present threat— whose impacts have already been felt by millions of farmers and pastoralists across the country. In this report, we show how drought and flood risks have changed over the past thirty years, and what impact this has had on rural livelihoods and food security in the country. The aim is to inform national-level prioritization of areas and livelihoods groups for climate change adaptation and disaster risk reduction programmes.

The poorest people—particularly subsistence farmers and pastoralists who are often already living on marginal land—are also those who suffer most from climate change. Yet it is difficult to get an overall, national-level understanding of where the impact of climate change on food security and livelihoods are most worrying and need to be addressed most urgently.

Climate analyses tend to show which areas have seen—or are expected to see—the biggest change in rainfall, temperature or other physical climate parameters. However, such climate information on its own tells us little about what impact these changes will actually have on poverty and food security —as this depends on what livelihoods people depend on for food and income.

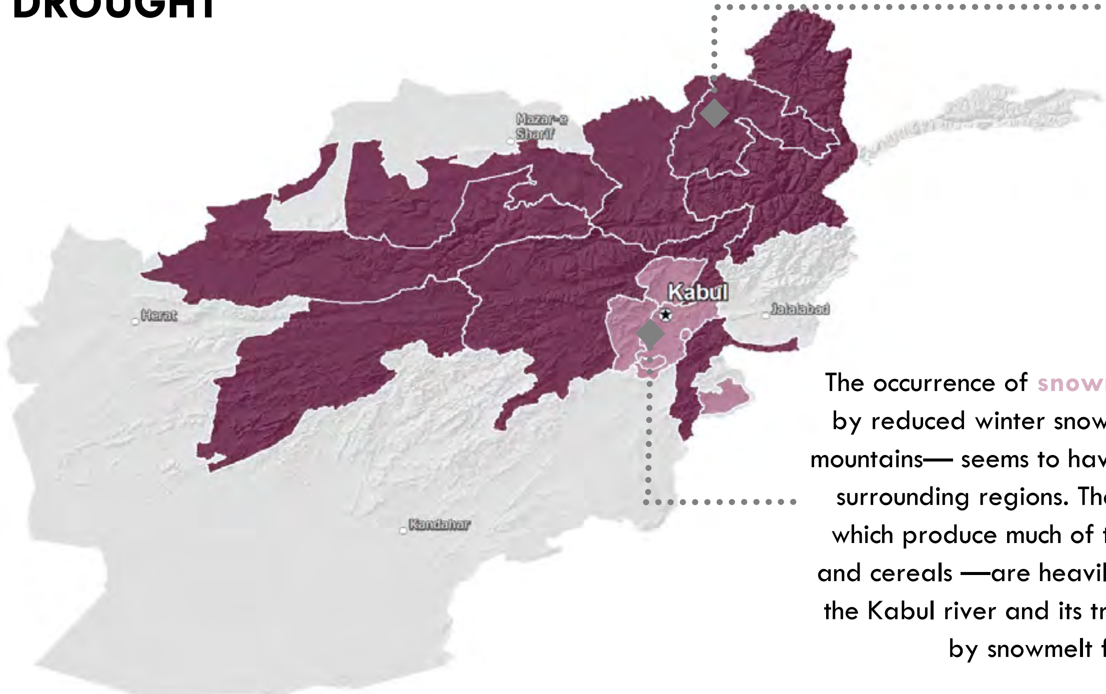
The guiding question for this analysis was therefore not "where have droughts or floods become more frequent and severe?", but rather "where has the impact of droughts and floods on livelihoods—and ultimately food security—been most severe?" To answer this question, we combine climate information with livelihood zoning to obtain an overview of which areas and population groups are most vulnerable to climate change.

We focus on the four climate hazards which pose the largest risk to livelihoods in Afghanistan: drought caused by reduced spring rainfall, drought caused by declining river flows due to reduced springtime snowmelt in the highlands, floods caused by increased heavy spring rainfall, and riverine floods caused by heavier and faster upstream snowmelt in the highlands.

For each of these four hazards, we mapped out where it had become more severe over the past thirty years, as well as where livelihoods were most sensitive to it. We then overlaid these two maps to highlight "hotspot areas" —i.e. livelihood zones where each of these hazards has had the largest impact on livelihoods and food security, over the past thirty years. Results are shown on the page opposite.

We also use climate models to look at how the risk associated with these four hazards is expected to change in the next thirty years—keeping in mind the high level of uncertainty associated with such climate projections.

DROUGHT

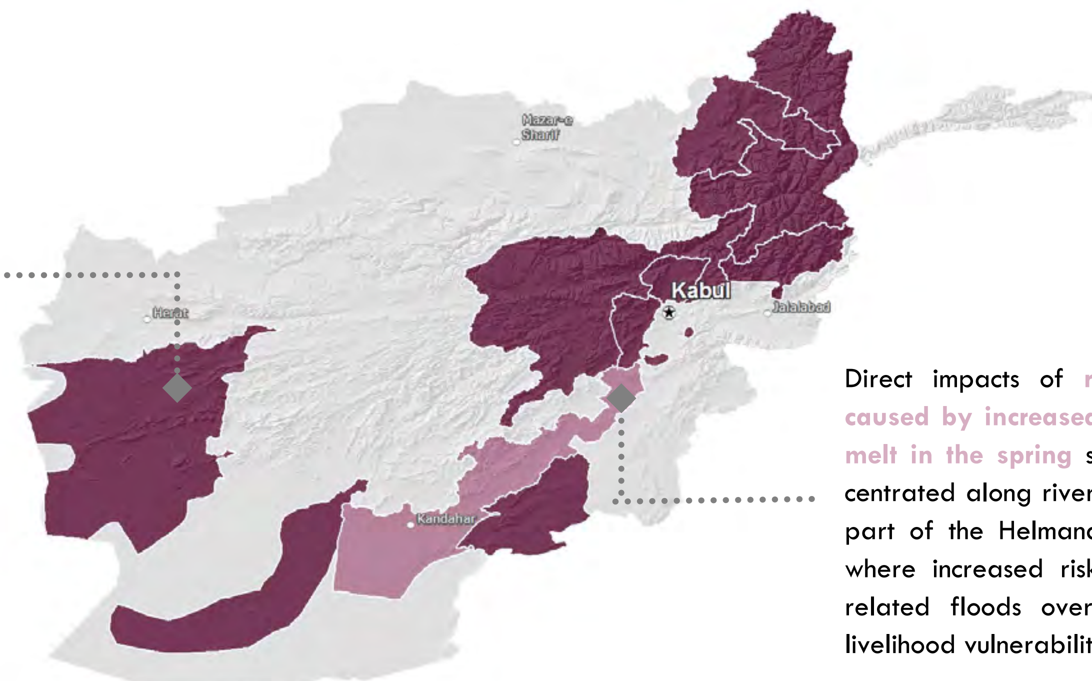


While the climatic risk of **rainfall-related drought** has increased over the past thirty years across most of the country, the main areas of concern in terms of negative impacts on food security are concentrated in the north and parts of the Central Highlands. These are areas where the dominant livelihoods—rainfed farming and pastoralism—are highly dependent on rainfall, and where the observed decline in spring rainfall therefore has a direct impact on households' ability to produce food and earn income.

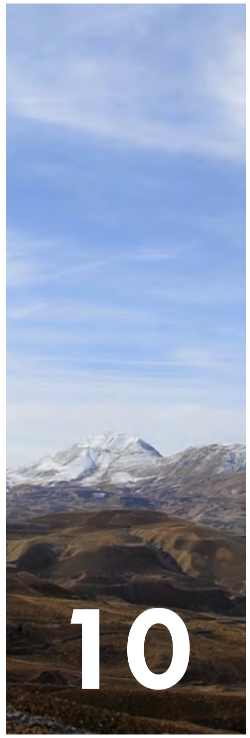
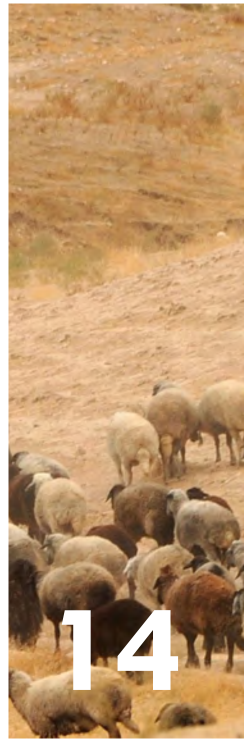
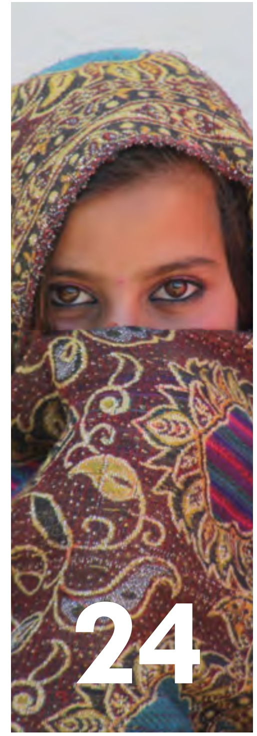
The occurrence of **snowmelt-related drought**—caused by reduced winter snowfall in parts of the Hindu Kush mountains— seems to have primarily affected Kabul and surrounding regions. These densely populated areas, which produce much of the country's vegetables, fruits and cereals —are heavily dependent on irrigation from the Kabul river and its tributaries, which are partly fed by snowmelt from the Hindu Kush.

FLOODS

Negative impacts of **floods caused by heavy spring rainfall** have been felt across a range of different livelihood zones – from the mountainous areas in the north-east and centre of the country, to the hilly border areas in the south-east, all the way down to the flat, arid southern provinces. These are zones where heavy precipitation events have increased by 10 to 25% in the past thirty years, and where livelihoods are dominated by agriculture and pastoralism—both highly sensitive to flooding.



Direct impacts of **riverine floods caused by increased spring snowmelt in the spring** seem to be concentrated along rivers in the eastern part of the Helmand river basin—where increased risk of snowmelt–related floods overlaps with high livelihood vulnerability to flooding.

CONTENTS

ACKNOWLEDGEMENTS

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The authors would like to thank FEWSNET, who produced the livelihood zones and profiles used in this report, under their Livelihood Zones Zoning "Plus" Activity.

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C-ADAPT Climate Resilience for Food Security: ANALYSES, INNOVATIONS & STANDARDS

SWEDEN

INTRODUCTION

Afghanistan's government has warned that climate change is putting "the foundation of the country's economy, stability, and food security under threat"[1]. Yet the very real risk posed by climate change to Afghanistan's development is usually overshadowed by the more immediate and visible concerns around conflict and economic crisis. This general perception of climate change as a secondary priority suggests that it is still misconceived as a purely technical, environmental problem—somehow distinct from socio-economic concerns.

Climate change does not occur in a vacuum: its impacts are intrinsically linked to the economic and security concerns which are at the top of the government's priorities. Climate change will make it extremely challenging to maintain—let alone increase—any economic and development gains achieved so far in Afghanistan. Increasingly frequent and severe droughts and floods, accelerated desertification, and decreasing water flows in the country's glacier-dependent rivers will all directly affect rural livelihoods—and therefore the national economy and the country's ability to feed itself. It is now widely acknowledged that "large parts of the [country's] agricultural economy will become marginal without significant investment in water management and irrigation."[1] Given the importance of agriculture to Afghanistan's economy and food security— agriculture is a source of income for 61% of the country's 29.1 million people, and accounts for 44% of employment (self-employed or salaried)[2]— this could increase both the number of food insecure people, and the severity of food insecurity (from transient/ seasonal to chronic, and from moderate to acute).

As conventional crops becomes less and less viable in some areas due to drought and desertification, rural populations will increasingly be driven to alternative livelihood options—including the production of less water-intensive poppy and, potentially, insurgency. The question of whether and how conflict and climate change are linked is still hotly debated. However, there is growing empirical evidence that while climate disasters are rarely the primary trigger for conflict outbreaks, they can exacerbate existing societal tensions—significantly enhancing the risk that a volatile situation will break out in conflict, or that a conflict which might otherwise have subsided will persist. A recent study found that the link between climate disasters and conflict was particularly strong in ethnically divided countries, and was stronger for droughts and heatwaves than for floods.[3]

Photos: WFP/ Diego Fernandez/ Mazar-e-Sharif

In Afghanistan specifically, some studies have linked reduced rainfall or irrigation flows in some areas with increased poppy production —which could in turn have helped finance and fuel the insurgency in the area.[4]

From a development and humanitarian perspective, climate change most directly and heavily affects the poorest people—particularly subsistence farmers and pastoralists who are already living on marginal land. The first step in helping Afghanistan's most vulnerable people to cope with and adapt to climate change is therefore understanding which areas and livelihoods are being most severely affected. This study is an attempt to better understand how climate hazards impact people—not just geographic areas. In other words, the aim is to go beyond simply showing which areas are highly prone to drought or floods, and instead to highlight how these shocks actually affect the people living in those areas—based on their livelihoods.

The guiding question was therefore not "where have droughts or floods become more frequent and severe?", but rather "where has the impact of droughts and floods on livelihoods—and ultimately food security—increased most?" This helps bridge the gap between the field of disaster risk reduction (which traditionally focuses on the physical occurrence of climate hazards) and that of livelihoods and food security analysis (which focuses on what people do for a living and how they obtain their food), in order to understand how specific climate risks impact the most vulnerable people.

Climate change in Afghanistan is not an uncertain, "potential" future concern, but a very real, present challenge— whose impacts have already been felt for years by millions of farmers and pastoralists across the country. This report seeks to highlight this by focusing primarily on changes that have already occurred in Afghanistan's climate over the past thirty years. However, we do present an overview of future risks under projected climate change in the last section. Despite the inherent uncertainties associated with climate projections, they help shed light on how the impacts on livelihoods that have already been observed might be exacerbated (or alleviated) in the future.

[1] Islamic Republic of Afghanistan (2015) Intended Nationally Determined Contribution, Submission to the UNFCCC.
[2] Central Statistics Organization (2016). ALCS 2013-14.
[3] Schleussner, C. et al. (2016) Armed-conflict risks enhanced by climate-related disasters in ethnically fractionalized countries.
[4] Parenti, C. (2015) Flower of War: An Environmental History of Opium Poppy in Afghanistan. SAIS Review of International Affairs.

METHODOLOGY

Livelihood zones—rather than administrative units such as provinces and districts—are the key analytical unit used in this study. A livelihood zone is an area within which people broadly practice the same type of activities to obtain food and income. The livelihood zones used here (see p.14) were developed by FEWSNet in 2011, in consultation with the Afghan government and development partners.

This report is structured around the **four climate hazards** with the largest impact on food security in Afghanistan: drought caused by localized lack of rainfall; drought in irrigated areas caused by reduced snowmelt in upland areas; floods caused by localized heavy rainfall; and riverine floods caused by rapid snowmelt in the spring. While the report does include a section on how Afghanistan's climate is projected to change under **future climate change** (p. 50-57) it mostly focuses on how climate hazards have **already changed** over the past decades.

For each of the four hazards listed above, we start by identifying the livelihood zones where this hazard has become more frequent and more severe over the past thirty years (**hazard analysis**). While this tells us whether a given area is prone to a particular hazard, it says little about whether that hazard actually has a significant impact on the livelihoods of people living there. For example, an area could be very prone to drought, but the dominant livelihood activities might not be particularly vulnerable to drought (manufacturing or handicrafts, for example).

Looking at hazard data on its own, with no contextual livelihood information, might therefore be misleading when it comes to identifying and prioritizing areas for development or humanitarian support.

The second step in the analysis is therefore to identify livelihood zones which are most vulnerable to this type of hazard — i.e. zones where, were this hazard to occur, it would have the largest negative impact on people's ability to grow food and earn income (**livelihood vulnerability**).

We then overlay these two maps to identify "**hotspot areas**" of concern in terms of food security—i.e. livelihood zones where this hazard has not only been occurring more frequently/ intensely over the past few decades, but where people's livelihoods have also been most severely affected.

Photo (opposite) : WFP/ Diego Fernandez/ Nahr-e-Shahi , Balkh

HAZARD ANALYSIS

This report looks at four types of climate hazards—distinguishing between two types of drought and floods because they are caused by different climate variables and affect different areas and livelihood groups:

(1) **Drought** caused by localized **lack of spring rainfall** , with the highest impact on rainfed agriculture and pastoral areas;

(2) **Drought** caused by **reduced snowmelt in upland areas** in spring and summer, mostly affecting downstream irrigated areas;

(3) **Floods** caused by localized **heavy spring rainfall**, affecting all livelihood zones;

(4) **Floods** caused by **increased snowmelt in highland areas** during the spring and summer, mostly affecting downstream agricultural livelihood zones, particularly areas located along rivers.

To understand how the occurrence of droughts and floods has changed over the past few decades, we use a combination of different climate indicators :

- For drought and flood caused by too little or too much rain, we look at changes in spring precipitation, heavy precipitation events and evapotranspiration.
- For drought and flood caused by too little or too much snowmelt in upstream mountain areas, we look at changes in number of snow days per year, winter precipitation, and spring temperatures in the Central Highlands, Hindu Kush and Pamir mountains.

Most of the climate data used in the report was produced by UNEP and NEPA using a combination of climate observations and regional climate models:

- **Past climate data** was produced through reanalysis—a method which combines climate models with observations (satellite and rain station data). This method was selected due to the scarcity of historical climate observations for Afghanistan before the start of satellite observations in the 1980s, which would make an analysis based solely on observations unreliable. To quantify change in climate trends, we looked at how much each climate indicator (spring rainfall, heavy rainfall, temperature etc.) had changed between the period 1950–1980 and the period 1981–2010 .
- **Future climate projections** were done using CORDEX South Asia models. Analysis was done for the period 2021-2050 (compared to the base period 1976–2005), for a moderately optimistic emissions scenario (RCP4.5) which assumes that both global greenhouse gas emissions and global average temperatures will continue to increase until 2040, and then plateau thereafter (see Annex 3 for details).

LIVELIHOOD VULNERABILITY TO CLIMATE HAZARDS

The second step in the analysis, after hazards analysis, is assessing the vulnerability of each livelihood zone to each of these four hazards. In other words, for each livelihood zone, we asked the question: how severely are people's access to food and income impacted by each of these hazards? Livelihood activities are not all equally vulnerable to climate factors, with agriculture and livestock activities considered more vulnerable to climate hazards than trade and cross-border labor migration. Furthermore, a given activity might not be equally vulnerable to different climate hazards. For example, timber harvesting might be highly vulnerable to drought but only moderately vulnerable to floods; rainfed crop production might be highly vulnerable to localized drought caused by lack of rainfall, but not vulnerable to drought caused by reduced availability of snowmelt water for irrigation.

For each of the four climate hazards, we therefore identified the livelihood zones most vulnerable to that hazard, in order to highlight hotspot areas where each hazard could potentially cause the largest impact on food security and livelihoods. Various sources of information on livelihoods was used for this: the climate change vulnerability matrix in Afghanistan's National Adaptation Programme of Action (NAPA, 2009), the 2013/14 Afghan Living Conditions Survey (ALCS), FEWSNet's Livelihood Zoning "Plus" report (2011), and the provincial Seasonal Livelihoods Programming (SLP) consultations carried out by WFP and partners in 2013. Because most livelihood zones include several livelihood activities, our vulnerability classification was based on the dominant activity practiced by the majority of households, focusing on the most vulnerable.

Again, a zone's vulnerability to a particular climate hazard does not tell us whether people are in fact exposed to that hazard—it simply tells us that livelihoods in that zone would be heavily impacted by that hazard *if it did occur*. For example, a livelihood zone could be highly *vulnerable* to drought because most households rely on rainfed cereal production, but have low *hazard risk* (i.e. the frequency and intensity of droughts has not increased) —in which case it would not be considered a hotspot in terms of food security.

Photo: WFP/ Diego Fernandez/ Mazar-e-Sharif, Balkh

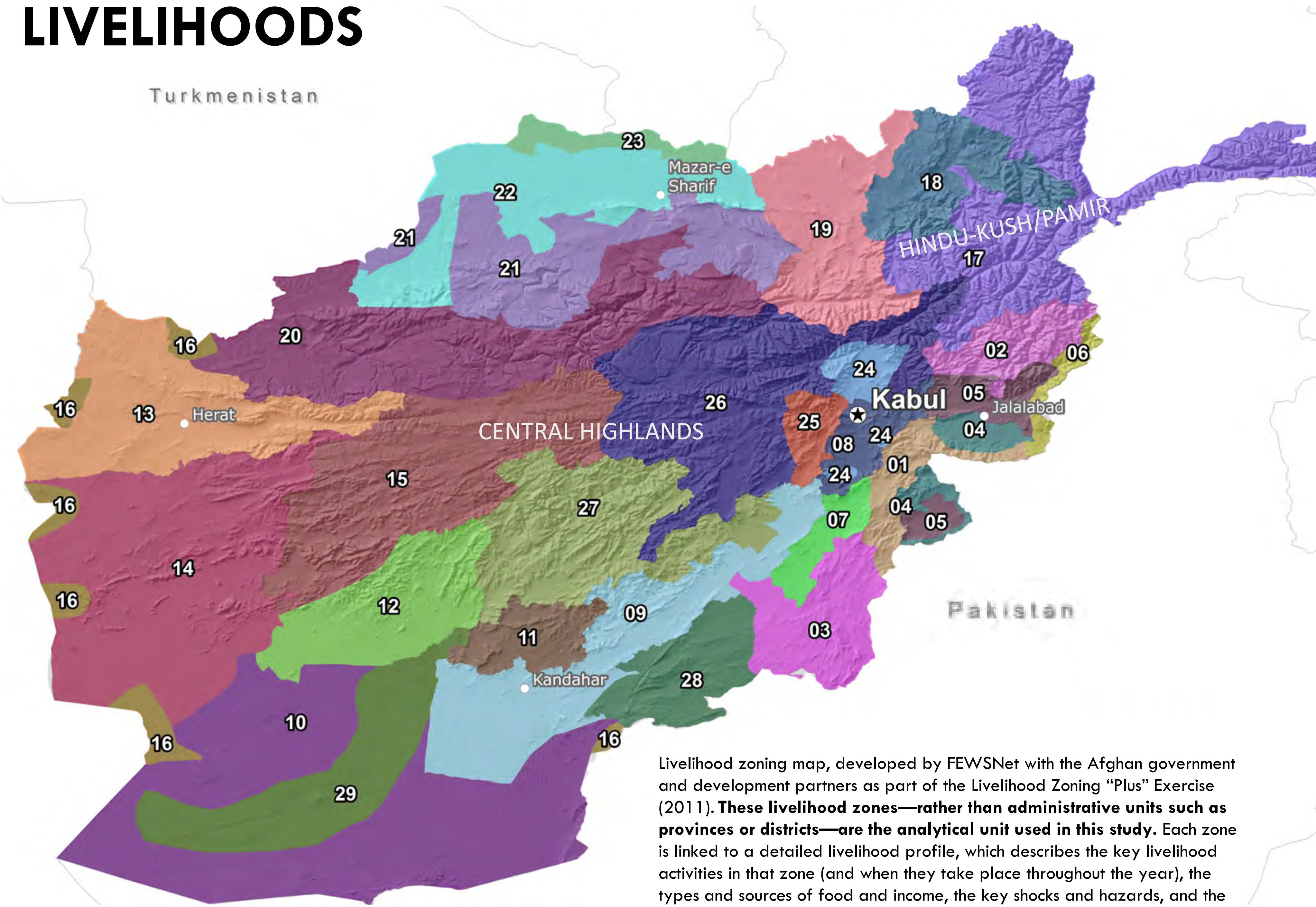
IMPACTS ON FOOD SECURITY: HOTSPOT AREAS

Finally, to identify the areas where climate hazards have most impacted livelihoods in the past thirty years, **we overlay the hazard and the livelihood vulnerability maps.**

We then use data on food security trends between 2007 and 2014 (see p. 24) to identify areas which simultaneously have high levels of food insecurity and where climate risks have particularly high impacts on livelihoods. While food insecurity in Afghanistan is obviously driven by many non-climatic factors, this allows us to highlight areas where reducing climatic risks could significantly improve food security— even if other drivers such as conflict or remoteness remain.

Photo: WFP/ Challiss McDonough/ Dega Payan, Badakhshan

LIVELIHOODS



Livelihood zoning map, developed by FEWSNet with the Afghan government and development partners as part of the Livelihood Zoning "Plus" Exercise (2011). **These livelihood zones—rather than administrative units such as provinces or districts—are the analytical unit used in this study.** Each zone is linked to a detailed livelihood profile, which describes the key livelihood activities in that zone (and when they take place throughout the year), the types and sources of food and income, the key shocks and hazards, and the level of access/ reliance on markets.

Livelihood Zones

1. Eastern mixed agriculture and forest zone
2. Eastern agro-pastoral and forest zone
3. South-eastern high migration, forest products, and livestock
4. Eastern semi-arid agricultural
5. Eastern intensive irrigated agriculture
6. Eastern cross-border trade and labor
7. Eastern deep-well irrigated agriculture
8. Kabul and Logar irrigated agriculture
9. Southern intensively irrigated vegetable and orchards
10. Southern semi-arid pastoral
11. Northern Kandahar rain-fed agriculture and livestock
12. South-central agro-pastoral
13. Western intensively irrigated agriculture zone
14. Western semi-arid agro-pastoral zone
15. West-central highland agro-pastoral zone
16. Western and southern cross-border trade and livestock
17. North-eastern highland agro-pastoral zone
18. Takhar-Badakshan mixed agriculture zone
19. Kunduz-Baghlan mixed agriculture zone
20. Northwestern agro-pastoral zone
21. Northern rain-fed mixed farming zone
22. Northern intensively irrigated agriculture zone
23. Amo river irrigated cereals and oilseeds zone
24. East-central vineyard, cereal and horticulture zone
25. East-central orchard and agriculture zone
26. East-central mountainous agro-pastoral zone
27. South-central mountain wheat, dried fruit and livestock zone
28. South-eastern Zabul rain-fed cereals and orchard zone
29. Helmand intensively irrigated wheat and cash crop zone

A livelihood zone is an area within which people broadly practice the same type of activities to obtain food and income. The physical environment—climate, topography, access to water, soil fertility—is an important determinant of livelihood zones, as it influences the type of natural resources available to people (forest products, pastures etc.), the crops they can grow, or the type of livestock they can keep. Having said that, environmental and climatic factors do not single-handedly explain the variations in livelihoods across Afghanistan: conflict, agricultural technology and techniques, transport, access to markets, poppy eradication campaigns, and proximity to borders all play a key role in determining how people obtain income and food.

Livelihood zones allow us to understand broad differences—at the national level—in how households make a living. In the context of this study specifically, they provide key insight in how climate hazards can have different impacts on food security throughout the country, depending on what activities households practice.

Of course, the degree to which a particular livelihood zone is negatively impacted by floods (for example) will depend not only on the magnitude of the floods and on how vulnerable livelihoods in that area are to floods, but also on poverty levels, conflict, access to additional farming inputs or assistance, amongst other things. This study, however, focuses on the link between climate and livelihoods, to provide a "baseline" picture into which other socio-economic/political considerations can be factored in.

Livelihoods in Afghanistan are heavily based on **farming and livestock**, which together account for about 45% of the active population, and are a source of income for over 60% of all households (and the primary source of income for 28% of households). [1]

Notable exceptions are areas along the border with Iran and Pakistan—where cross-border trade and migration dominate– and in urban areas (which account for about a quarter of the population) [1].

While the relative importance of agriculture will likely decline with economic development, the sector is expected to increase in absolute size, and is the government's main focus for economic recovery and poverty reduction.[2]

[1]Afghanistan Living Conditions Survey (ALCS) 2013/14.
[2] National Environmental Protection Agency (2015) Afghanistan Initial National Communication to the UNFCCC

Photos: (above) WFP/ Djaounsede Pardon; (opposite) UNEP/ Alec Knuerr/ Wakhan, Badakhshan: Amu Darya river separating Afghanistan (left) from Tajikistan (right).

FARMERS

Wheat is by far the most important crop produced in all areas, though its relative importance is higher in rainfed than in irrigated areas—where other crops are much more common (particularly fodder crops, potatoes, maize, sorghum, fruits and vegetables).

Although the lands under rainfed and irrigated cultivation are roughly the same in terms of geographic area, irrigated farming plays a larger role in livelihoods and food production: about 36% of all households have access to irrigated land, compared to 16% of households having access to rainfed land, and 80% of all cereals are produced in irrigated areas[1]. Rivers and streams are by far the dominant source of irrigation, feeding an estimated 86% of irrigated areas, followed by springs (7%) and the traditional gravity flow system known as *karez* (6%). Wells are not a significant source of irrigation (less than 1% of irrigated areas), though their number and capacity has been increasing due to greater use of modern drilling and pumping technologies[1].

[1] Ministry of Irrigation, Water Resources and Environment (2004): Watershed Atlas of Afghanistan; Afghanistan Research and Evaluation UNIT (AREU) (2008): How the water flows: a typology of irrigation systems in Afghanistan.

A distinctive feature of Afghanistan is that irrigation water flows depend not just on rainfall, but also to a large extent on snow and glacier melt. Discharge of snowfed rivers tends to peak in the spring when the snow melts in lower elevation areas, while discharge of glacier-fed rivers peaks in the summer, when higher elevation areas with permanent snow cover and glaciers start to melt.

Some snow-fed rivers, such as the Gomal and Shamal rivers in the south east, are also affected by summer monsoon rainfall, and therefore have two peak discharge seasons: one in the spring, and the other in the summer [1].

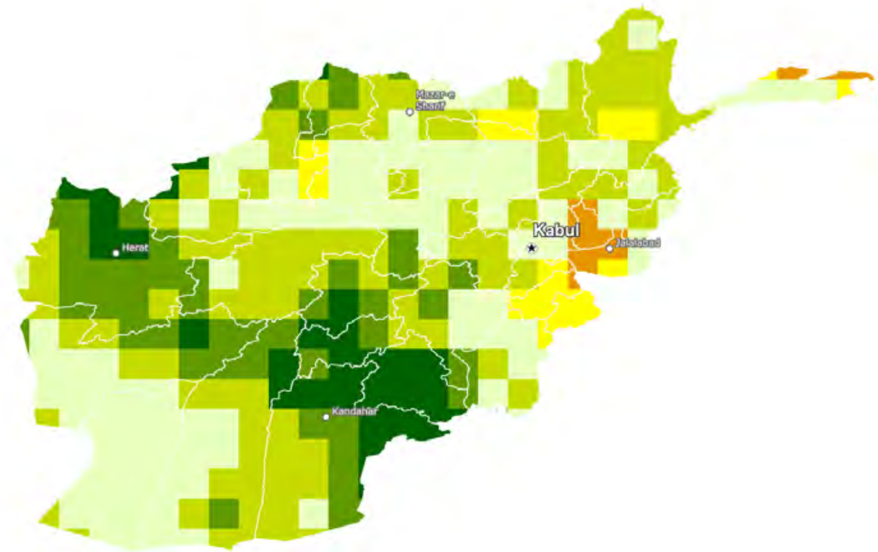
[1] Ministry of Irrigation, Water Resources and Environment (2004): Watershed Atlas of Afghanistan; Afghanistan Research and Evaluation UNIT (AREU) (2008): How the water flows: a typology of irrigation systems in Afghanistan.

Photo: UNEP/ Alec Knuerr/ Glacial waters in Badakhshan

One often overlooked impact of climate change on food security is its impacts on the **length of the growing season**: shorter growing seasons in rainfed areas means that only one major crop can be harvested per year, instead of two. Cropping intensity—or the ability to grow more than one crop per year, is an important determinant of rural food security.

In Afghanistan, the growing season has gotten longer in much of the country over the past thirty years, due to warmer spring and fall temperatures—particularly across a band stretching from Herat in the west to Zabul in the south east. A notable exception is the pocket around Nangarhar and Laghman in the north-east, where the growing season has gotten shorter. Not surprisingly, this corresponds to an area where there has been no increase in temperature (map p. 67).

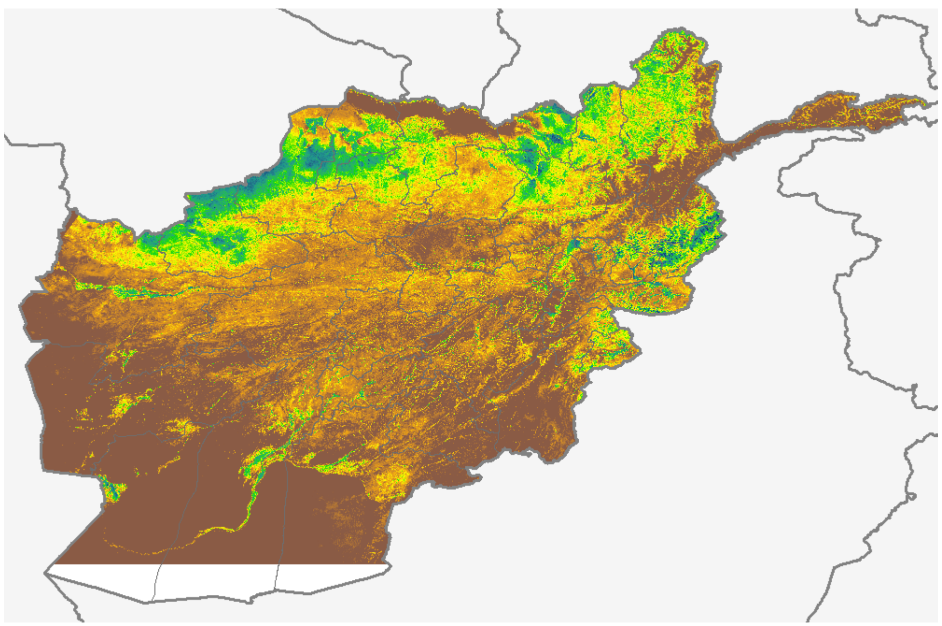
However, the longer growing season in the west and south-east may not have necessarily translated in increased in agricultural productivity, as it was accompanied by a decrease in spring rainfall over the same time period (map p. 64)—meaning that crop growth could have been impeded by lack of rain, despite adequate temperatures.



Change in growing season length[1] (difference between 1950–1980 and 1981–2010). Data from UNEP and NEPA.

- > 10 days longer
- 10– 15 days longer
- 5– 10 days longer
- 0-5 days longer
- 0 to 5 days shorter
- > 5 days shorter

[1] Growing Season Length (GSL) is a standard index defined by the World Meteorological Organization (WMO), which counts the days between the first span of at least six days with daily mean temperature above 5°C and the first span after July 1st of six days with mean temperature below 5°C, in a given year (based on assumption that crops don't grow below 5°C).



Vegetation maximum development (NDVI), 2001-2014. Map by WFP, using data from Modis/ Terra 250mt.

Bare soil — Highly vegetated

PASTORALISTS AND AGRO-PASTORALISTS

Livestock is also a key source of income and food for many households, either as a supplement to farming, or as the main livelihood—especially for the nomadic pastoral Kuchis. Over 45% of the country's total land mass is estimated to be under permanent pasture (almost four times the area covered by arable land)[1].

Kuchis, which represent an estimated 5.2% of the population (1.6 million people)[2], were traditionally all nomadic and entirely dependent on livestock—particularly goats and sheep, as well as camels. Over the past decades, however, many Kuchis have been forced to sedentarize and seek unskilled work on the outskirts of cities, due to a combination of conflict over grazing areas, prolonged drought, security, and unfavorable economic trends[3]. Nevertheless, most Kuchis remain highly dependent on livestock, with almost 70% of active Kuchis employed in the livestock sector in 2014[2] —and as such are one of the groups most vulnerable to rainfall-related droughts, which have become more frequent in the southern arid rangelands where many Kuchis spend the winter.

Because Kuchis have traditionally migrated from one area to another rather than settled in any one place, there is no specific "Kuchi livelihood zone" in the livelihood zoning used here. However, pastoral and agro-pasoral zones (mostly concentrated in the country's arid south and in the Central Highlands), are considered important Kuchi areas. Rainfall-related drought is therefore of particular concern in these areas, given that Kuchis are already amongst the country's most food insecure and marginalized population, and given how much their income and food depend on good pasture conditions.

Photos: WFP/ Diego Fernandez/ Mazar-e-Sharif , Balkh (above); Challiss McDonough/ Sarhad-e-Broghil , Wakhan (opposite).

[1] Afghanistan National Risk and Vulnerability Assessment (NRVA) 2011/12.
[2] Afghanistan Living Conditions Survey (ALCS) 2013/14.
[3] Afghanistan Analyst Network (2013). The Social Wandering of the Afghan Kuchis.

WOMEN'S LIVELIHOODS[1]

Unemployment and underemployment are a major issue in Afghanistan—affecting close to **40% of the total working-age population.** Women are particularly affected: over half of women who are of working age and seeking employment are either underemployed or unable to find a job at all (1.1 million people). This is in addition to the 71% of women (5.4 million) of working age who are inactive and not seeking employment. This means that 85% of the female working-age population (6.5 million people) is either unemployed, underemployed or inactive. This compares with 47% of working-age men.

Trends in women's employment are worrying. **Between 2007 and 2013, the female unemployment rate almost doubled, in both urban and rural areas.** Interestingly however, the *inactivity* rates over the same period have followed opposite trends in urban and rural areas—possibly due to different evolutions of the socio-cultural and security contexts in urban and rural areas. In rural areas, female inactivity has increased in tandem with unemployment (going from about 50% to 70%); in urban areas, on the other hand, inactivity rates actually *decreased* slightly (going from 81% to 78%).

This suggests that **active women** (i.e. who are employed or seeking employment) **are finding it harder to find a job in both urban and rural areas.** However, the number of women who actually *want* to work is increasing in urban areas but decreasing in rural areas. This likely reflects the fact that **working is becoming more and more socially accepted for women in cities, but less accepted—and less safe—for women in rural areas.**

Inactivity amongst men in rural areas has also increased over the same period, but much less—reinforcing the idea that this increased inactivity amongst rural women is primarily driven by increased social conservatism and security concerns—rather than purely by the country's general economic situation.

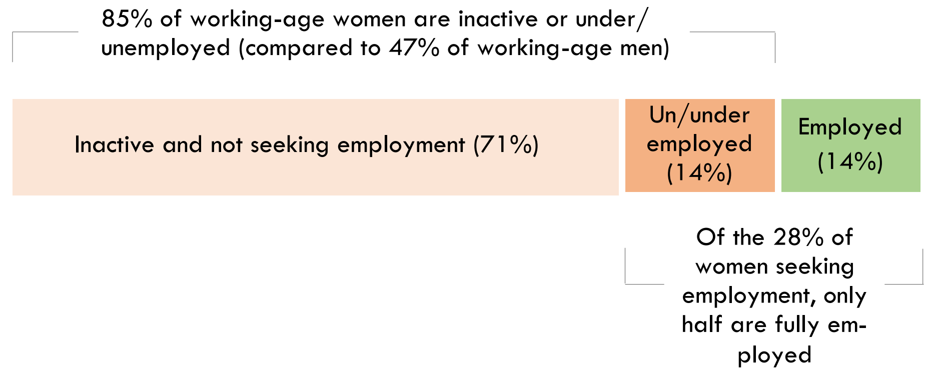


Figure 1: Employment profile of the working-age female population in Afghanistan.

Of the 1.3 million women who are employed (fully or partially), the vast majority (73%) are engaged in **unpaid family work**. In terms of sector of employment, **livestock production** dominates, accounting for 42% of employed women. Manufacturing (24%) and farming (21%) are the next most important sources of employment. Women's employment rates varies significantly between urban, rural, and Kuchi (nomadic pastoral) populations, being significantly higher among Kuchi women (close to 50%) than rural women (about 30%) and urban women (about 20%).

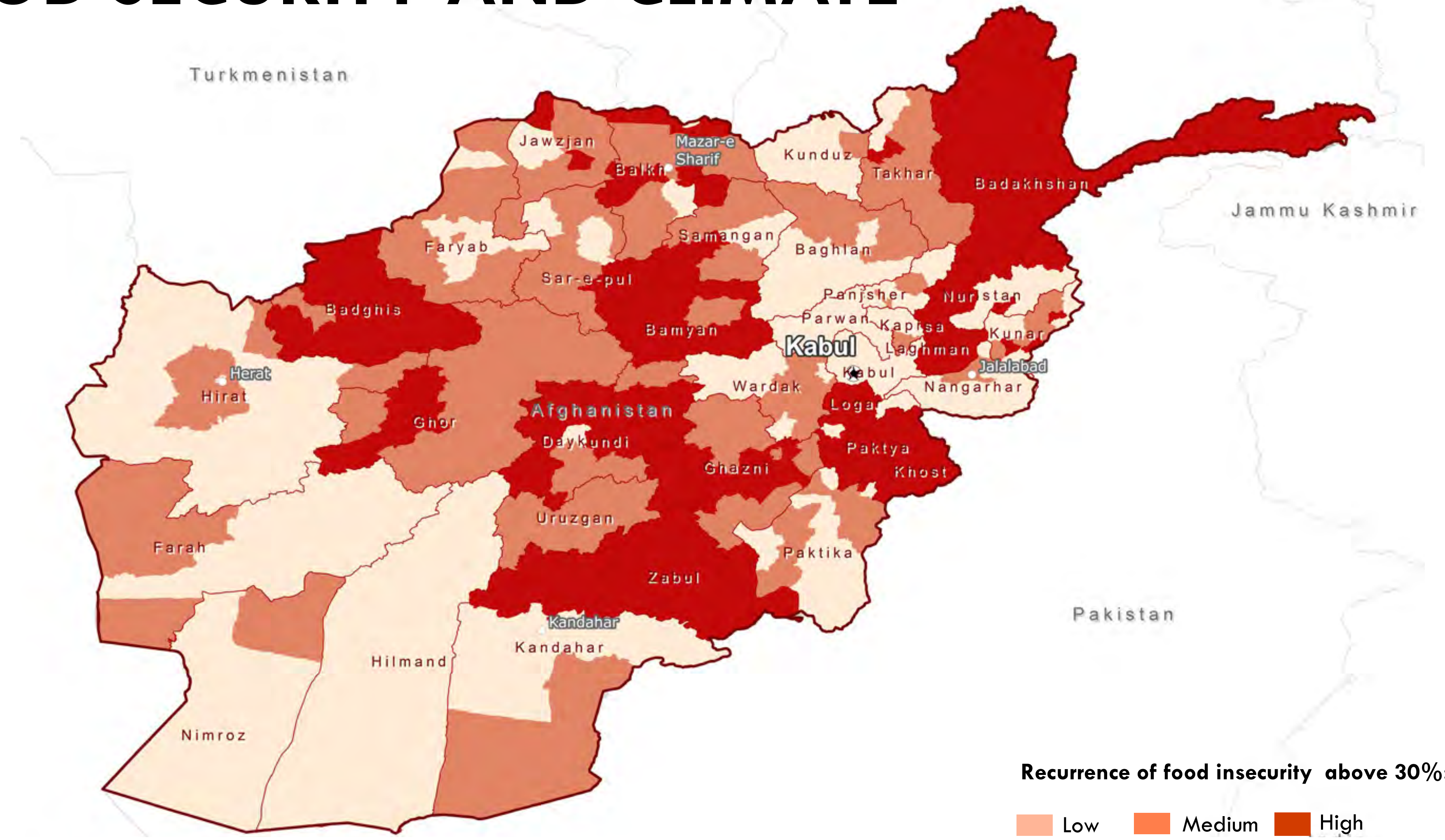
Unlike men, **women rarely migrate internally or emigrate abroad for work** (77% of internal migrants and 94% of those who emigrate abroad are men). The few women who do migrate or emigrate usually do so for marriage or to join family members, rather than to seek work.

Another major difference with men is that **women's employment does not vary much across age groups:** within the 14—60 years of age working-age bracket, women's employment goes from 29% for girls aged 14, to 33% for women aged 45-49. In contrast, men's employment rates within this same working-age bracket varies vastly—going from a low of 50% for boys aged 14, and peaking at almost 100% for men aged 30-49.

[1] All data in this section from ALCS 2013/14.

Photo (opposite): WFP/ Silke Buhr/ Shash Pul valley, Bamyan

FOOD SECURITY AND CLIMATE



Food security trends over the past seven years: recurrence of food insecurity above 30%, 2007—2014. Note that although livelihood zones are used as the analytical unit for the rest of this study, we look at food insecurity by district, because food insecurity in Afghanistan depends on a wide variety of factors that are not linked to livelihoods – including conflict, access to markets, and food prices in local markets. Some districts belonging to the same livelihood zone therefore have vastly different levels of food insecurity, so aggregating results by broad livelihood zone would be misleading. Because of this difference in analytical units, the food security information presented here is used only to contextualize the results of the analysis, but is not actually overlaid in any of the final "hotspot" maps. Analysis and map done by WFP in 2016 as part of the Integrated Context Analysis (ICA).

Data source: NRVA 2007/08, NRVA 2011/12, ALCS 2014.

Photo (opposite): UNEP/ Alec Knuerr/ Ishkashem, Badakhshan

Because this report seeks to highlight the impact of climate risks on food security and livelihoods, it focuses on rural areas, and on the two underlying factors of food security which are directly affected by climate conditions: **local agricultural production** and **household income**. It does not explore the myriad other factors which influence food security in Afghanistan, notably conflict, food imports, access to markets, and food prices.[1]

In rural Afghanistan, agricultural production and household income are closely linked. Indeed, the majority of rural households' income is derived from agricultural production – either from the sale of their own production (for those who own land), or from wages (for those who work as daily laborers on other people's land). Household income is a major determinant of food security, given that both rural and urban households tend to rely much more on markets than on their own production for food.

Because cereals (particularly wheat) are the main staples in the Afghan diet, the source of cereals consumed is used as an indicator of where households mainly obtain their food from. The latest data suggests that 76% of all households purchase most of the cereals consumed by their household, with the remaining 23% relying mostly on home-produced cereals. Not surprisingly, almost all urban households (97%) buy the majority of their cereals[2]. However, purchases are also extremely important among rural households—73% of which buy most of their cereals.

Importantly, food insecure households are most dependent on markets: in rural areas, 80% of severely food insecure households buy most of their food, compared to only 66% of food secure households[2]. This particularly high reliance on market purchases among food insecure rural households largely reflects the fact that they are often either landless or own too little land to produce enough food for the whole year. As a result, poorer households usually work as daily agricultural laborers for at least part of the year, and are paid either in cash or in-kind, through a sharecropping system known as *dekhani*.

This means that even though households purchase most of their food, rural livelihoods and food security are still closely linked with climatic factors — since the amount of daily agricultural labor available throughout the year depends in large part on agricultural conditions (favorable planting conditions and good harvest).

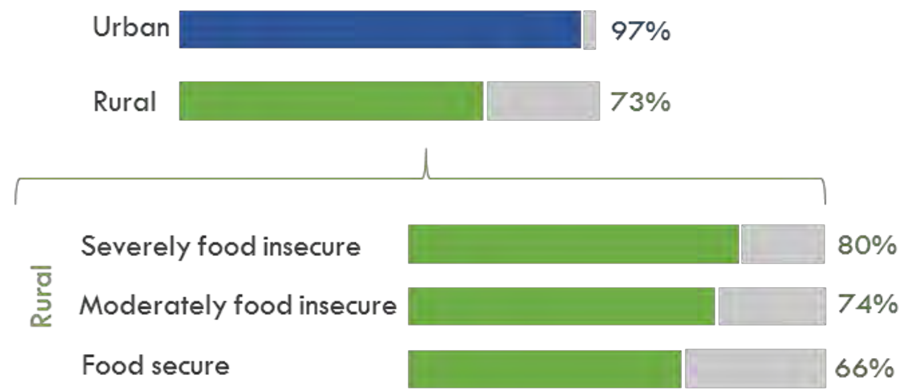


Figure 2: Share of purchases in total household cereal consumption, by location and food security status (Data from ALCS 2013/14).

[1] The impact of climate risks on prices are, to some extent, implicitly addressed, as climate-related decreases in local production will obviously affect prices in that area, thereby impacting households' access to food. However, prices in any given area depend not just on local production, but also production in other parts of the country and in neighboring countries – especially in Afghanistan's main import trading partners, Pakistan, China, Iran and India.

[2] Afghanistan Living Conditions Survey (ALCS) 2013/14.

Photo (opposite): WFP/ Teresa Ha/ Mazar-e-Sharif, Balkh

Cash & Voucher Project
پروژه کوپون نقده
UN - World Food Program
Type of Project/Activity: Cash & Voucher
Project Location: Seven districts of Mazar City
Duration:
Starting and Completion date:
Jul 2011 to Feb 2012
WFP Cash Voucher
Price of Voucher
AFN 1250
Voucher food items
Wheat or Wheat flour
Rice
Pulses
Oil
Sugar
Salt
Kg
Food Voucher
Number of Beneficiaries in Mazar City: .... 3000 HH
برادران هروی
WESTON

DROUGHT

This report distinguishes between two types of drought: localized drought caused by lack of rainfall, and drought caused by reduced river discharge due to reduced snowmelt in upland areas in spring and summer. This distinction is important because these two types of drought do not have the same climatic causes and do not necessarily affect the same areas.

The first type of drought is caused by localized lack of rainfall during the rainy season, and has a particularly strong impact on rainfed agricultural areas; the second type is caused by less winter snowfall in the mountains, resulting in less snowmelt in the spring and reduced river or *karrez* flows downstream.

Some areas are affected by both types of drought, sometimes during the same year.

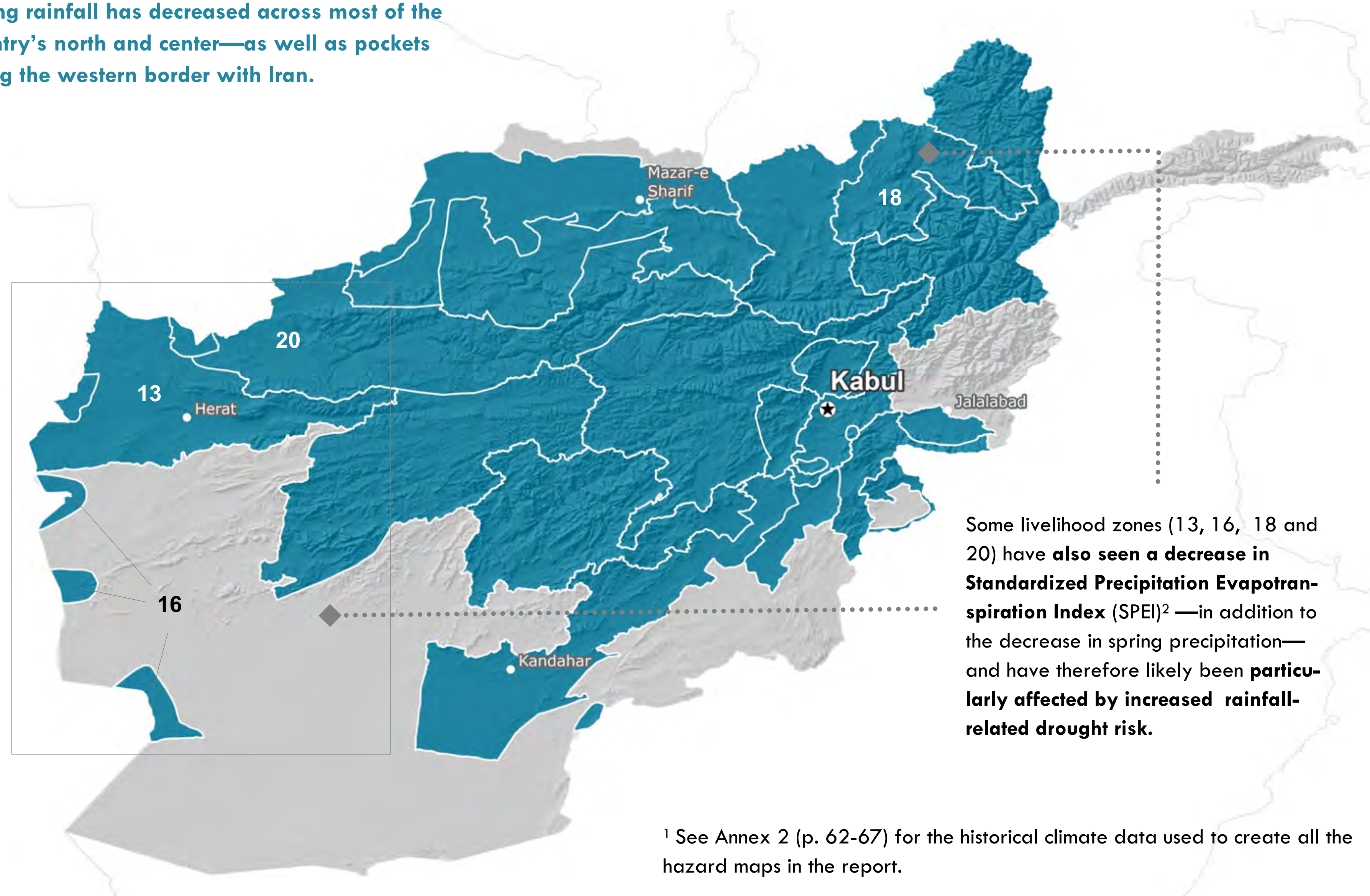
Photo (opposite): WFP/ Teresa Ha/ Khram wa Sarbagh , Samangan.

Food distribution as part of a WFP emergency food-for-assets project implemented following the lack of rain and snow during the 2010-11 winter. The resulting drought conditions caused a significant reduction of the wheat harvest, leaving 2.86 million people in need food assistance, in areas that were already chronically food insecure.

LOCALIZED DROUGHT DUE TO LACK OF RAINFALL

HAZARD[1]

Spring rainfall has decreased across most of the country's north and center—as well as pockets along the western border with Iran.



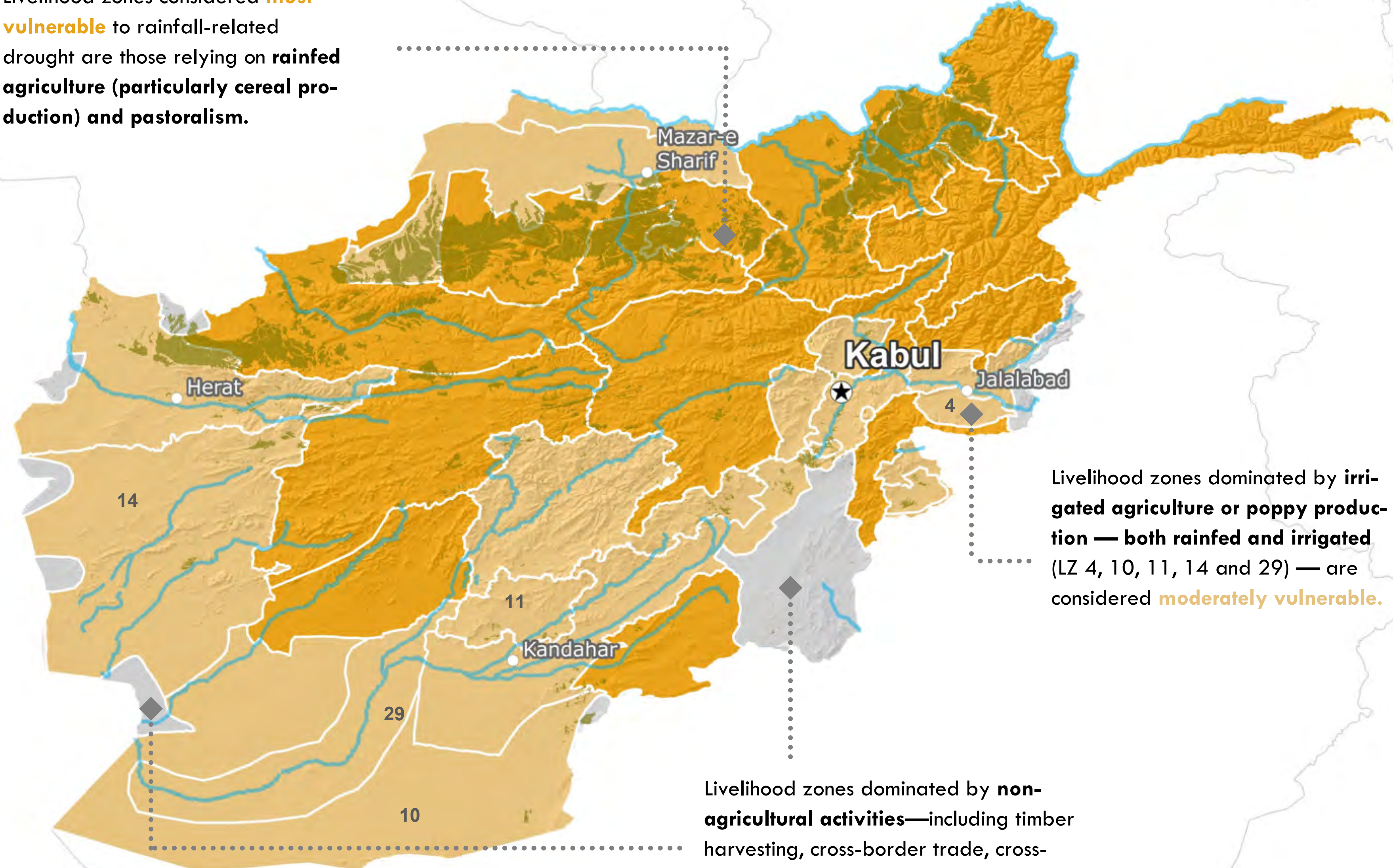
Some livelihood zones (13, 16, 18 and 20) have **also seen a decrease in Standardized Precipitation Evapotranspiration Index** (SPEI)[2] —in addition to the decrease in spring precipitation—and have therefore likely been **particularly affected by increased rainfall-related drought risk.**

[1] See Annex 2 (p. 62-67) for the historical climate data used to create all the hazard maps in the report.

[2] The SPEI is a measure of drought (calculated over a 12 months period), which captures both precipitation and potential evapotranspiration levels.

LIVELIHOOD VULNERABILITY

Livelihood zones considered **most vulnerable** to rainfall-related drought are those relying on **rainfed agriculture (particularly cereal production) and pastoralism.**

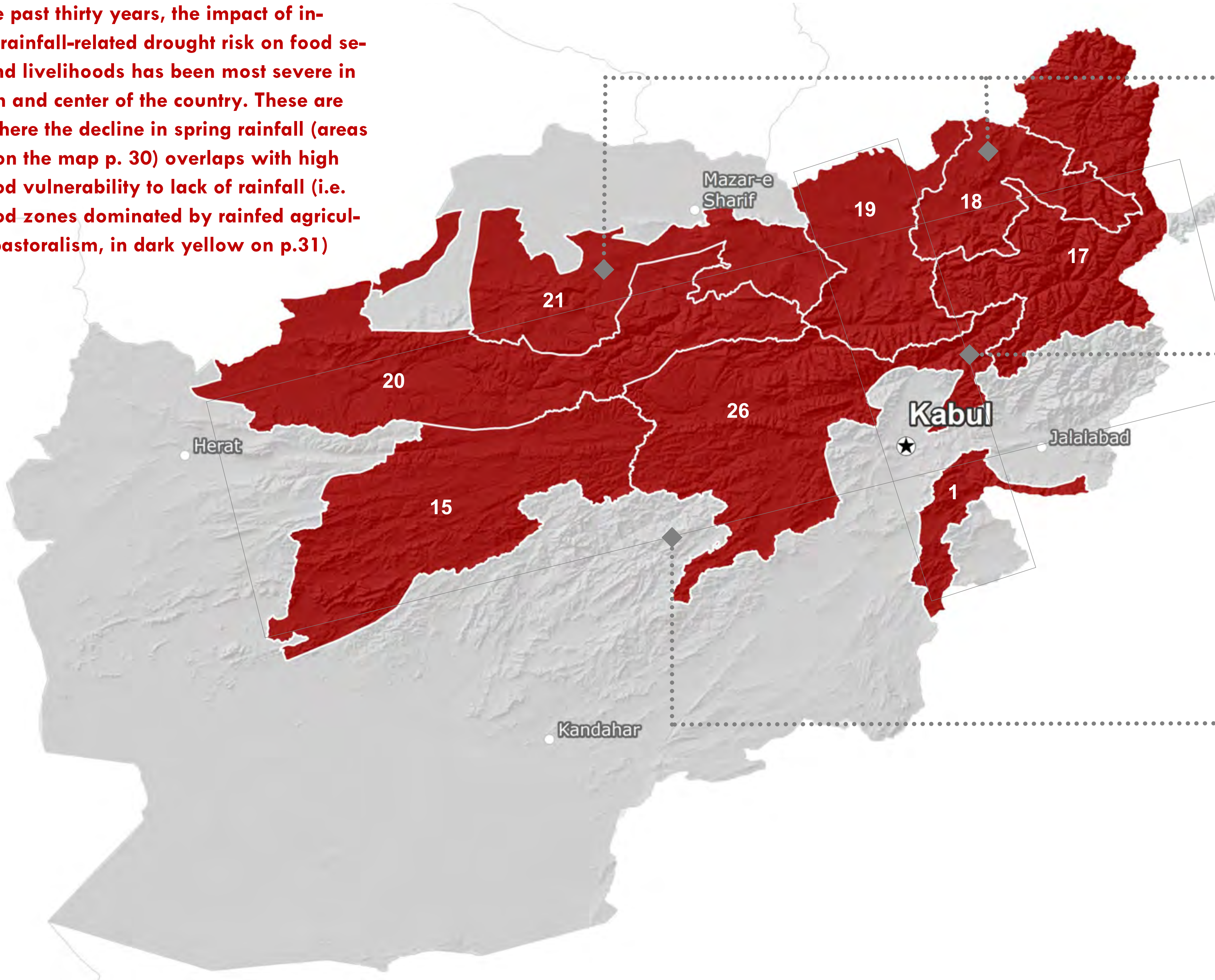


Livelihood zones dominated by **irrigated agriculture or poppy production — both rainfed and irrigated** (LZ 4, 10, 11, 14 and 29) — are considered **moderately vulnerable.**

Livelihood zones dominated by **non-agricultural activities**—including timber harvesting, cross-border trade, cross-border labor migration, and handicrafts—are considered **least vulnerable**.

Rainfed-dominated areas (Data from AMIS)

Over the past thirty years, the impact of increased rainfall-related drought risk on food security and livelihoods has been most severe in the north and center of the country. These are areas where the decline in spring rainfall (areas in blue on the map p. 30) overlaps with high livelihood vulnerability to lack of rainfall (i.e. livelihood zones dominated by rainfed agriculture or pastoralism, in dark yellow on p.31)



Low-productivity rainfed mixed farming zones (18 and 21), which stretch across the north through parts of Faryab, Sari Pul, Samagan, Takhar and Badakshan. These areas are affected by chronic **food insecurity**, in part due to small land size, which means that most households only produce a few months-worth of food on their own land. Sharecropping is the main source of food and income for poorer households: land-poor laborers work on better-off households' farms, in exchange for part of the harvest (typically following a ratio of 3:1 or 2:1 land-owner: laborer)[1]. It is also common for poor households to send one male family member to Iran or Pakistan during the winter, to work in construction or other off-farm employment. **Labor migration and food insecurity are likely to increase further if current drought trends continue:** not only will poor households produce even less on their small plots, demand for casual labor on better off households' farms will also decline.

Productive rainfed mixed farming zones (1 and 19), which cover most of Kunduz and Baghlan provinces in the north, as well as parts of Paktia, Logar and Nangahar in the east. These densely populated and generally food secure areas depend on rainfed agriculture to produce cereals and cash crops. They **provide both surplus grains as well as labor opportunities for the surrounding areas**. Decreased agricultural productivity because of declining spring rainfall in these zones can therefore have **significant impacts on food security and livelihoods well beyond these immediate areas.**

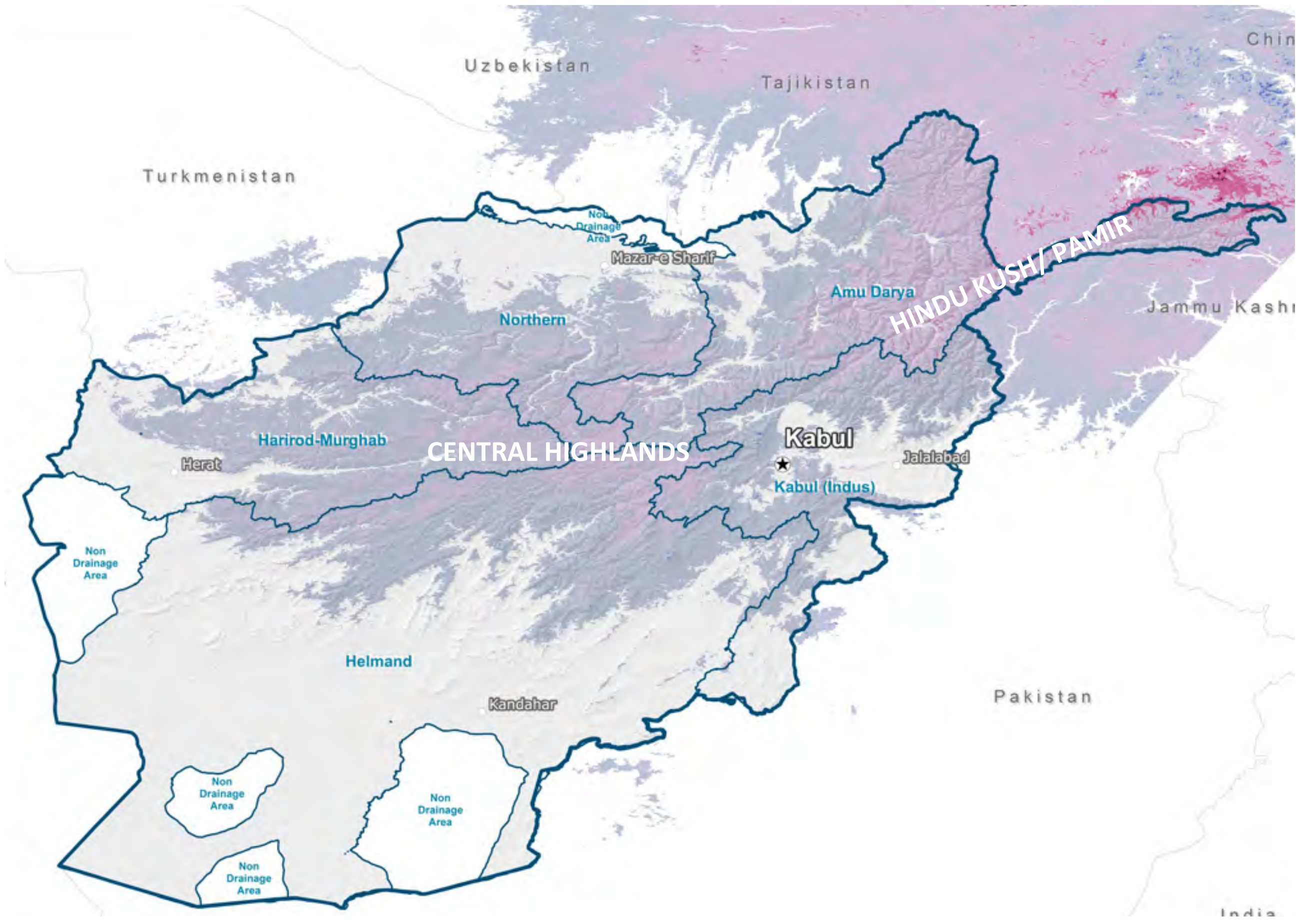
Mountainous Agro-Pastoral zones(15, 17, 20, and 26), covering much of Bagdhis, Sari Pul, Ghowr and Bamyan provinces in the Central Highlands, as well as most of Badakshan (except the Wakhan corridor, where spring rainfall appear to have increased rather than decreased). These zones usually depend on a mixture of livestock production and farming—mostly rainfed, though some households also have access to snowmelt irrigation. Though sparsely populated, most of these areas are amongst the country's most food insecure, due to a combination of remoteness, limited access to markets (especially in winter), and limited agricultural productivity. Any increase in the frequency and severity of drought in these areas is therefore **particularly concerning, as it risks further exacerbating food insecurity—either increasing the severity of food insecurity, or pushing households which were previously only seasonally food insecure into chronic food insecurity.**

[1] FEWSNet (2011). Livelihood Zoning "Plus" Activity for Afghanistan.

IRRIGATION DROUGHT DUE TO REDUCED SNOWMELT

Whereas drought in rainfed areas is primarily caused by lack of rainfall locally, drought in irrigated areas is in large part linked to climate conditions further upstream. **Spring and summer water flows in all three of Afghanistan's main irrigation systems— rivers, *karez* and springs— depend to a large extent on the amount of snow that falls the preceding winter in the Hindu Kush mountains or the Central Highlands,** where these systems originate. Lower snowfall in winter leads to lower snowmelt in the spring and summer, leading to reduced water flows in downstream irrigation systems. For example, an area which relies on *karez* irrigation could face drought in the summer—despite normal local rainfall conditions that year—due to lack of snow during the preceding winter at the catchment source in the mountains.

To understand where drought risk has increased most in irrigated areas over the past few decades, we therefore looked at changes in winter snowfall in the mountains where the country's five major river basins originate. For livelihood zones located in the Northern, Harirod-Murghab and Helmand basins, we looked at changes in snowfall in the Central Highlands. For the Kabul basin, we looked at changes in snowfall in the Hindu Kush mountains, further north east. Finally, for the Amu Darya basin, which is part of a larger transboundary catchment originating outside of Afghanistan, we looked at changes in snowfall in the Pamir mountains, in the Wakhan corridor and in neighboring Tajikistan.



Change in number of snow days per year (2000—2014) and main river basins. Map by WFP, data from Modis/ Terra.

Snow absent or uncommon

Strong decrease (> 64 days less)

Medium decrease (32—64 days less)

Light decrease (0—32 days less)

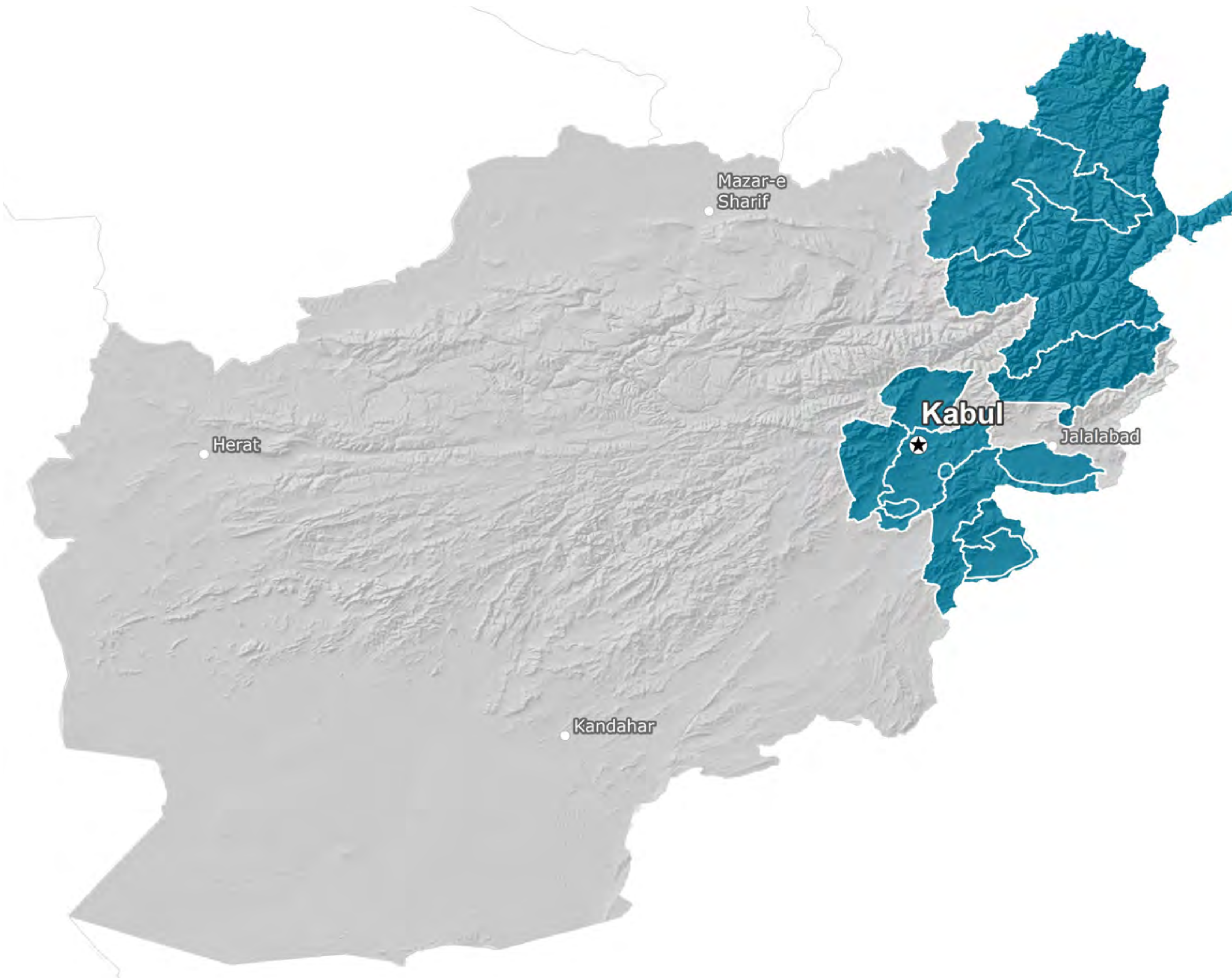
Light increase (0—32 days more)

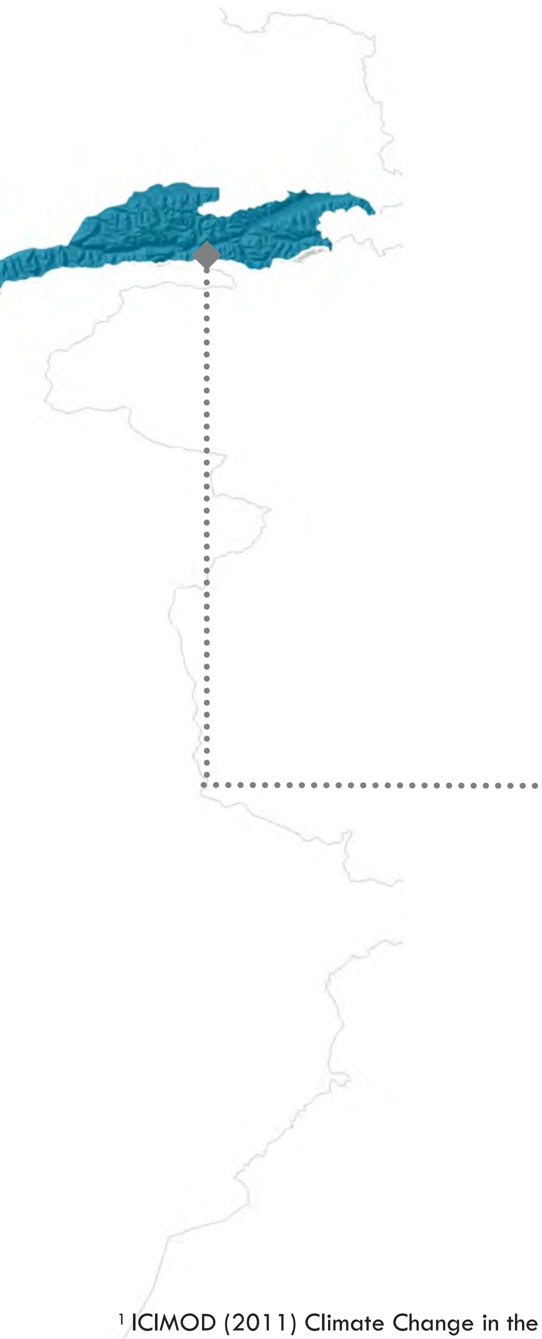
Medium increase (32—64 days more)

Strong increase (>64 days more)

Photo: WFP/Challiss McDonough / Sarhad-e-Broghil, Wakhan

HAZARD





The extent, rate and spatial variation of glacier melt in the Hindu Kush-Himalaya mountain range is still not well understood, nor is the impact of this melting on river discharge downstream[1].

However, research suggests that many of the region's glaciers are retreating [2, 3]. There is also evidence that river flows in the Amu Darya and its tributaries, which takes its source in the Hindu Kush and Pamir glaciers, has decreased in recent years.

Despite these uncertainties, there is therefore a very real **risk that river flows in the Kabul and Amu Darya basins will decrease significantly in the near to medium term future.** This would have serious implications for irrigated agriculture, and water access more generally, in some of Afghanistan's most populated and productive regions.

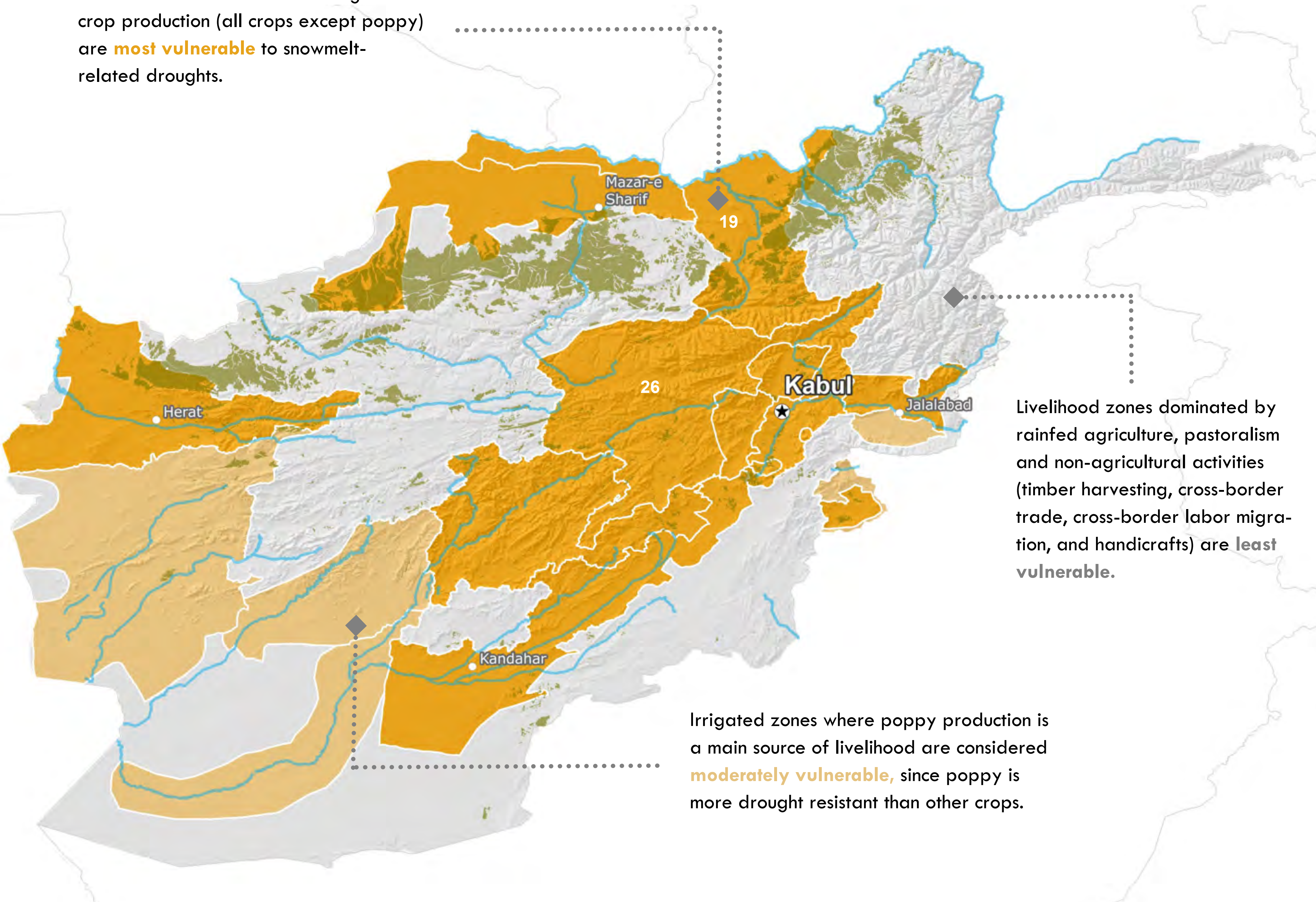
Over the past thirty years, the risk of drought caused by reduced snow/ ice melt appears to have increased the most in **north-east Afghanistan**, due to **reduced winter snowfall in the upper parts of the Hindu Kush/ Pamir mountains (in Tajikistan and Badakhshan).**

Note that this map shows the drought risk related to changes in annual snowmelt in elevated areas, which have an immediate impact on river flows downstream. However, **it does not capture the longer term drought risk associated with the gradual disappearance of permanent glaciers** which also feed into rivers downstream.

[1] ICIMOD (2011) Climate Change in the Hindu Kush-Himalayas; and ICIMOD (2010) The Glaciers of the Hindu Kush-Himalayan Region.
[2] Sarikaya et al. (2012) Space Based Observations of Eastern Hindu Kush Glaciers between 1976 and 2006, Afghanistan and Pakistan.
[3] Haritashya et al. (2008) Space-based Assessment of Glacier Fluctuations in the Wakhan Pamir, Afghanistan.

LIVELIHOOD VULNERABILITY

Livelihood zones centered on irrigated crop production (all crops except poppy) are **most vulnerable** to snowmelt-related droughts.



Livelihood zones dominated by rainfed agriculture, pastoralism and non-agricultural activities (timber harvesting, cross-border trade, cross-border labor migration, and handicrafts) are **least vulnerable.**

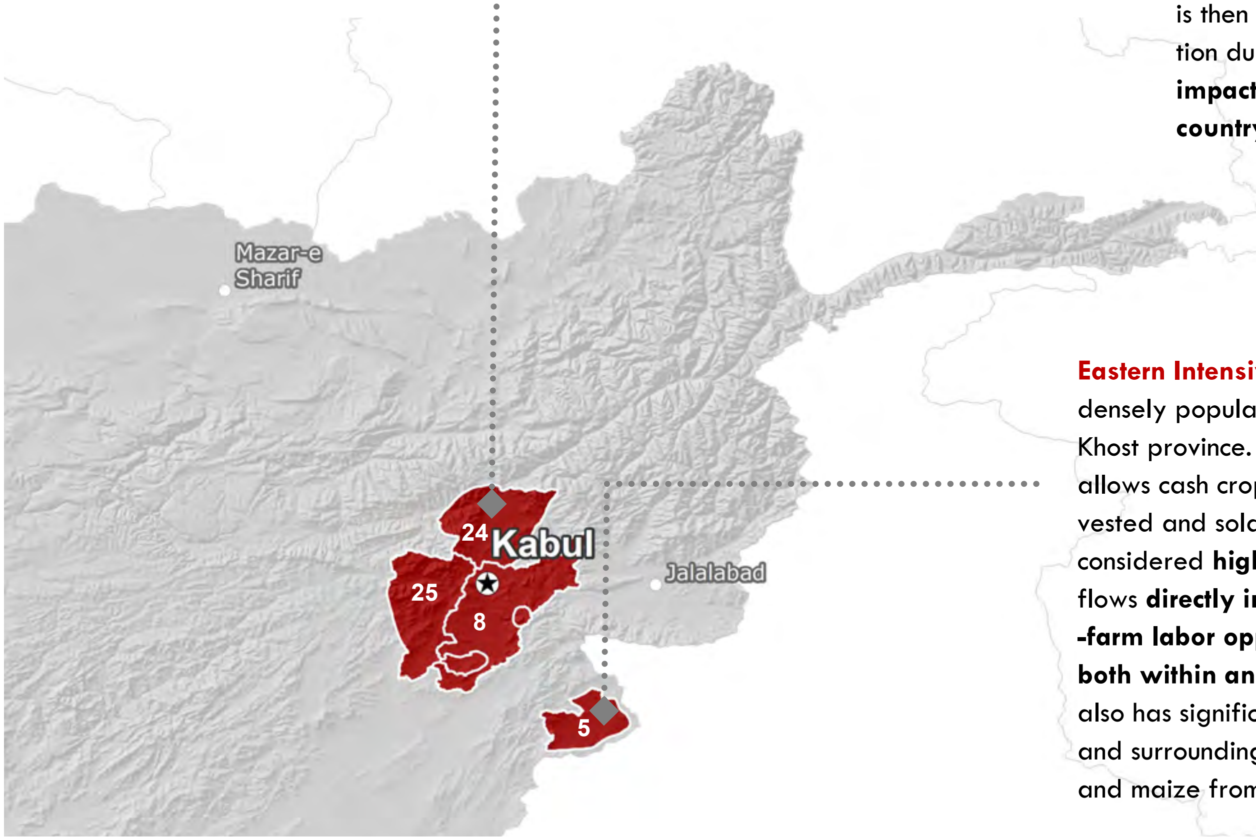
Irrigated zones where poppy production is a main source of livelihood are considered **moderately vulnerable,** since poppy is more drought resistant than other crops.

Note: Zones where rainfed and irrigated agriculture are equally prevalent (LZ 19 and 26) are considered highly vulnerable to both types of drought: rainfall-related (map p. 31) and snowmelt-related (this map).

Rainfed-dominated areas (data from AIMS).

The threat posed by drought to the sustainability of the country's irrigated farming is already acutely visible: in 2014, an estimated 31% of the total land normally available for irrigation was uncultivated—mostly due to lack of water in river and water-basin irrigation systems[1]. The irrigated areas around Kabul, which produce much of the country's grain and vegetables, have been particularly affected, due to reduced spring snowmelt from the Hindu-Kush

Irrigated cereal, orchard and horticulture-producing zones around Kabul (8, 24 and 25). These zones, which spread across Kabul, Wardak and Parwan provinces, are relatively food secure, with most household staple food coming from own production or sharecropping. Better-off households earn income from selling surplus grain, fruits and vegetables and some livestock products to the Kabul market, where it is then distributed nationally. Reduced production due to reduced river flows therefore has an **impact on food availability throughout the country, beyond the immediate Kabul area.**



Eastern Intensively Irrigated Agriculture Zone (5), a densely populated area which encompasses much of Khost province. Although intensive irrigation normally allows cash crops (particularly vegetables) to be harvested and sold three times a year, much of this zone is considered **highly food insecure.** Reduced irrigation flows **directly impacts home-production as well as on-farm labor opportunities for poor households—from both within and outside the zone.** Reduced production also has significant food security implications for Kabul and surrounding areas, which source vegetable, wheat and maize from this zone.

[1] Afghanistan Living Conditions Survey (ALCS) 2013/14. Interestingly, while the proportion of uncultivated land was similar for rainfed areas, the main cause was poor soil quality, rather than lack of water. This suggests that drought may be a more immediate risk to irrigated areas than rainfed ones.

FLOODS

There are two main types of floods in Afghanistan: those caused by heavy rainfall over a short period of time (causing river overflow and/ or heavy surface run-off in the surrounding areas), and those caused by rapid melting of snow and ice in highland areas during the spring (causing rivers and streams further downstream to overflow).

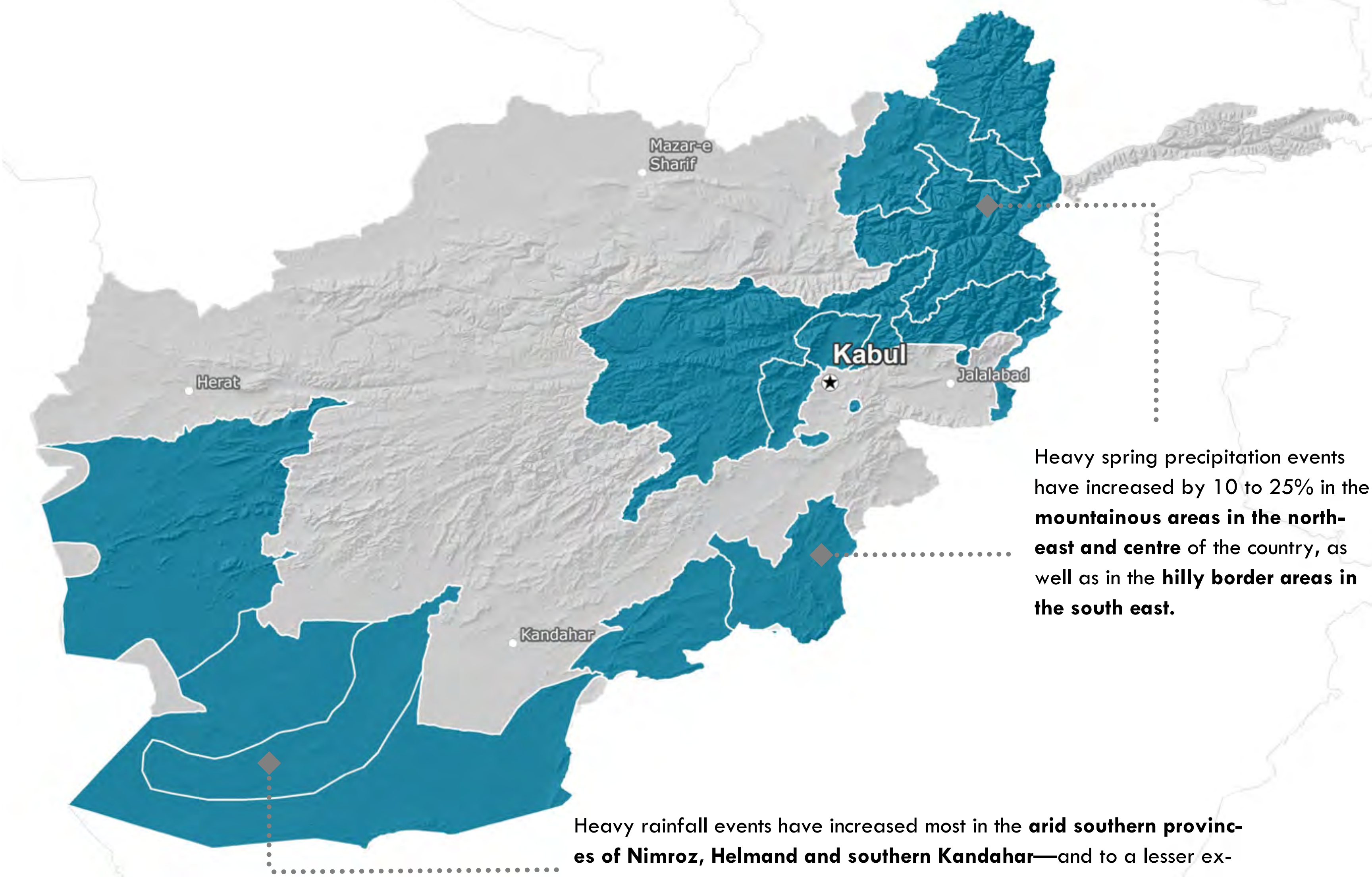
As was the case for drought, this distinction is important because these two types of floods are driven by different climate factors (local heavy rainfall vs. upstream snowmelt in highlands) and can occur in different areas.

Both types of floods nevertheless have similar impacts of livelihoods—causing severe damage to crops and livestock (directly killing livestock, destroying pasture, or causing disease outbreaks), and hindering access to markets.

Photo (opposite): WFP/ Wahidullah Amani/ Argo, Badakhshan.
Hundreds of families were affected by a massive landslide caused by heavy rainfall in spring 2014.

LOCALIZED FLOODS CAUSED BY HEAVY RAINFALL

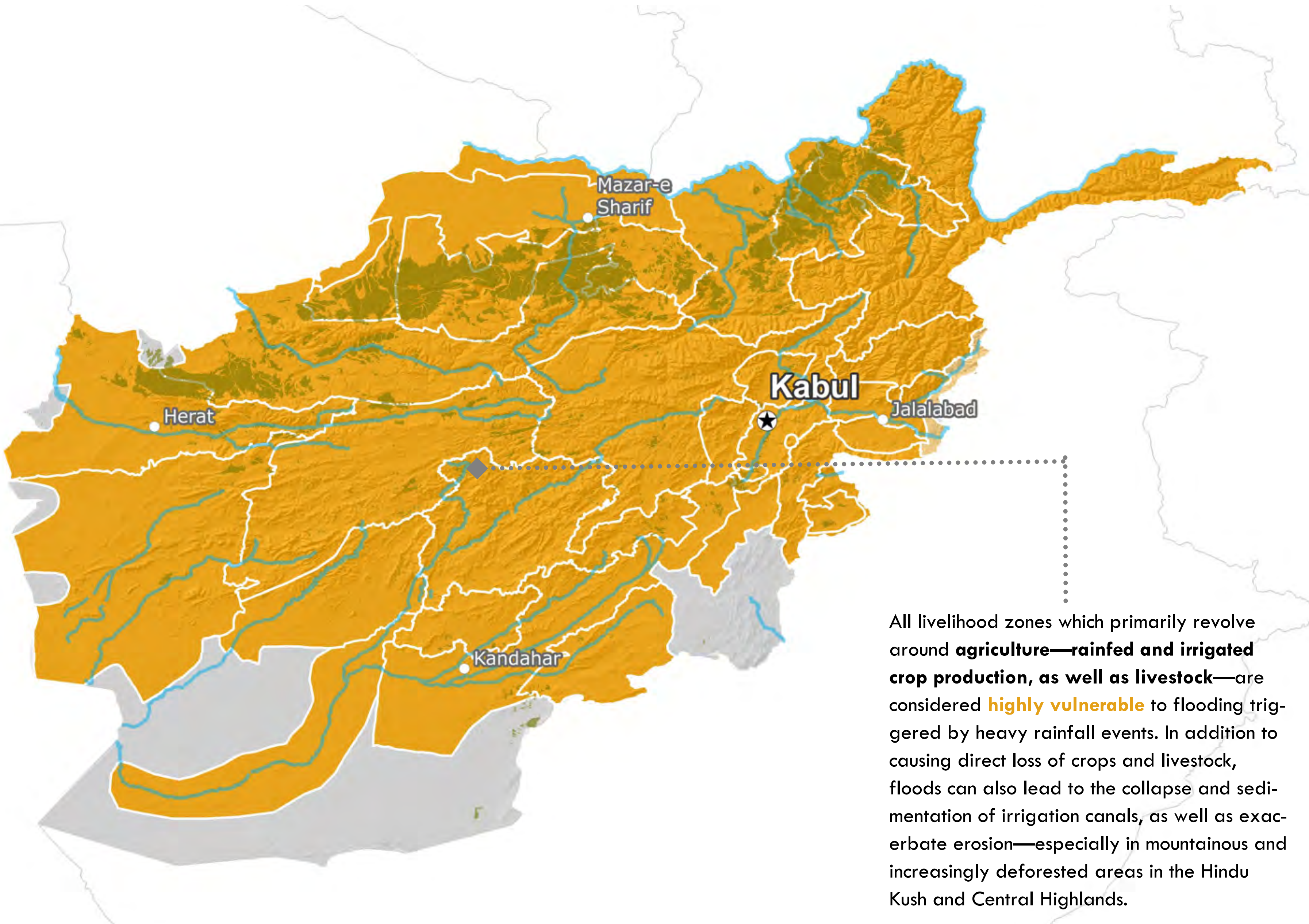
HAZARD



Heavy spring precipitation events have increased by 10 to 25% in the **mountainous areas in the north-east and centre** of the country, as well as in the **hilly border areas in the south east.**

Heavy rainfall events have increased most in the **arid southern provinces of Nimroz, Helmand and southern Kandahar—**and to a lesser extent in the **semi-arid western province of Farah.** Though the south typically receive less than 100mm of rain per year, heavy rainfall has increased by more than 25% over the past 30 years. In these flat, sparsely vegetated areas, this can quickly lead to flooding, as water runs off on the dry, bare soil.

LIVELIHOOD VULNERABILITY



All livelihood zones which primarily revolve around **agriculture—rainfed and irrigated crop production, as well as livestock**—are considered **highly vulnerable** to flooding triggered by heavy rainfall events. In addition to causing direct loss of crops and livestock, floods can also lead to the collapse and sedimentation of irrigation canals, as well as exacerbate erosion—especially in mountainous and increasingly deforested areas in the Hindu Kush and Central Highlands.

Impacts will be **most severe for people living along rivers,** at greater risk of flash floods and land inundation.

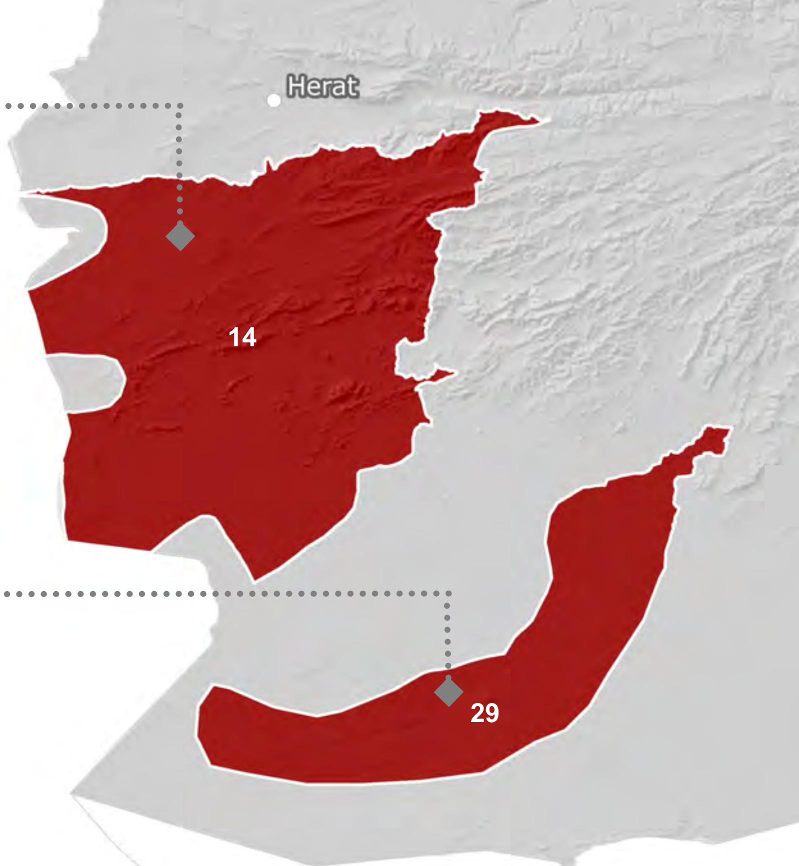
Rainfed-dominated areas (data from AIMS)

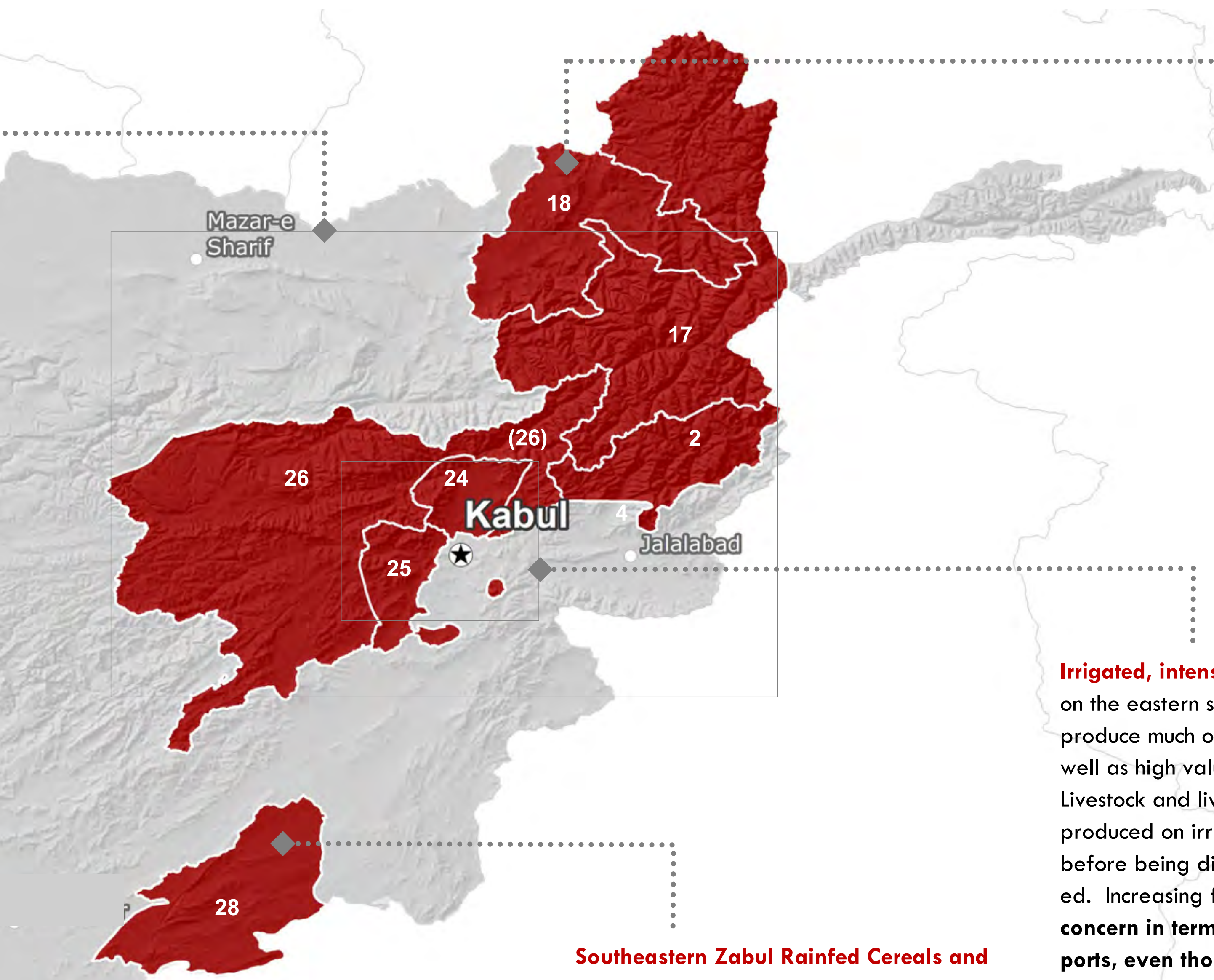
Almost all of the zones were heavy rainfall has increased are also dominated by agricultural livelihoods—and are therefore considered "hotspot areas" in terms of negative impacts on livelihoods. Notable exceptions are the Southern Semi-Arid Pastoral zone (covering parts of Nimroz, Helmand and Kandahar) and the South Eastern High Migration, Forest Products zone (covering much of Paktika), where livelihoods are less sensitive to floods, and where the observed increase in heavy rainfall therefore poses less of a food security risk.

Mountainous agro-pastoral zones (2, 17 and 26), which include parts of Bamyan, Wardak and Ghazni provinces in the Central Highlands, as well as Badakshan, Nuristan and Baghlan in the north-east. These areas are characterized by mountainous grassland pastures interspersed with farmland and fruit or nut trees. **Food insecurity is generally very high,** due to a combination of limited market access (especially in winter when snow blocks off road access), small plot size amongst poorer households, and limited labor opportunities. **Seasonal migration** to other regions or Pakistan is already common amongst poorer households in these zones, and **could increase further if increased flooding continues to threaten the viability of agricultural livelihoods.**

Western, semi-arid agro-pastoral zone (14), which borders Iran and covers part of Herat, Farah, and Nimruz provinces, is sparsely populated. **Most settlements and agriculture are concentrated around rivers, and are therefore highly vulnerable to flooding.** Food insecurity in parts of this zone is relatively high, due to ongoing insecurity, small plot sizes, and periodic disruptions to cross-border trade with Iran.

Helmand intensively irrigated wheat and cash crop zone (29), located along the Helmand river, is **normally a food secure, cash-crop producing area.** However, conflict can cause pockets of food insecurity and displacement. Increased flooding due to heavy rainfall can also cause **temporary displacement or ruin crops in areas along the river.**





Rainfed Takhar-Badakshan mixed agriculture zone (18), characterized by **high food insecurity and high labor migration** to neighboring Kunduz-Baghlan high cereal production zone or to Pakistan and Iran. Increasing flood risk will likely further **exacerbate household food insecurity by reducing home production yields, as well as work opportunities** and payments from share-cropping on neighboring plots.

Irrigated, intensive agriculture zones (24 and 25), located on the eastern slopes of the Central Highlands. These areas produce much of the fresh produce sold in urban centers, as well as high value export crops such as dried fruits and nuts. Livestock and livestock products, vegetables, fruits, nuts are produced on irrigated plots and sold to the Kabul market, before being distributed throughout the country or exported. Increasing flood risk in these areas is therefore of major **concern in terms of national-level food supply and exports, even though household-level food insecurity is relatively low.**

Southeastern Zabul Rainfed Cereals and Orchard zone (28), which includes parts of Zabul, Ghazni and northern Kandahar provinces. **Market access in this relatively food insecure zone is constrained by poor roads and insecurity,** and this could be further exacerbated by increased flooding.

RIVERINE FLOODS CAUSED BY EXCESS SNOWMELT

The second main type of floods in Afghanistan occurs in the spring and summer, when snow and ice which accumulated in the winter in the mountains start melting, feeding into rivers and causing them to overflow further downstream. To identify where this flood risk had increased the most over the past twenty years, we use the same approach used to identify areas exposed to drought caused by reduced snow and ice melt (see p. 34) —but this time looking for **mountainous areas where snowfall had increased**, rather than decreased.

We also look at **temperature trends over mountainous areas,** as this affects the rate at which snow/ ice melts, and therefore how concentrated in time the river discharge will be downstream. Temperatures have been increasing all over the country over the past thirty years, especially in the spring and fall.

GLACIAL LAKE OUTBURST FLOODS (GLOFs)

Another source of flood risk in Afghanistan on the medium-long term is glacier melt– which is distinct from the immediate risk from seasonal melting of snow and ice addressed in this section. **Contrary to common misconceptions, rapid melting of glaciers does not directly lead to catastrophic flooding downstream.** Glacial melt occurs over the timescale of years/ decades, so cannot, on its own, cause floods.

The **immediate hazard risk associated to glacial melt is related not to the melting per say, but to glacier lake outburst floods (known as GLOFs).** These occur when a glacial lake forms gradually behind the terminal moraine of a rapidly melting and retreating glacier (a moraine is a dam made of silt and debris left behind as the glacier retreats). A glacial lake outburst flood occurs when the moraine dam breaks, unleashing the lake water downstream. [1]

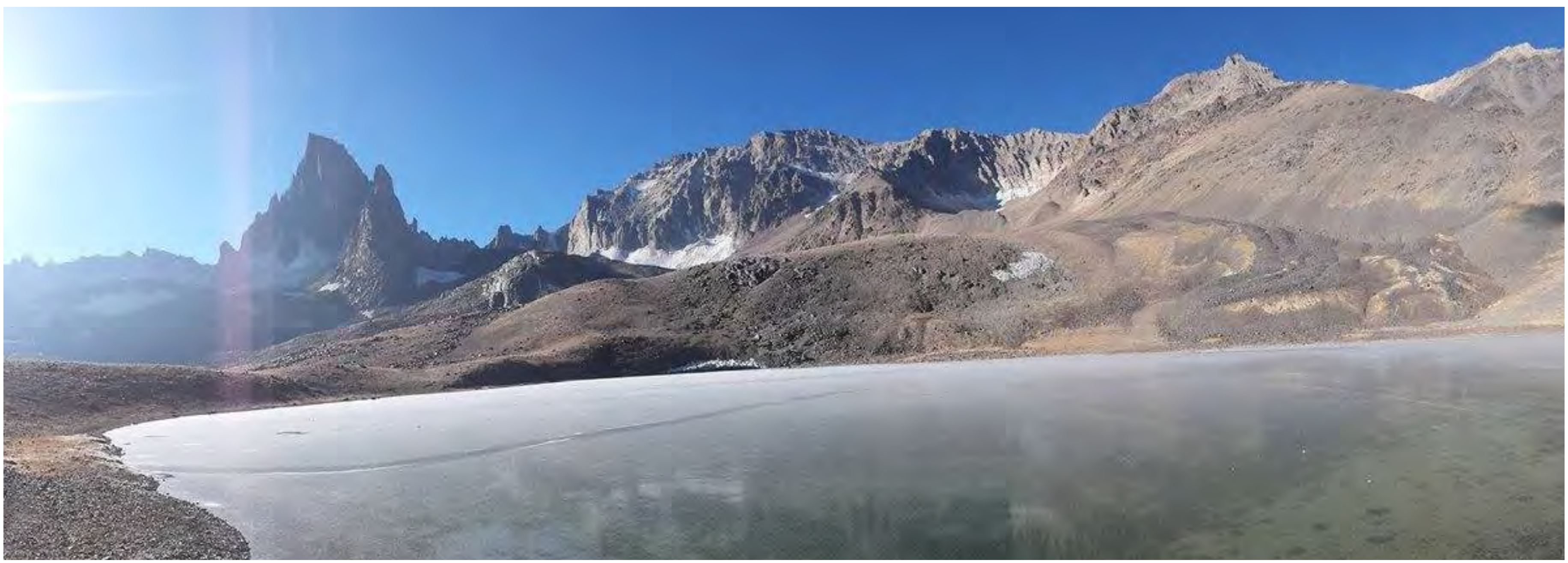
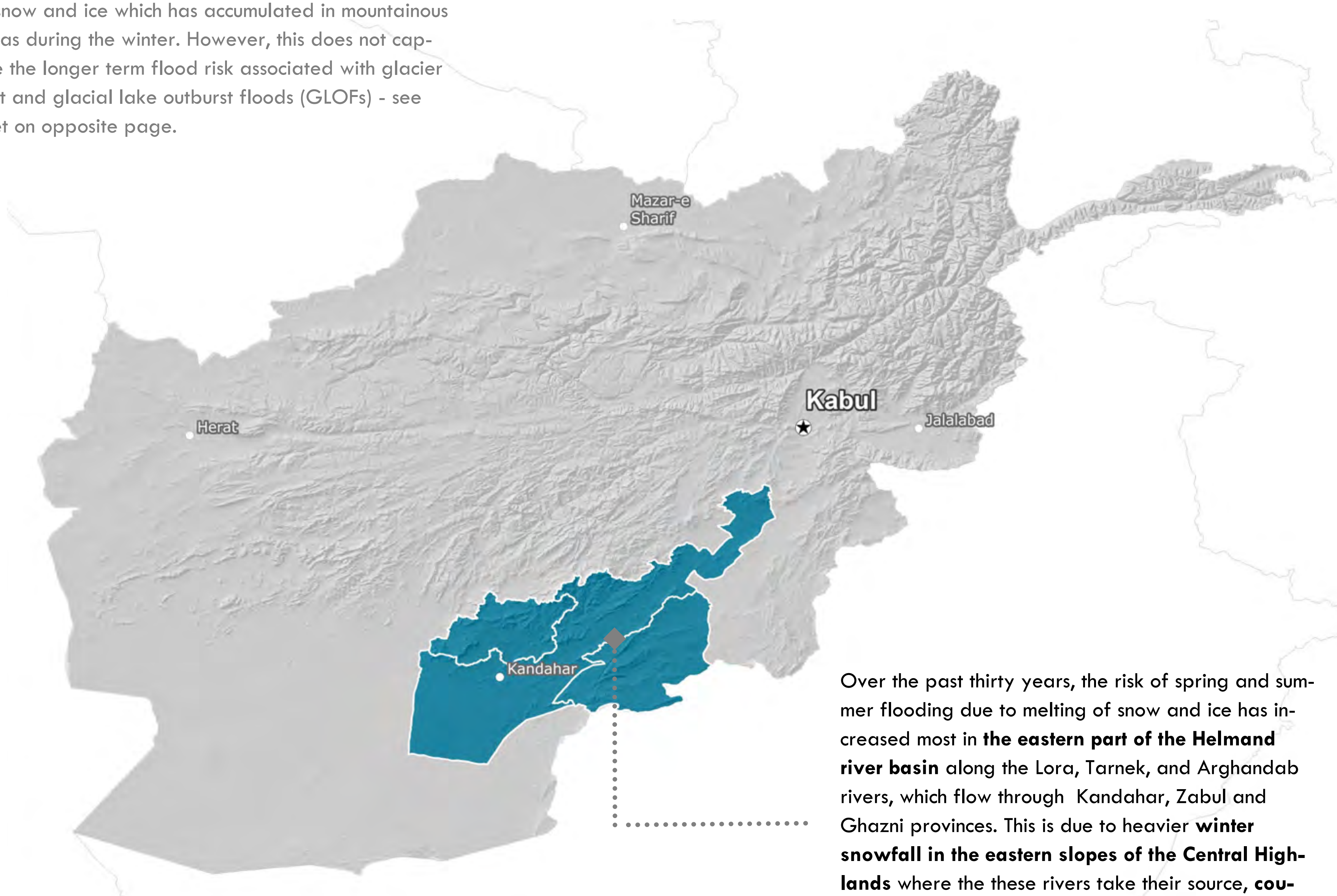


Photo: UNEP/ Band-e-Bala lake in Shah Foladi National Protected Area, Bamyan.

[1] ICIMOD (2010) The Glaciers of the Hindu Kush-Himalayan Region.

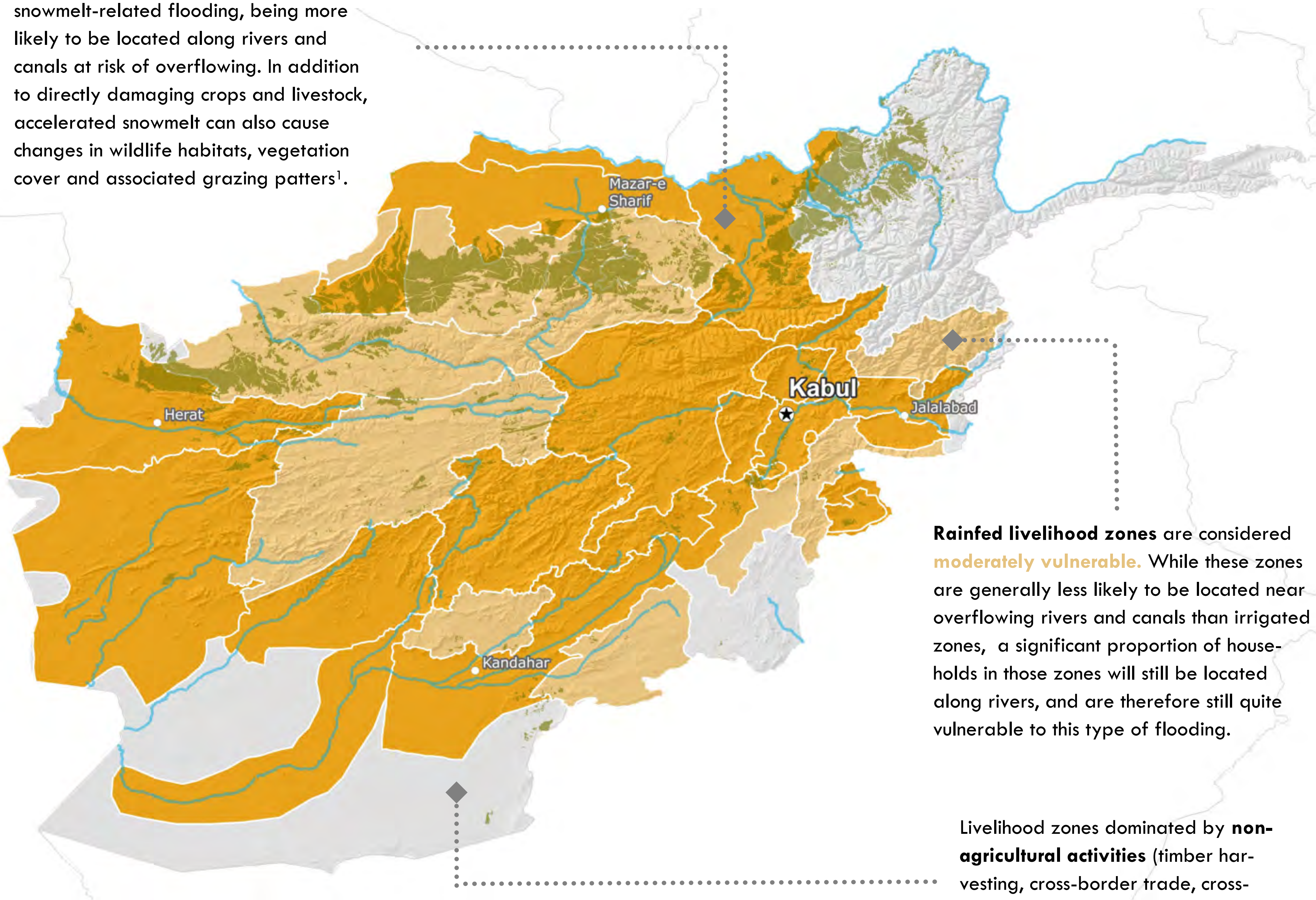
Note: the flood risk shown here is the short-term, annual spring/ summer risk of floods caused by the melting of snow and ice which has accumulated in mountainous areas during the winter. However, this does not capture the longer term flood risk associated with glacier melt and glacial lake outburst floods (GLOFs) - see inset on opposite page.



Over the past thirty years, the risk of spring and summer flooding due to melting of snow and ice has increased most in **the eastern part of the Helmand river basin** along the Lora, Tarnek, and Arghandab rivers, which flow through Kandahar, Zabul and Ghazni provinces. This is due to heavier **winter snowfall in the eastern slopes of the Central Highlands** where the these rivers take their source, **coupled with higher spring and summer temperatures.**

LIVELIHOOD VULNERABILITY

Livelihood zones dominated by **irrigated crop production** are **most vulnerable** to snowmelt-related flooding, being more likely to be located along rivers and canals at risk of overflowing. In addition to directly damaging crops and livestock, accelerated snowmelt can also cause changes in wildlife habitats, vegetation cover and associated grazing patters[1].

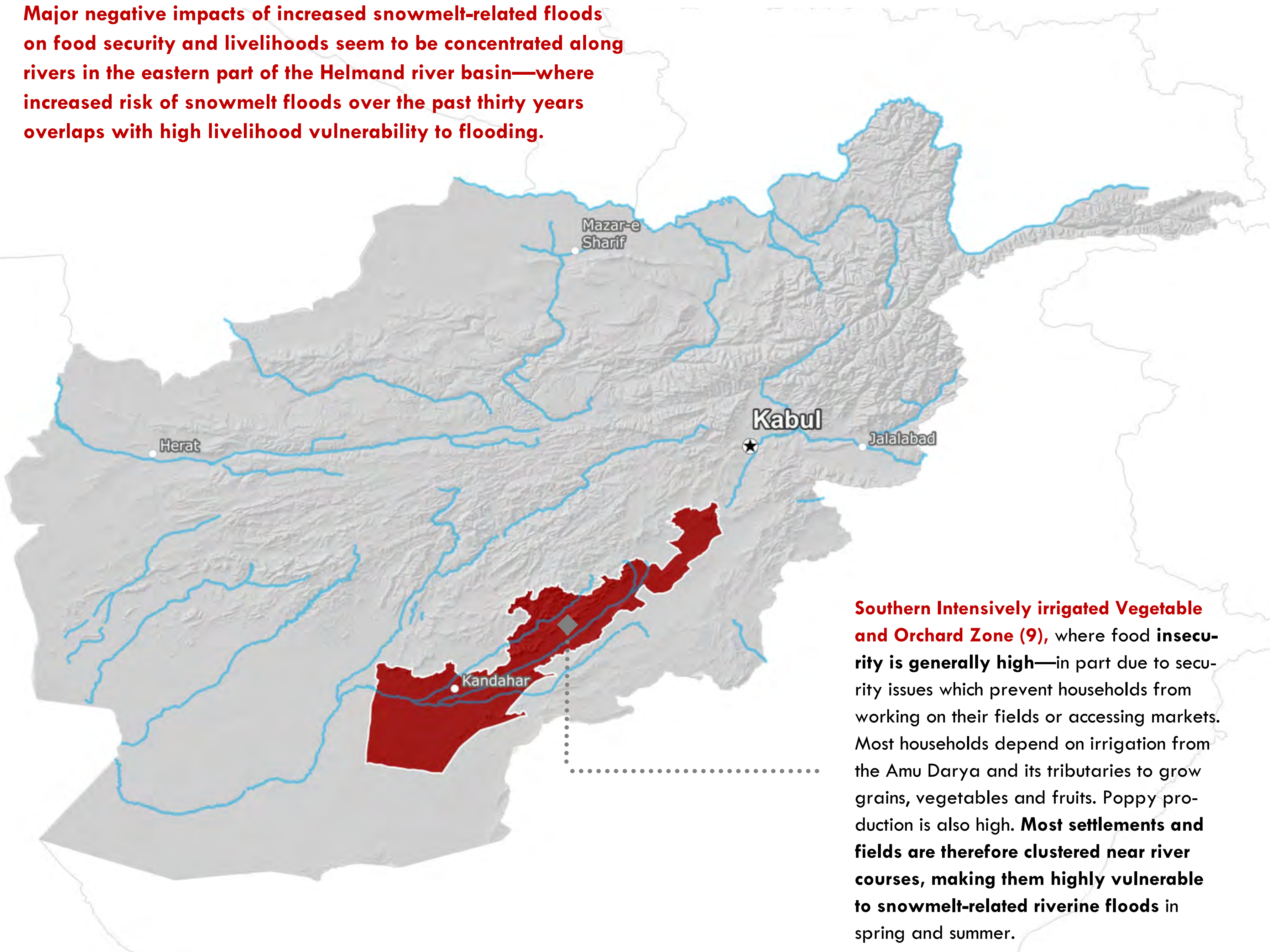


Rainfed livelihood zones are considered **moderately vulnerable.** While these zones are generally less likely to be located near overflowing rivers and canals than irrigated zones, a significant proportion of households in those zones will still be located along rivers, and are therefore still quite vulnerable to this type of flooding.

Livelihood zones dominated by **non-agricultural activities** (timber harvesting, cross-border trade, cross-border labor migration, and handicrafts) are **least vulnerable.**

[1] Afghanistan National Adaptation Progamme of Action for Climate Change (NAPA), 2009.

Major negative impacts of increased snowmelt-related floods on food security and livelihoods seem to be concentrated along rivers in the eastern part of the Helmand river basin—where increased risk of snowmelt floods over the past thirty years overlaps with high livelihood vulnerability to flooding.



Southern Intensively irrigated Vegetable and Orchard Zone (9), where food **insecurity is generally high**—in part due to security issues which prevent households from working on their fields or accessing markets. Most households depend on irrigation from the Amu Darya and its tributaries to grow grains, vegetables and fruits. Poppy production is also high. **Most settlements and fields are therefore clustered near river courses, making them highly vulnerable to snowmelt-related riverine floods** in spring and summer.

FUTURE RISKS UNDER CLIMATE CHANGE

The climate analysis shown so far in this report focuses on understanding how climate risks have already changed in Afghanistan over the past thirty years. In this section, we turn to potential risks under future climate change. Despite the inherent uncertainties associated with model-based climate projections, these can be useful to get a sense of **how the livelihood impacts already observed might be exacerbated (or alleviated) in the future**. Projections provide broad indications of what we can expect in terms of speed and severity of change up to the year 2050, under different emissions scenarios.

The climate projections in this report were done by UNEP and NEPA for the period 2021– 2050, using Cordex South Asia regional climate models. We selected a moderate emissions scenario (known as RCP4.5), which assumes that global greenhouse gas emissions will continue to increase until 2040 and then decrease, and that temperatures will continue to increase until 2100 to around 2 °C, and then plateau thereafter (see Annex 3 for details).

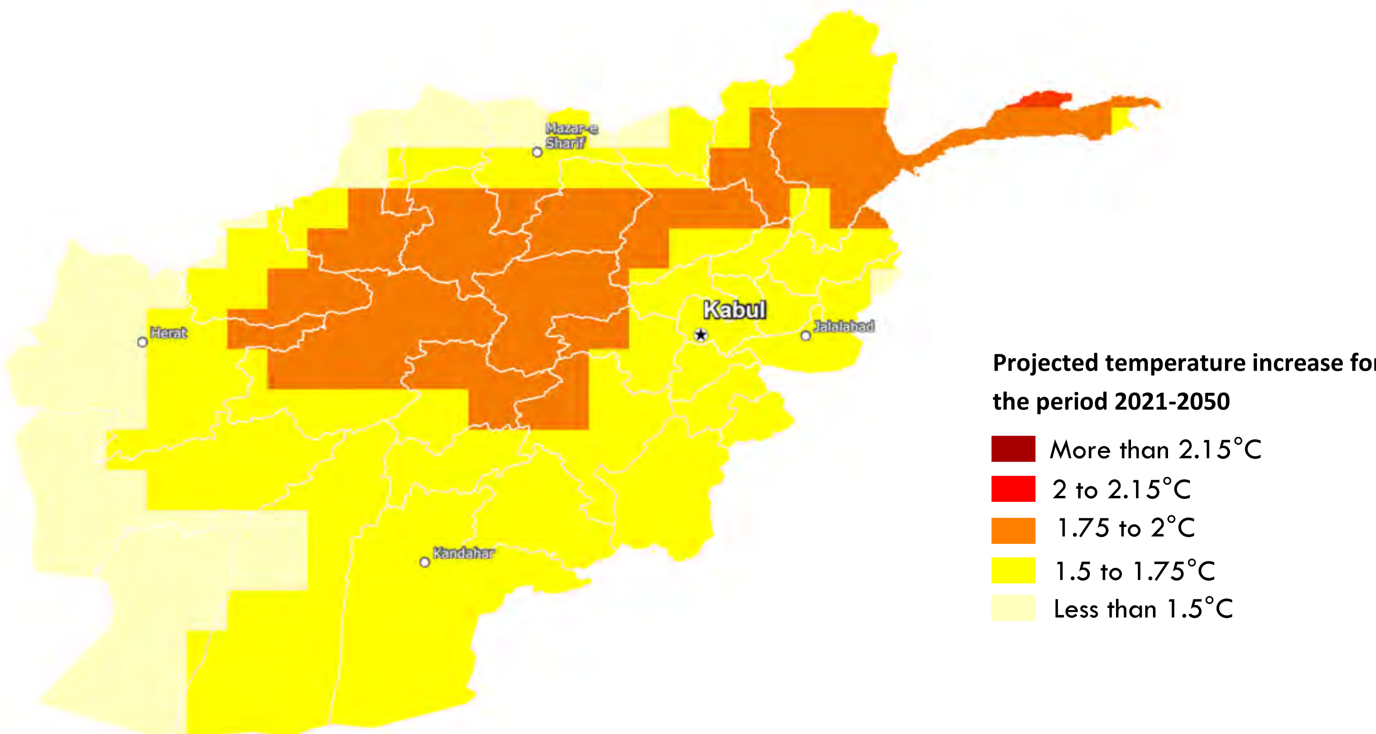
These projections suggest that the main negative impact of climate change in Afghanistan in the future will be **increased drought risk—with increased flood risk being of secondary concern. Annual droughts in many parts of the country will likely become the norm by 2030, rather than being a temporary or cyclical event.** This will mostly be due to higher temperatures leading to higher evapotranspiration and higher crop and livestock water demand.

Note that while there is relatively high confidence in temperature projections for Afghanistan, **precipitation projections are highly uncertain**. The precipitation maps shown here should therefore be interpreted with caution, and simply seen as the best estimate currently available.

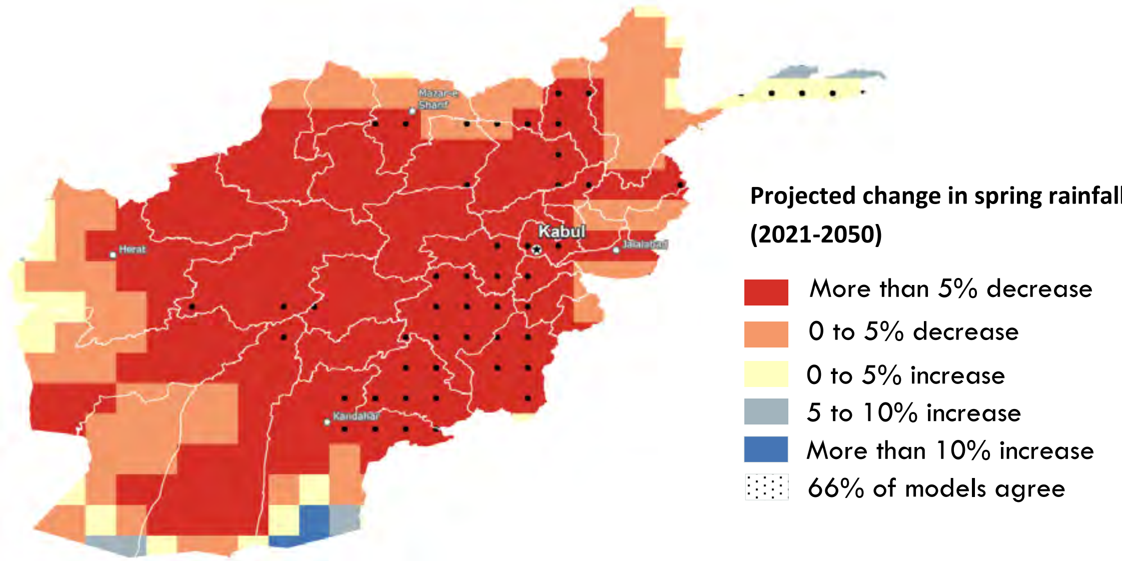
Photo (opposite): UNEP/ Andrew Scanlon/ Bamyan.

Temperatures in Afghanistan are expected to increase more than the global average. Under a high greenhouse gas emissions scenario (RCP8.5), maximum warming could reach about 2.3°C until 2050, and up to 6.5°C by 2100. Under a lower emissions scenario (RCP4.5), warming is expected to reach 1.7°C by 2050 and then plateau around 2°C by 2100. For both scenarios, this warming is expected to occur fairly **uniformly throughout the year**, but will vary geographically— with the **most severe warning occurring in the mountainous Central Highlands and Hindu Kush areas.**

Even without reliable rainfall projections, we can be quite confident that drought will increase in many parts of the country, simply due to **increased evapotranspiration resulting from warmer temperature.**

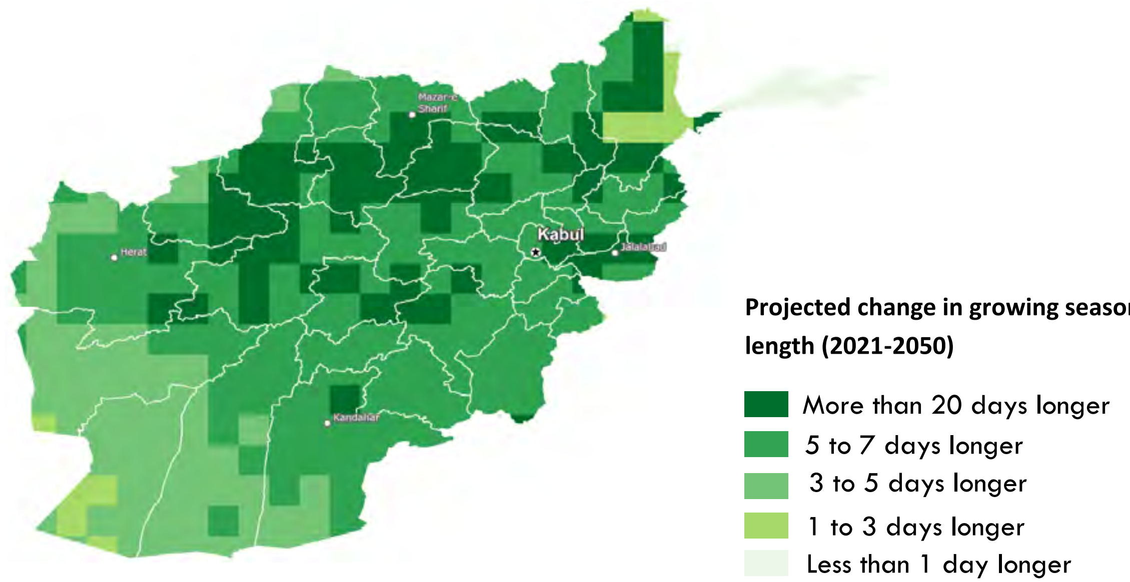


Spring rainfall is expected to decrease over most of the country, except in the Wakhan corridor and small areas along the southern border. This is of particular concern given the importance of spring rainfall for plant growth, and suggests that agricultural droughts are likely to increase. This could have a particularly severe impact on livelihood zones in the north-west, which are almost entirely dependent on rainfed-agriculture.



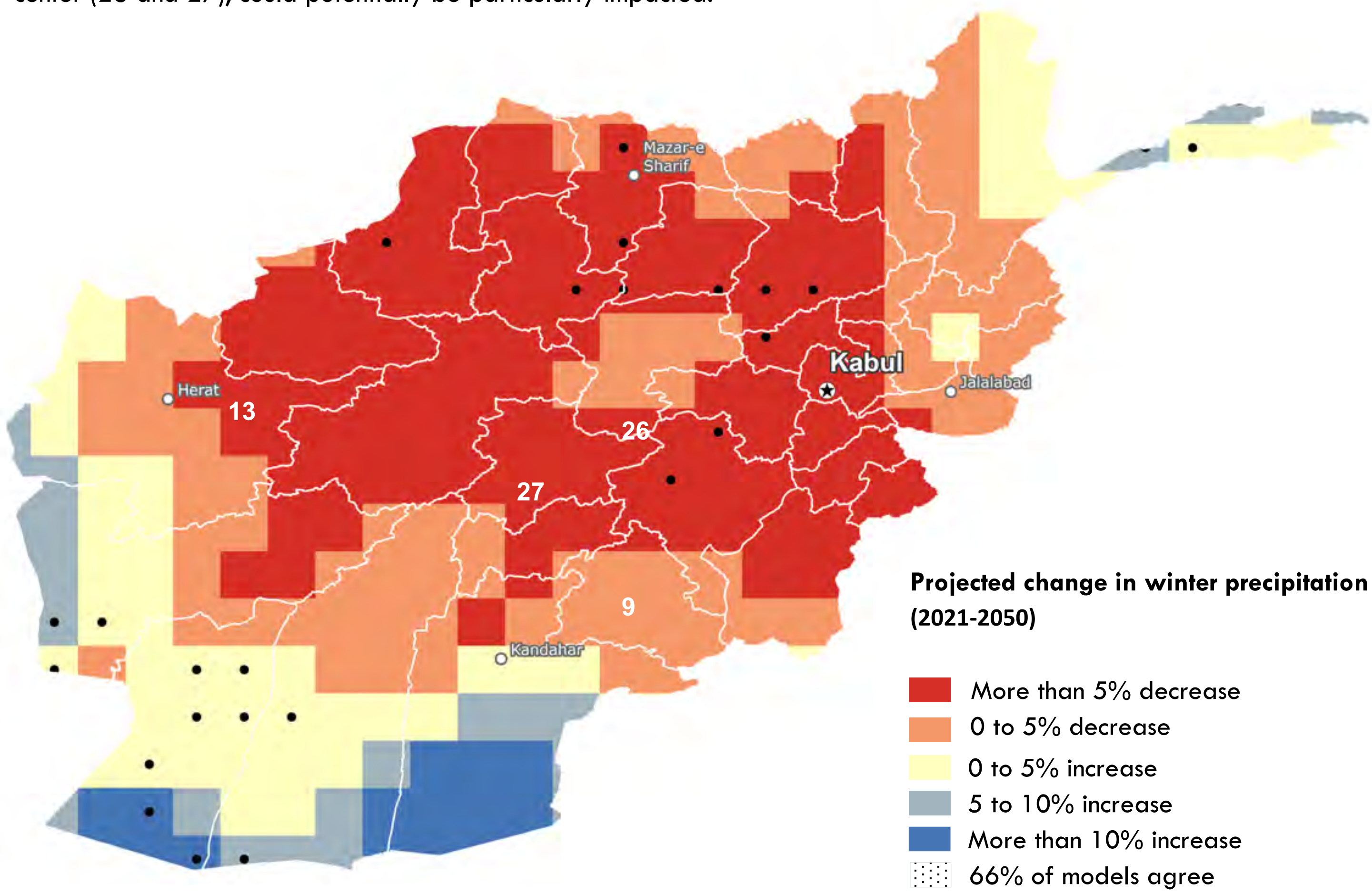
However, it's worth noting that under a high emission scenario (RCP8.5), ***average annual* rainfall is** in fact expected to increase across most of the country (except in northern rainfed areas). The **length of the growing season** is also expected to increase in the entire country (except the Wakhan corridor), under all emissions scenarios. Taken together, these two factors suggest that the **outlook for agricultural livelihoods in Afghanistan could be less bleak than appears at first glance—but only on the condition that water resources are managed properly and significant investments are made in the country's irrigation infrastructure.**

If such investments are made, farmers could in fact have access to **more water overall and to longer growing seasons**—thus allowing several harvests. This is however contingent on having the irrigation infrastructure necessary to store the excess rain which falls during the rest of the year, and distribute it during the spring growing season —when rainfall is expected to decrease.



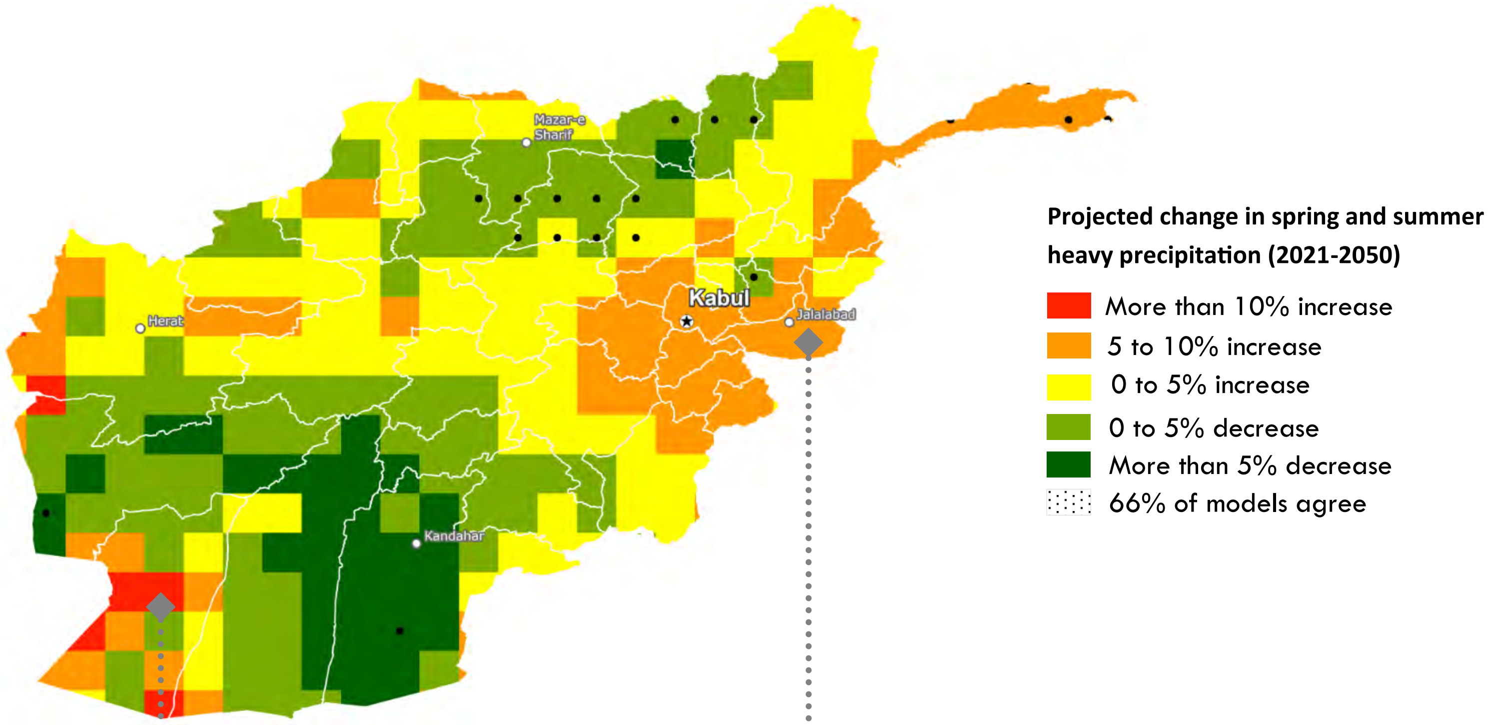
Winter snowfall is expected to decrease in the Central Highlands—potentially leading to **reduced spring and summer flows in the Helmand, Harirud-Murghab, and Northern river basins.** If this does occur, it would particularly affect livelihood zones downstream which depend heavily on these rivers and their tributaries, for irrigation or pasture. Intensively irrigated zones in the east and south (9 and 13), as well as mountainous agro-pastoral zones in the center (26 and 27), could potentially be particularly impacted.

However, it is important to note that change in snowmelt runoff is extremely difficult to predict, as it depends not just on snowfall amount and temperature, but also on highly complex glacier dynamics—which are beyond the scope of this study. [1]



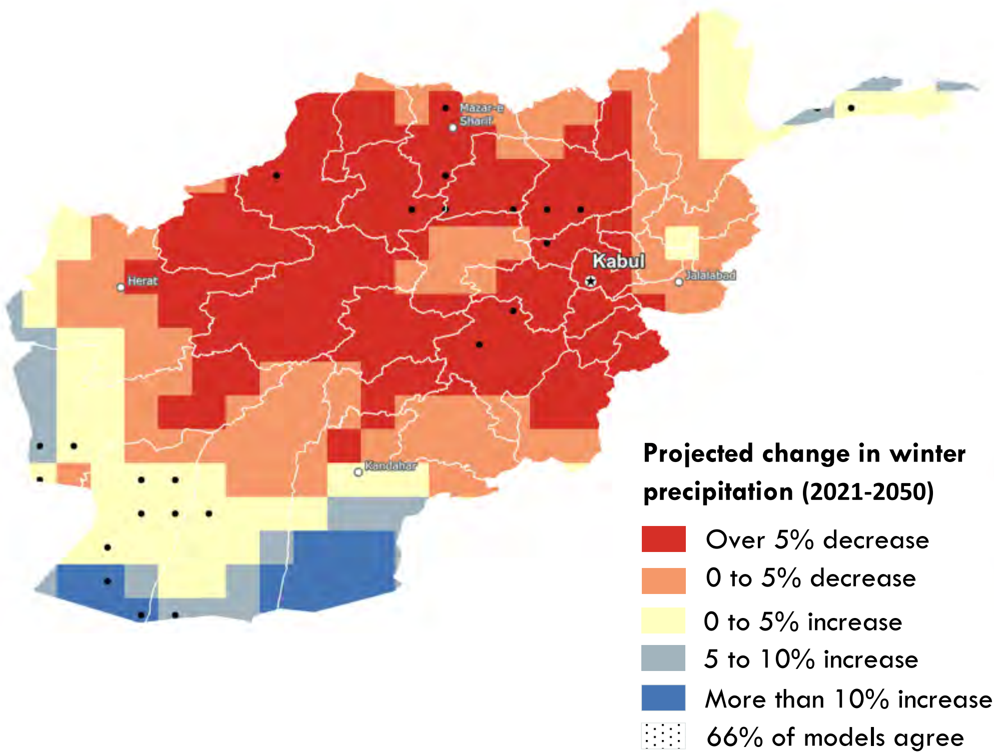
[1] See for example Hagg et al., (2013) Glacier and runoff changes in the Rukhk catchment, upper Amu-Darya basin until 2050.

Photo (opposite): WFP/ Teresa Ha/ Khram wa Sarbag , Samangan



Projections suggest that **heavy precipitation** events might increase by 5% or more in the north east and small pockets in the south and east, on the border with Iran—but might actually decrease across most of the south and parts of the north. However, as mentioned on p.48, there is high uncertainty associated with precipitation projections, and clear signals are difficult to separate from the "noise" in the data.

Winter snowfall is projected to decrease everywhere in Afghanistan, except in the Pamir mountains in the north east (Wakhan corridor and Tajikistan). **In the medium-term future, the frequency of snowmelt-related floods in spring might still increase simply due to accelerated melting** associated with higher spring temperatures. But the risk of such floods is **likely to decrease in the longer term future,** as winter snow cover becomes increasingly thin.



FUTURE RISK OF GLACIAL LAKE OUTBURST FLOODS

In addition to increasing the risk of annual snowmelt–related flooding, higher temperatures in mountainous areas could increase the risk of one-off glacial lake outburst floods (GLOFs)—massive sudden floods which occur when the moraine walls which dams a glacial lake breaks (see box p. 44).

Records suggest that GLOFs occur every 3 to 10 years in the Himalayan region, and have become more frequent since 1950. While only a minority of the existing moraine-dammed lakes in the region are currently considered dangerous, rising temperatures and potential accelerated glacier melt could increase the number and size of such lakes—thereby significantly increasing the risk of major, sudden floods in some areas. [1]

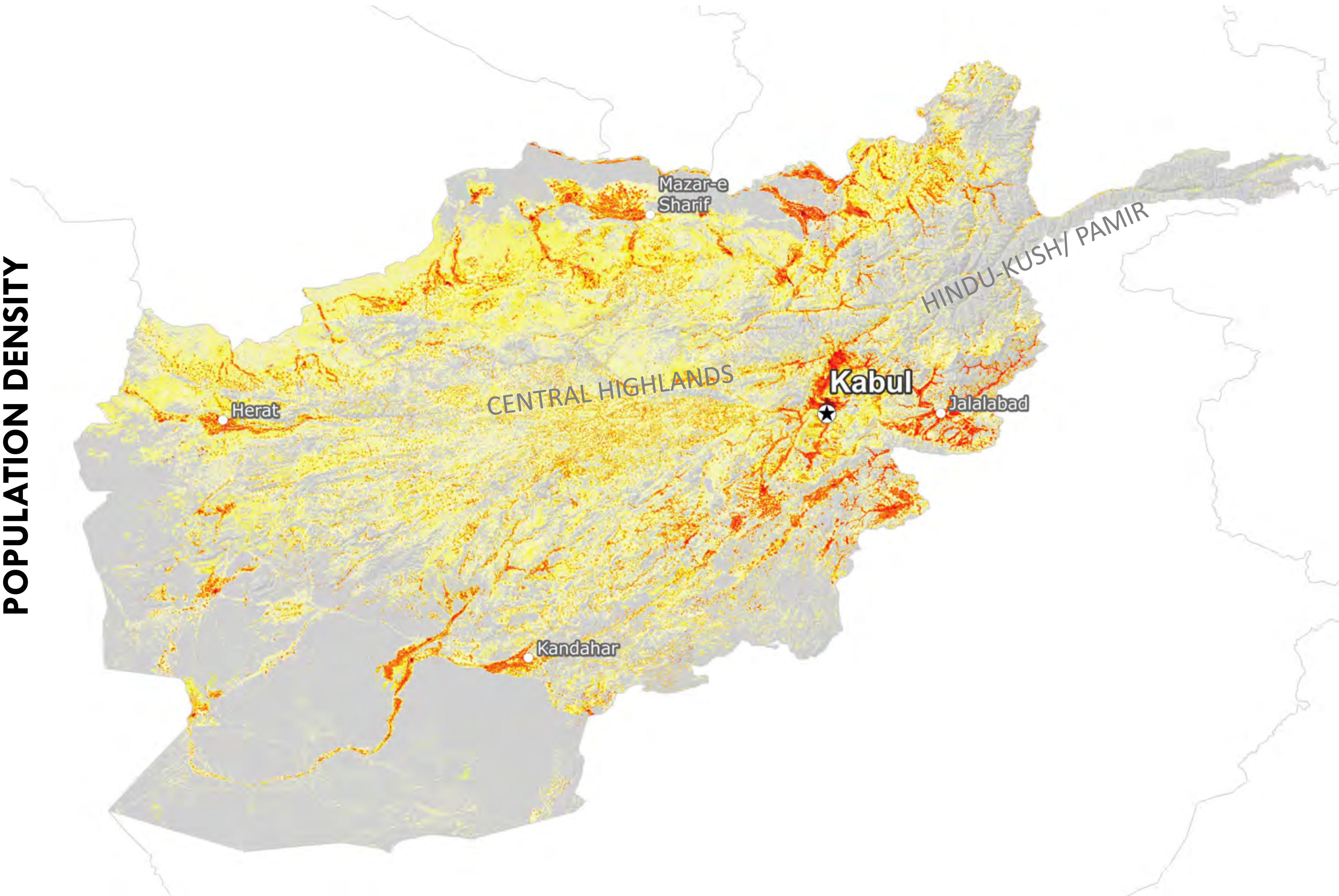
While GLOFs are an area of increasing interest amongst climate change researchers, information of how GLOF risk has changed in the recent past or is projected to change in the future is very limited. GLOF risk is extremely difficult to assess, as it requires detailed understanding of local temperature change, glacial melt rates, glacial lake numbers and size, and structural strength of moraine damns.

[1] ICIMOD (2010) The Glaciers of the Hindu Kush-Himalayan Region.

ANNEX 1– REFERENCE MAPS

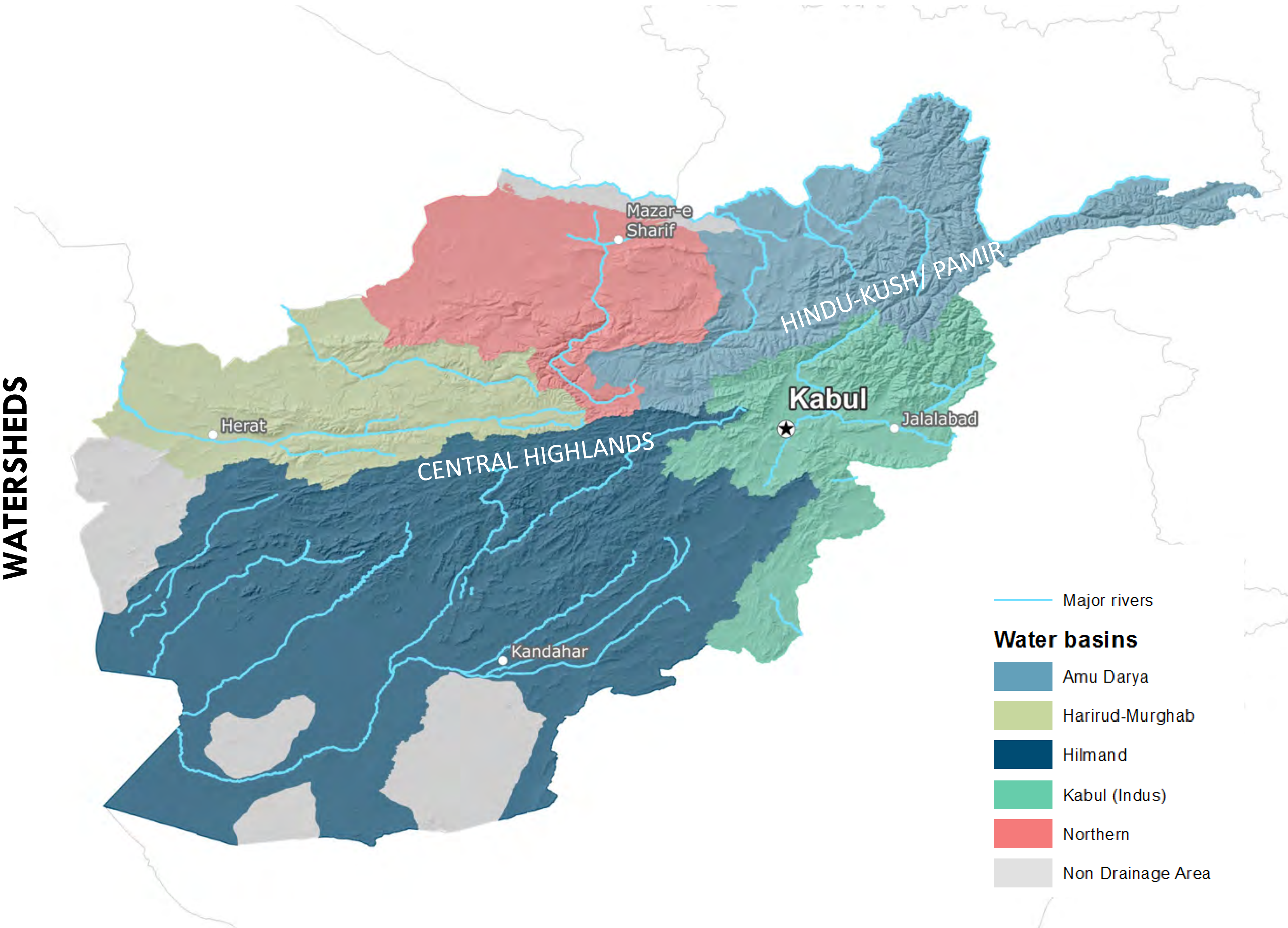
PROVINCES F AFGHANISTAN

POPULATION DENSITY



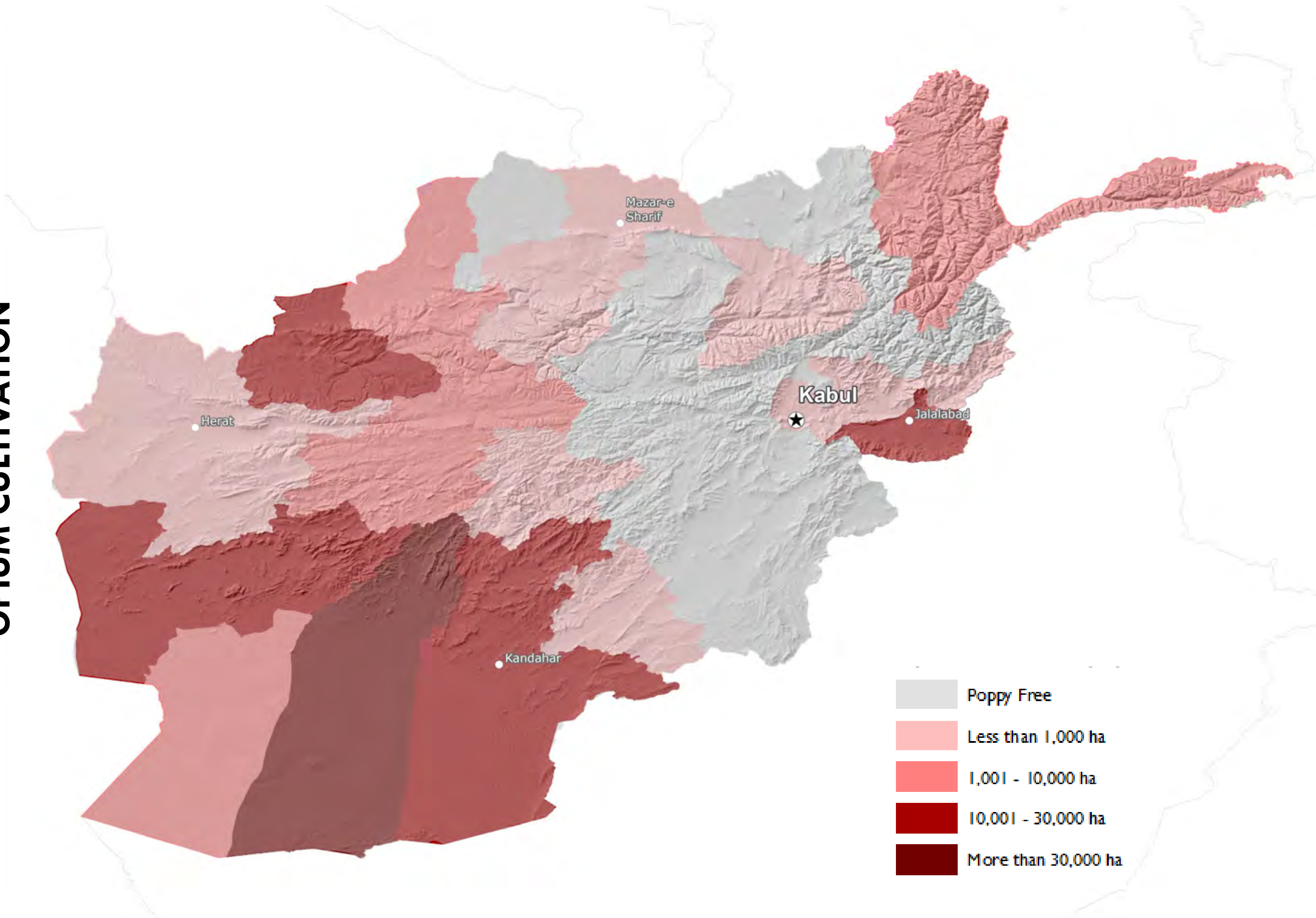
Data source: Landscan

WATERSHEDS



Mazar-e Sharif
HINDU-KUSH/ PAMIR
Kabul
Jalalabad
Herat
CENTRAL HIGHLANDS
Kandahar
Major rivers
Water basins
Amu Darya
Harirud-Murghab
Hilmand
Kabul (Indus)
Northern
Non Drainage Area

OPIUM CULTIVATION



Opium poppy cultivation, by province. Data from Ministry of Counter Narcotics and UNODOC, Afghanistan Opium Survey 2015.

ANNEX 2 - PAST CLIMATE: ANALYSIS METHOD AND DATA

Information on past climate trends was produced by UNEP and NEPA through reanalysis—a method which combines climate models with observations (satellite and rain-station data). This method was selected due to the scarcity of historical climate observations for Afghanistan before the start of satellite observations in the 1980s, which would make an analysis based solely on observations unreliable. Climate reanalysis are numerical description of the past climate, produced by combining the outputs from climate model with climate observations.

The accuracy of various reanalysis products was evaluated against historic observation datasets. These datasets have been restored by the PEACE project[1] and are publicly available. The most complete time series for each of Afghanistan's five climate regions (Hindu Kush, Northern Plains, Central Highlands, Eastern Highlands, and Southern Plateau), and additionally for Kabul, were used to validate the reanalysis.

Out of the four reanalysis products which were evaluated, the Global Soil Wetness Project Phase 3 (1901-2010) (GSWP3) was selected for this analysis because of its overall good performance over Afghanistan, and its temporal coverage of the entire period of interest, 1950-2010. GSWP3 is generated globally on a 0.5° x 0.5 ° grid.

[1] Weedon et al. (2011). Creation of WATCH Forcing Data and Its Use to Assess Global and Regional Reference Crop Evaporation over Land during 20th Century.

Photos: WFP/ Diego Fernandez/ Mazar-e-Sharif (right); WFP/ Challiss McDonough/ Sarhad-e-Broghil , Wakhan (opposite)

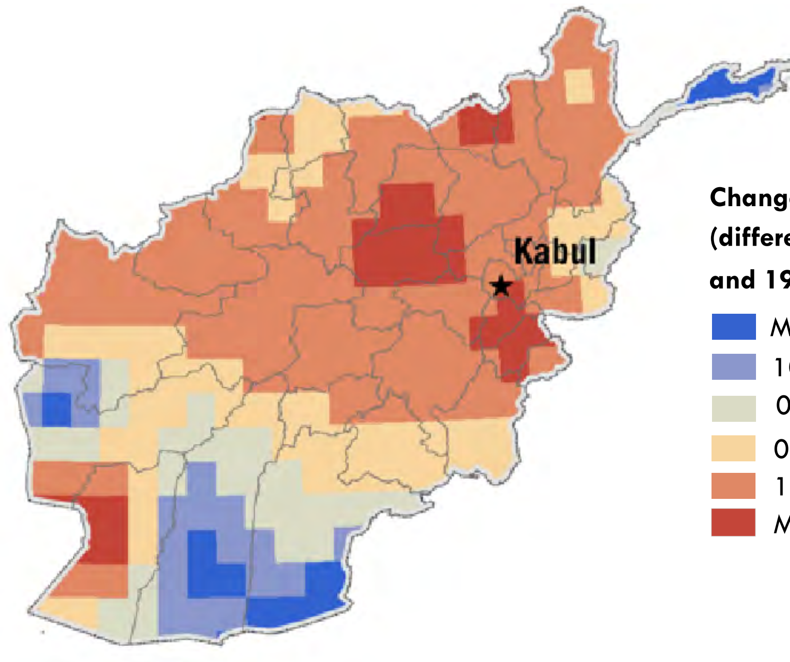
RAINFALL– RELATED DROUGHT

To identify areas which have experienced more frequent or intense rainfall-related drought, we looked at two climate indicators: change in spring precipitation and change in Standardized Precipitation-Evapotranspiration Index (SPEI) .

Unlike average annual rainfall, which simply tells us that an area has received less total rainfall than normal over an entire year (i.e. *meteorological* drought), spring precipitation and SPEI give a better indication of where rainfall anomalies might actually have significant negative impacts on crops and livestock (i.e. *agricultural* drought).

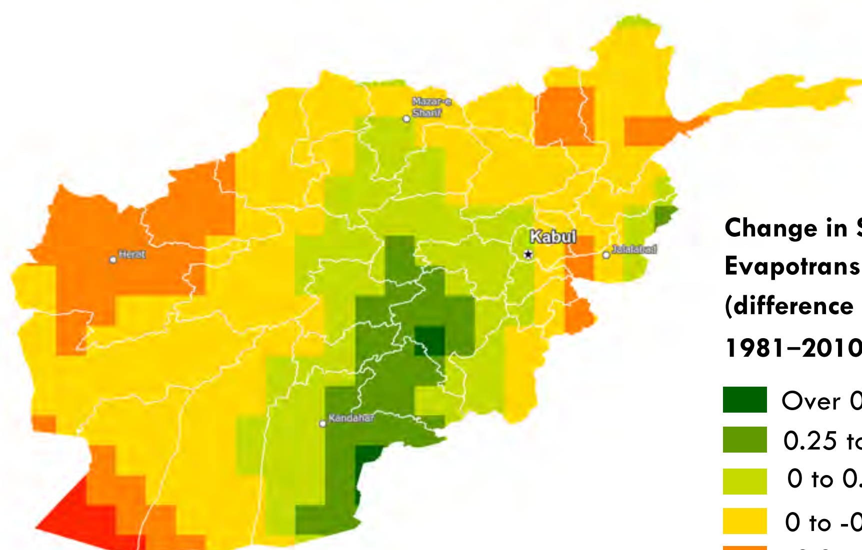
Spring precipitation is especially important for rain fed crop cultivation in Afghanistan, as it occurs during a critical stage of plant growth. For this analysis, spring was defined as the months from January to April.

The **Standardized Precipitation Evapotranspiration Index (SPEI)** is widely-used drought indicator, which takes into account not only precipitation but also potential evapotranspiration. For this analysis, the SPEI was calculated over a 12 month period .



Change in spring rainfall (difference between 1950–1980 and 1981–2010)

- More than 20% increase
- 10 to 20% increase
- 0 to 10% increase
- 0 to 10% decrease
- 10 to 20% decrease
- More than 20% decrease



Change in Standardized Precipitation Evapotranspiration Index (SPEI) (difference between 1950–1980 and 1981–2010)

- Over 0.5
- 0.25 to 0.5
- 0 to 0.25
- 0 to -0.25
- -0.25 to –0.5
- Below –0.5

SNOWMELT– RELATED DROUGHT

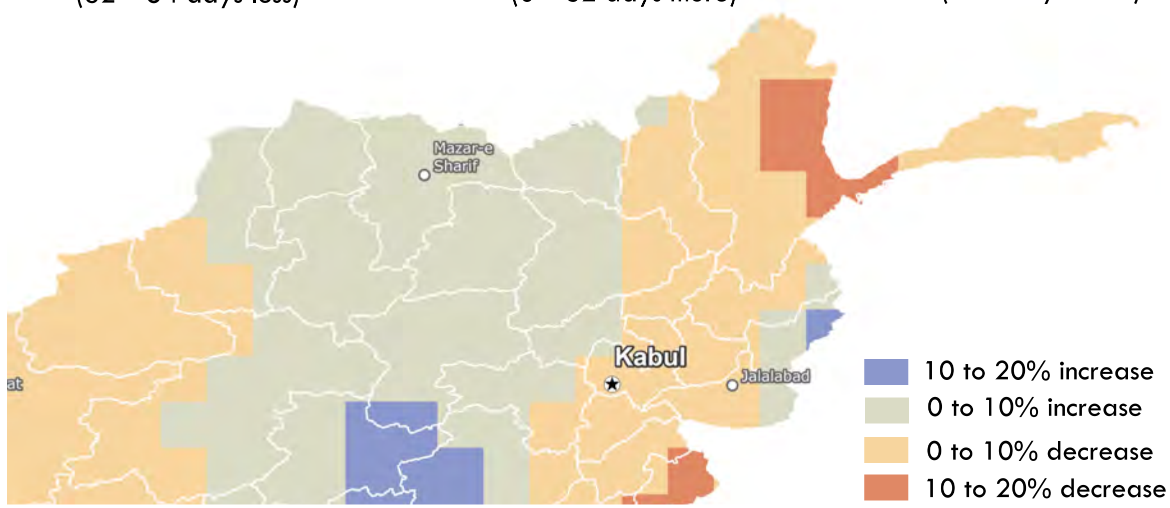
In order to assess where the risk of drought related to reduced snowmelt in spring and summer had increased, we looked at winter snowfall trends over the Central Highlands, Hindu Kush and Pamir mountains. We used two different data sources for this: change in *number of snow days* per year over the period 2000-2014 (top right map), and change in winter precipitation (bottom right).

Over the past 15 years, the highest elevation areas have generally seen a reduction in snowfall —particularly Badakhshan province in the Hindu Kush. In some of these areas, this reduction has been limited to 0 to 32 fewer snow days per year, or a 10% decrease in winter precipitation. In other areas however, the decline has been more severe, equivalent to 32 to 64 fewer snow days per year, or a 10-20% decrease in winter precipitation.

On the other hand, lower elevation areas have generally seen a slight increase in number of snow days. Again, this increase is relatively minor, ranging from 0 to 32 more snow days per year. However, such an increase can still directly affect household food security by further limiting market access in winter in these already isolated areas.

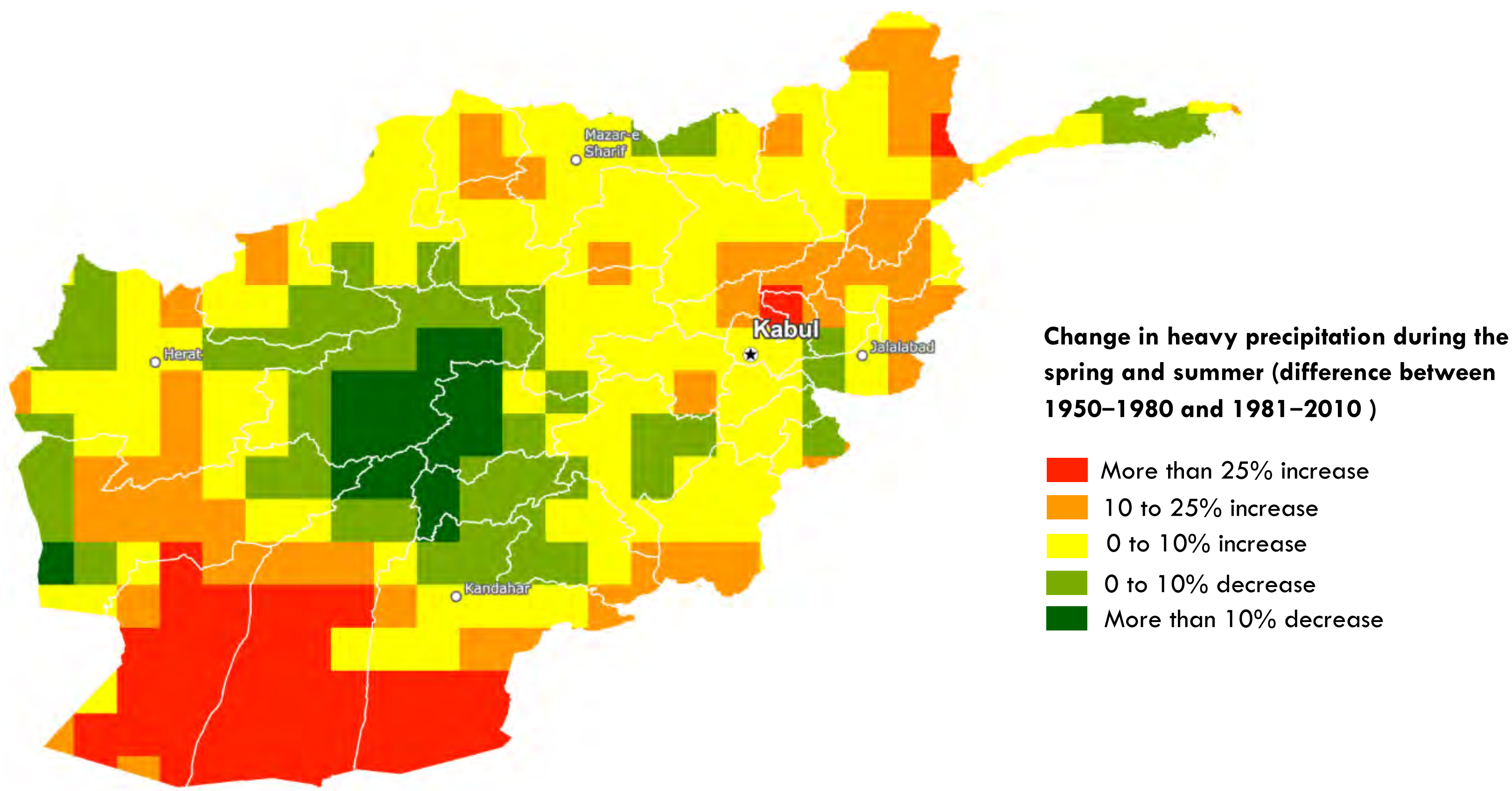
Change in number of annual snow days (2000—2014) and main river basins. Data: Modis/ Terra

Strong decrease (> 64 days less)
Medium decrease (32—64 days less)
Light decrease (0—32 days less)
Light increase (0—32 days more)
Medium increase (32—64 days more)
Strong increase (>64 days more)



Change in winter precipitation (difference between 1950–1980 and 1981–2010)

To identify areas which have experienced more rainfall-related floods over the past thirty years, we looked at changes in **heavy precipitation events**—which mostly occur from March to September. The analysis presented here was therefore limited to these months, and was defined as the 95th percentile of days above 1 mm precipitation—a standard indicator for precipitation extremes. The data suggests that heavy precipitation has **increased most in the arid south, as well as in some parts of the north-east .**

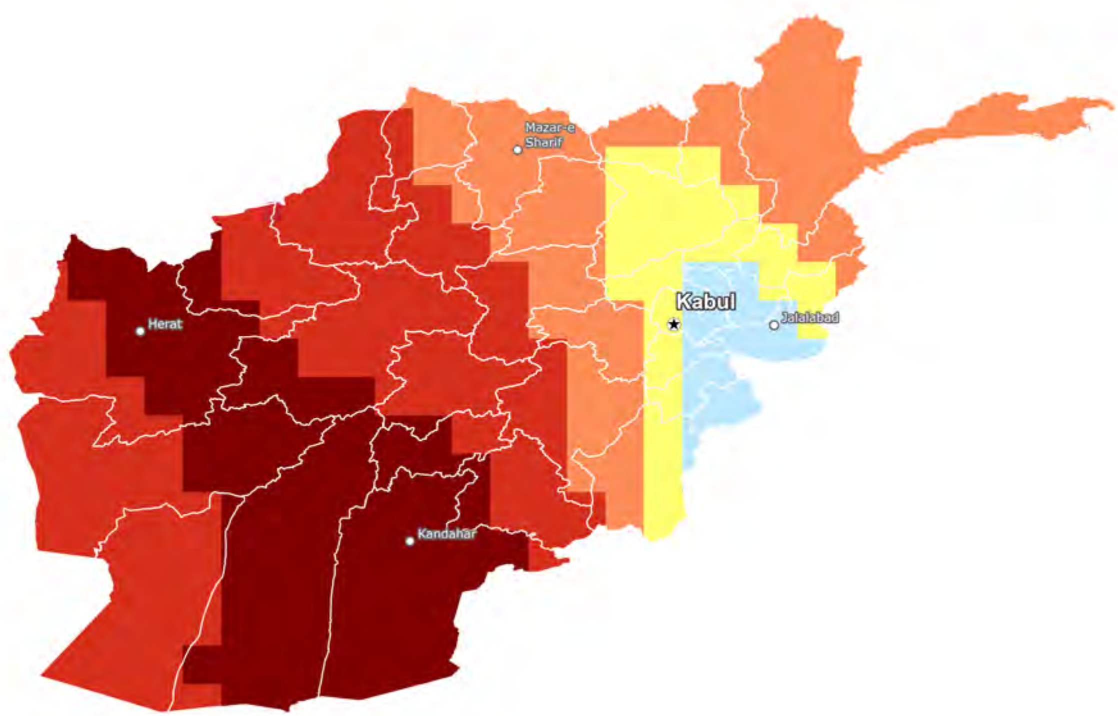


Change in heavy precipitation during the spring and summer (difference between 1950–1980 and 1981–2010)

To understand where exposure to snowmelt-induced riverine floods have increased most, we used a similar method as the one used for snowmelt-related droughts (described on p. 63)—but this time looking for areas where there had been an increase in **number of snow days and in winter precipitation**.

The rate at which snow and ice melts—and therefore the extent to which river discharge is concentrated in heavy flood events rather than distributed over time — depends in large part on temperature. We therefore also looked at **temperature** trends in mountainous areas.

While data suggests that **temperature has been increasing fairly uniformly throughout the year** (i.e. no major seasonal differences in temperature change), important **spatial variations** can be observed. Even within the Central Highlands/ Hindu Kush area, temperature increase has varied , ranging from marginal increase in Baghlan, Panjsher and Nuristan provinces, to moderate increase in Badakshan, Takhar, Kunduz and Samangan, to **high increase in Bamyan, Ghowr and Daykundi.** Interestingly, temperatures appear to have actually decreased in a pocket in the east, along the Pakistani border.



Change in annual average temperature (difference between 1950–1980 and 1981–2010)

- No change or slight decrease
- 0-0.3 °C increase
- 0.3—0.7°C increase
- 0.7—1.2°C increase
- More than 1.2°C increase

ANNEX 3 - CLIMATE PROJECTIONS: METHOD AND DATA

The climate projections shown in this report (p. 50-55) were done by UNEP and NEPA using model outputs from the Coordinated Regional Downscaling Experiment for South Asia (CORDEX–SA). CORDEX is an international coordinated framework whose aim is to generate improved regional climate change projections. CORDEX data is sub-divided into different regional domains, with Afghanistan falling into the South Asia domain.

For this study, 8 of the 12 Earth System Model-Regional Climate Model combinations available through CORDEX-SA were analyzed . The data is gridded in 05.° x 0.5° tiles— amounting to over 300 tiles for Afghanistan. This allows a detailed spatial analysis, especially for the mountainous areas of the Central Highlands and Hindu Kush where there are significant spatial variations in climate.

The projection maps shown here cover the period 2021-2050, using the reference period 1976-2005. In other words, they show the difference between what a particular climate parameter (such as rainfall or temperature) is projected to be in 2021-2050, compared to what is was during the period 1976-2005.

These projections were done using a moderately optimistic emissions scenario—known as RCP4.5— which assumes that global greenhouse gas emissions will continue to increase until 2040, and then start decreasing, while temperatures will continue increasing until 2100 and then stabilize . Under this scenario, global average temperatures are expected to stabilize at between 1.1 °C and 2.6°C above pre-industrial temperatures.

RCP4.5 is one of the four scenarios—or Representative Concentration Pathways (RCP)s—adopted by the IPCC to describe possible climate futures, depending on future global greenhouse gases emissions levels. The four emissions scenarios are RCP2.6, which corresponds to an increase in radiative forcing of 4.5 W/m^2 in 2100, compared to the preindustrial level, and assumes that emissions will peak between 2010-2020 and then decrease rapidly; RCP4.5, which assumes that emissions will peak around 2040 and then decrease; RCP6, which assumes that emissions will peak around 2080 and then decrease slightly; and RCP8.5, which assumes that will emissions continue to rise throughout the 21st century.[1]

[1] Intergovernmental Panel on Climate Change (IPCC) 2013.

Photo (opposite): WFP/ Teresa Ha/ Khram wa Sarbagh, Wakhan

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Photos: Opposite: UNEP/ Alec Knuerr/ Bamyan district, Bamyan | Front cover: WFP/ Challiss McDonough/ Sarhad-e-Broghil , Wakhan| Contents page: WFP/ Silke Buhr and Diego Fernandez| Back cover: WFP/ Diego Fernandez/ Mazar-e-Sharif, Balkh.


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