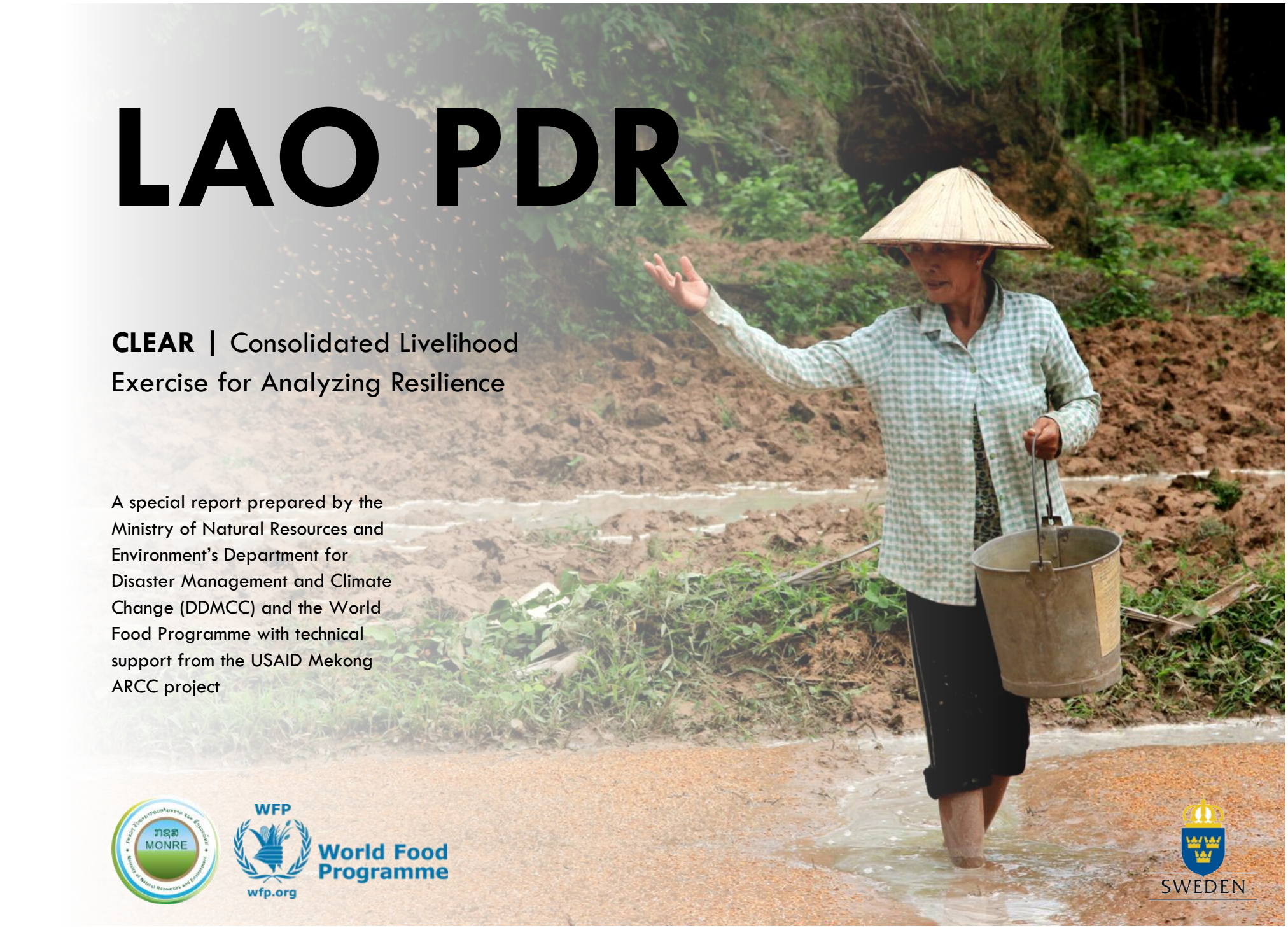
LAO PDR

CLEAR | Consolidated Livelihood Exercise for Analyzing Resilience

A special report prepared by the Ministry of Natural Resources and Environment's Department for Disaster Management and Climate Change (DDMCC) and the World Food Programme with technical support from the USAID Mekong ARCC project



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ABOUT THIS REPORT

This special report is published jointly by the Ministry of Natural Resources and Environment and the World Food Programme with technical support from the USAID's Mekong Adaptation and Resilience to Climate Change (Mekong ARCC) project, as well as inputs from the Ministry of Agriculture and Forests, Ministry of Planning and Investments, Ministry of Labour and Social Welfare, the United Nations Development Programme, the Food and Agriculture Organisation, the NGO Disaster Risk Reduction and Management consortium (Oxfam, CARE, World Vision, the French Red Cross) and Decide Info.

The report examines climate impacts on livelihoods and is intended to be used as a tool to identify adaptation options for the most vulnerable livelihoods.

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For more information, visit: **www.wfp.org/c-adapt**

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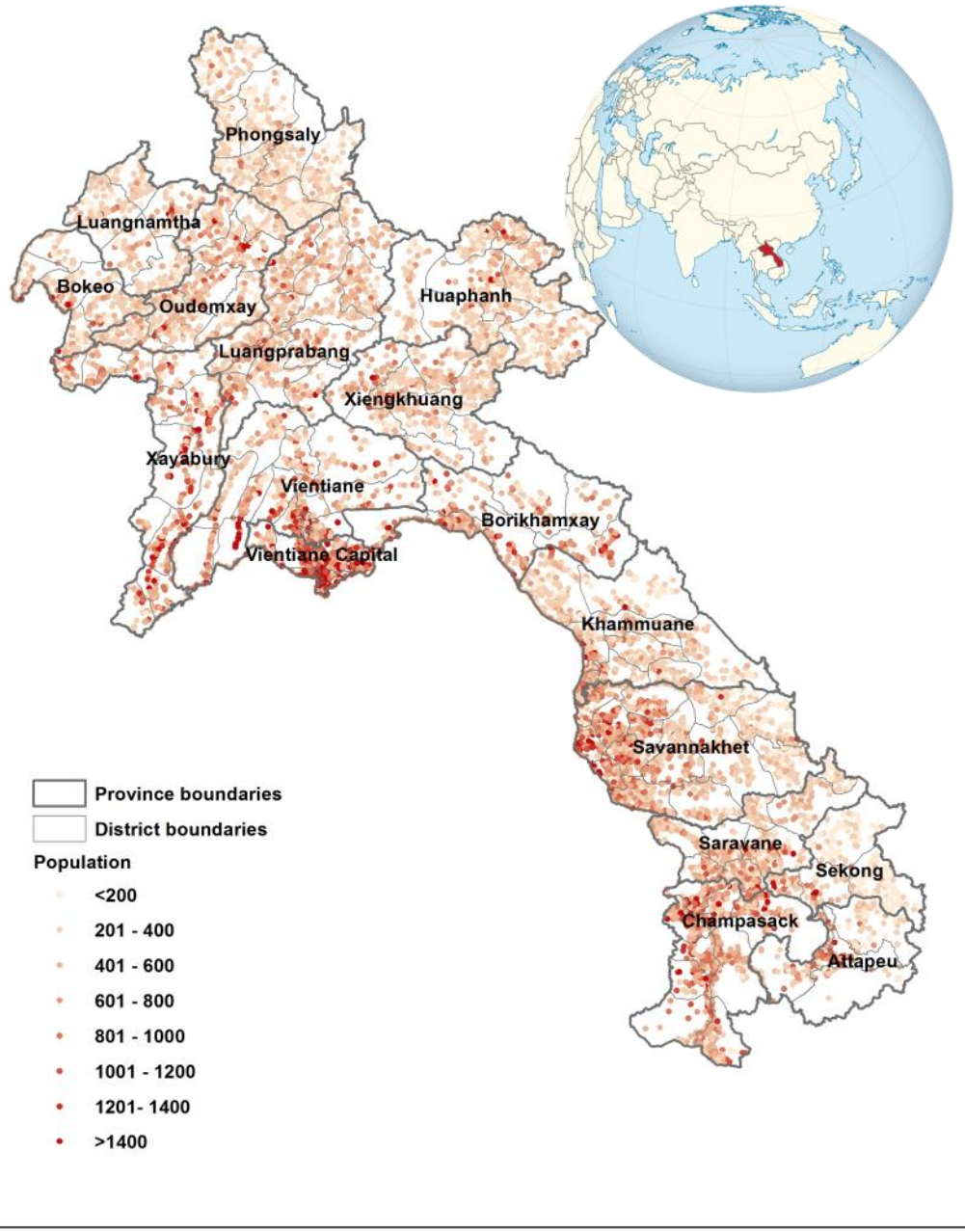
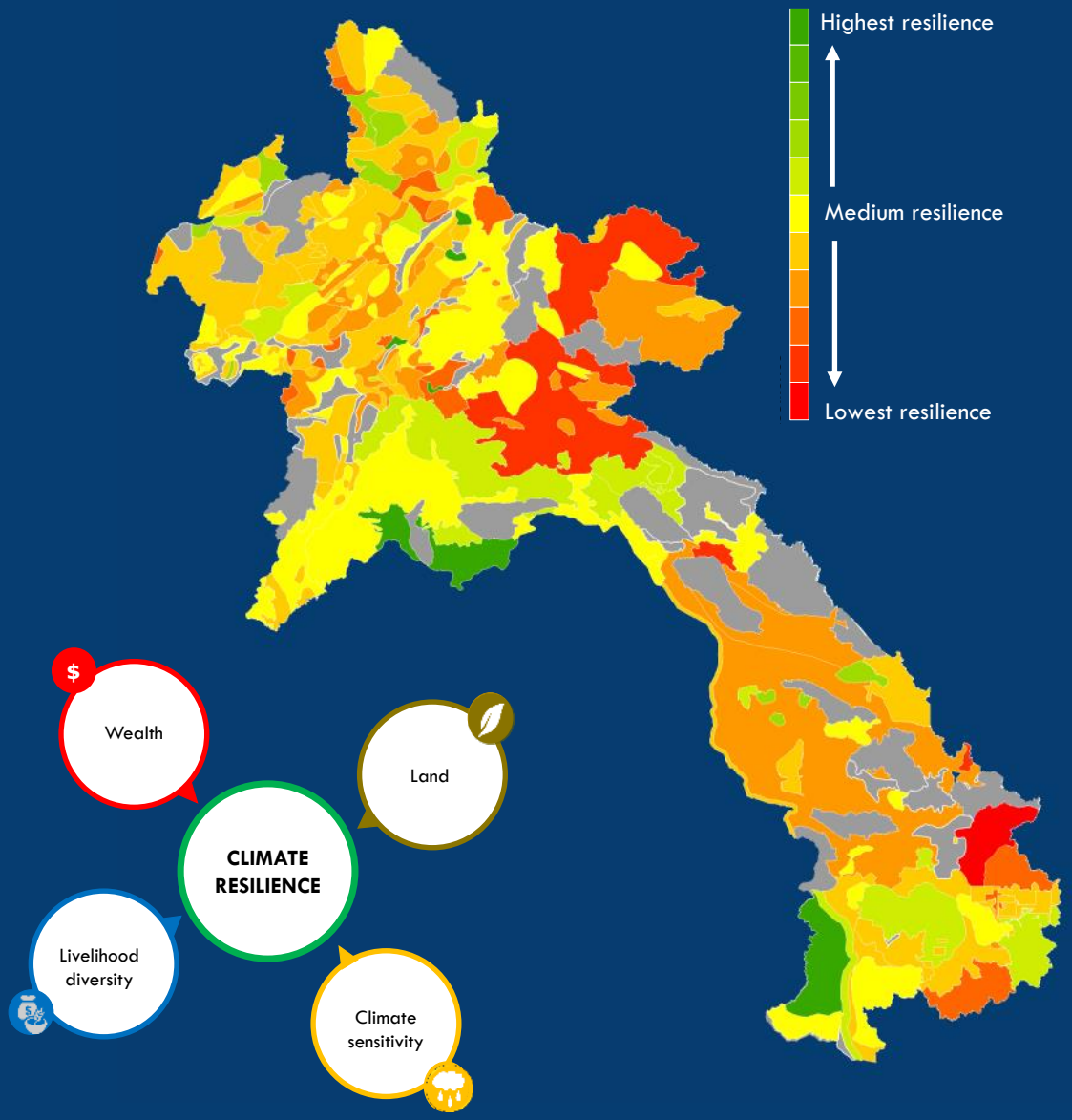
LAO PDR: Reference Map



contents

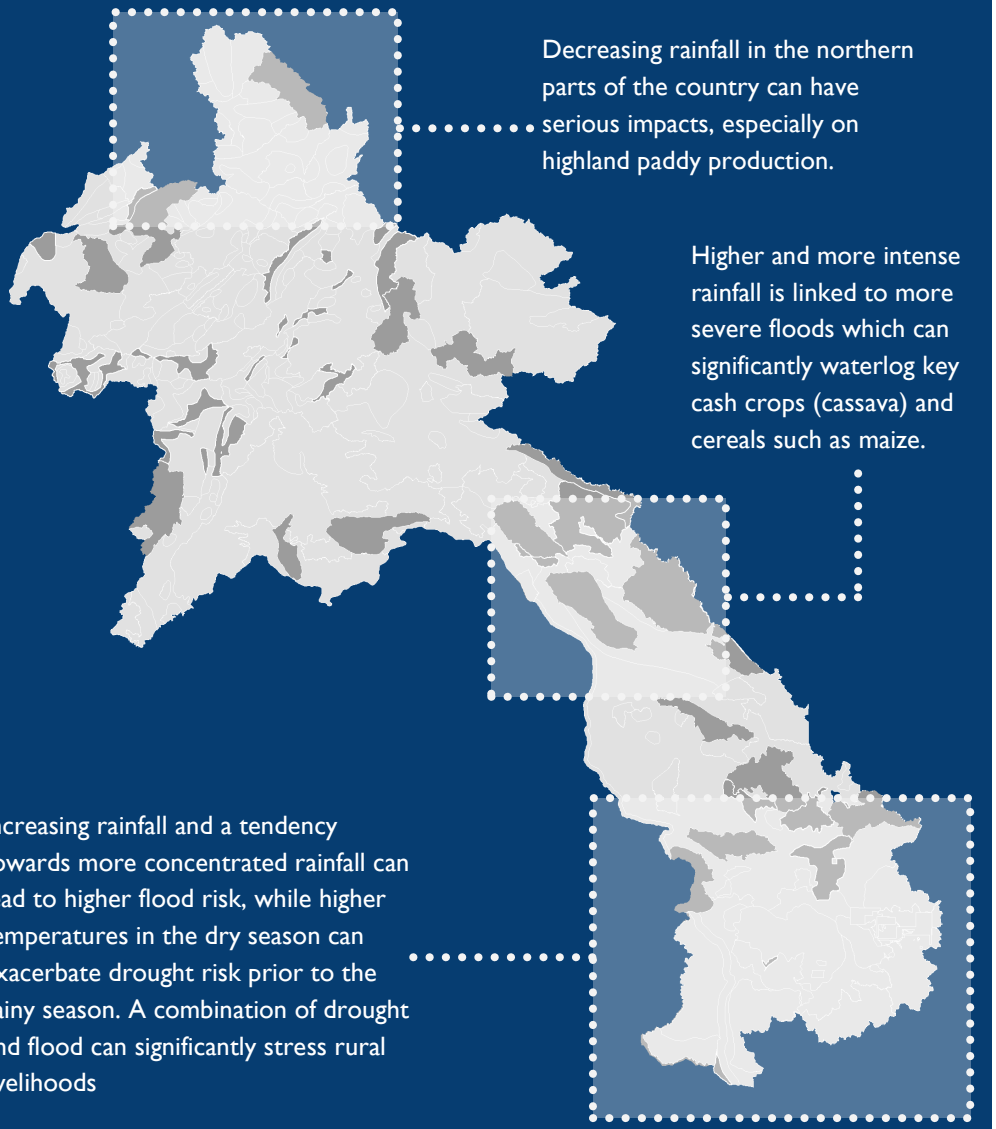
KEY MESSAGES

- Livelihoods in Lao PDR are diverse owing to a complex topography and the flows of the Mekong River basin. Over 40 unique livelihood groups exist in the country, each with a unique resilience profile.
- The livelihoods with greatest climate resilience are those with sufficient access to financial capital (and wealth) and land, those which are highly diversified, and those which do not rely on rainfed agriculture. Focusing on activities linked to these characteristics will enhance community resilience.
- Generally, livelihoods dependent on highland paddy are among the least resilient in part due to the rugged terrain and remoteness which limits access to land and additional livelihood activities. Communities dependent on highland paddy are also among the most severely affected by climate-related risks.

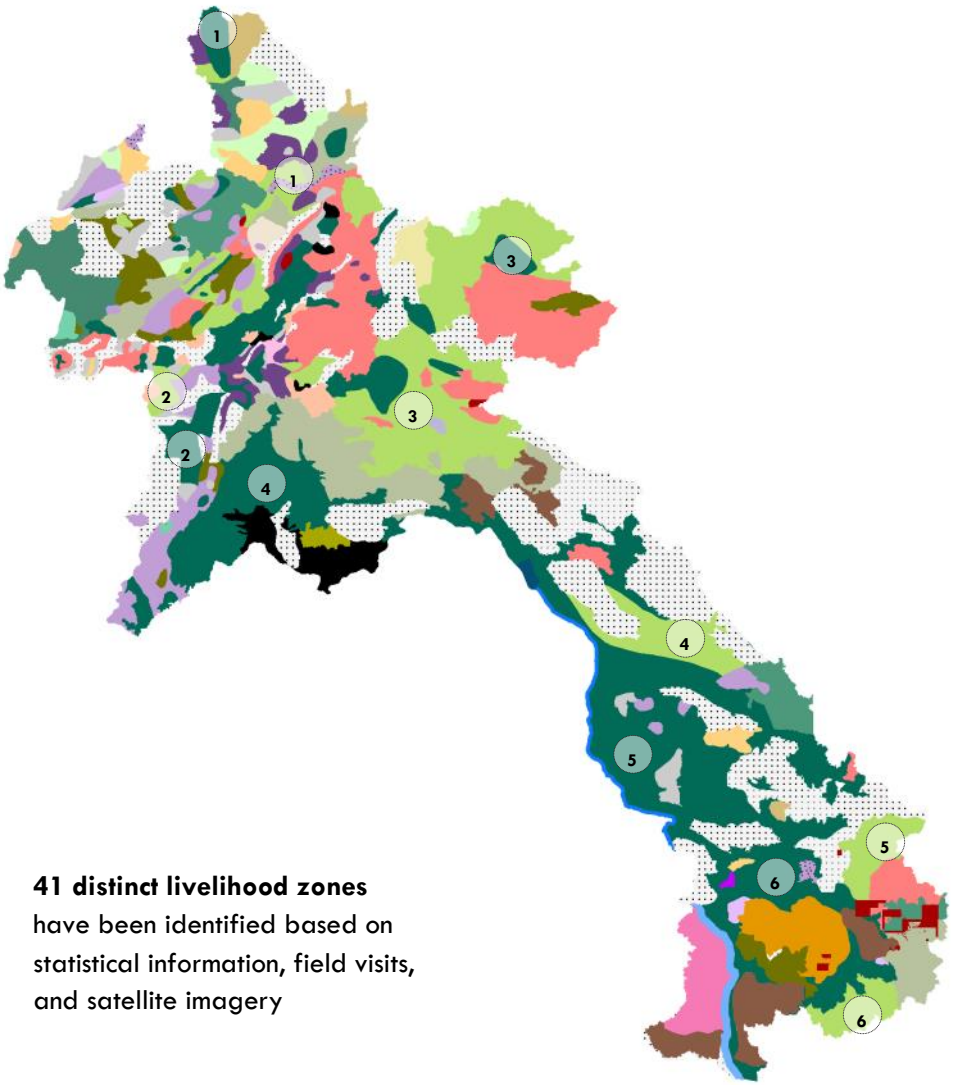


Climate change is one of the key challenges faced by rural communities. Four key climate trends have the potential to significantly affect livelihoods:

- ✓ Long-term climate trends: decreases in rainfall in the northern parts of the country can affect the ability of households to engage in rainfed agriculture in the absence of irrigation or water harvesting technology.
- ✓ Seasonal variability: delays in the onset of the rainy season in central and eastern Lao PDR would have detrimental consequences for paddy production. In addition, shorter but more intense rainy seasons increase flood risk. This generates a dual risk of increased drought *and* flood risk in the same area.
- ✓ Extreme climate events: changes in seasonality are likely to exacerbate drought and flood risk which would have detrimental consequences for most livelihoods. Damage to critical assets is a significant risk.
- ✓ Future climate: increases in rainfall together with more frequent heavy rainfall events will increase flood risk—particularly in southern Lao PDR. At the same time, higher temperatures in the dry season will increase the magnitude of dry spells and droughts. The combination of more rainfall and higher temperatures will affect crop suitability of paddy, coffee, cassava, and maize.



LIVELIHOOD ZONES



41 distinct livelihood zones have been identified based on statistical information, field visits, and satellite imagery

LOWLAND PADDY

1. Northern lowland paddy
2. Northwestern lowland paddy
3. Northeastern lowland paddy
4. Vientiane Plans lowland paddy
5. Central lowland paddy
6. Southern lowland paddy

- Lowland paddy and cash crops
- Lowland paddy and large-scale livestock
- Lowland paddy, cash crops, and NTFPs
- Lowland paddy and orchards (banana)

HIGHLAND PADDY

1. Northern highland paddy
2. Northwestern highland paddy
3. Northeastern highland paddy
4. Khammouan highland paddy
5. Xekong highand paddy
6. Attapeu highland paddy

- Highland paddy, cash crops and NTFPs
- Highland paddy, cash crops and livestock
- Highland paddy and cash crops
- Highland paddy and large-scale livestock

LIVESTOCK REARING

INDUSTRIAL POULTRY

FISHING

- Southern fishing and tourism
- Mekong large-scale fishing
- Fishing and tobacco

CASH CROPS

- Northern cash crops
- Northwestern cash crops
- Central cash crops
- Salavan cash crops
- Industrial crops (rubber and cassava)
- Orchards (pineapple, durian)
- Organic orchards (banana)

NON-TIMBER FOREST PRODUCTS

- Non-timber forest products
- NTFPs and lowland paddy
- NTFPs and highland paddy
- NTFPs and tourism

BOLOVEN PLATEAU (COMMERCIAL AGRICULTURE: COFFEE, TEA)

CROSS-BORDER TRADE, SEASONAL MIGRATION AND PADDY

MINING

RUBBER (PARTLY COMMUNITY OWNED)

URBAN AREAS

PROTECTED AREAS

*Note: Protected Areas in Champasack and Attapeu have been coded as Non-Timber Forest Products Livelihood Zones based on field visit verification

Livelihoods in Lao PDR are varied owing to the complex topography of the country, differences in agro-climatic conditions, the flow of the Mekong River, and the rapid economic development experienced by the country over the last few decades.

Rural livelihoods, which provide an income to over two thirds of the population, continue to be highly climate-sensitive and are predominantly dependent on paddy-accounting for over 80 percent of all agricultural production. Paddy farming is often combined with small-scale livestock raising and vegetable gardening for household consumption. Rice is also a top priority for the Government of Lao PDR as shown in the National Socio-Economic Development Plans. As such, paddy farming will continue to be a key livelihood.

Three distinct patterns of paddy production exist in Lao PDR: rainfed lowland paddy, irrigated lowland paddy, and highland (slash-and-burn rotational) paddy-each with specific climate sensitivities and resilience profiles.

Lowland paddy is the most common form of paddy production occurring in most parts of the country. Large areas of lowland paddy production exist in the central parts of the country, in Vientiane Province, as well as in smaller scale in northern and northeastern Lao PDR. Elsewhere it occurs in combination with other crops. Lowland paddy production is sensitive to both flood (during heavy rainfall events) and drought (due to delays in the onset of the rainy season), but impacts depend heavily on local practices.

Highland paddy is predominant in the southeastern parts of the country as well as in the north, where paddy is grown in combination with cash crops. Communities living in highland areas are often in more remote areas with limited access to markets and other resources. In addition, highland paddy is highly sensitive to climate-related risks: from landslides destroying landholdings on slopes to dry spells and droughts limiting production.

Irrigated lowland paddy is rare and only occurs in pockets. Irrigated paddy production is the least sensitive type of paddy-based production given the availability of different water sources.

Major cash crops include maize (grown by around 50% of households), banana and other fruits, and cassava, all of which contribute significantly to household income.

Communities along the Mekong River and near major lakes primarily engage in fishing and paddy farming in combination with small-scale vegetable gardening. In the southernmost parts of the river, tourism is also an important source of income for households.

Communities near the Thai border have developed close economic ties with communities on the other side of the border and practice trade. During the dry season, migration is also a major livelihood.

The highly fertile Boloven Plateau, in southern Laos, has weather conditions which are extremely conducive to the production of high-value cash crops such as coffee, tea, and fruits-the main source of livelihood for communities in the Plateau.

In national protected areas, given limitations for agricultural production, communities typically resort to a range of non-timber forest products including mushrooms, tree bark, wild orchids, cardamom and spices, and wild fruits-all of which are a profitable source of income.

In recent years, the increase in mining concessions have offered new livelihood options to some communities but this is still limited.

Over the coming years, livelihoods can be expected to change as communities search for alternative crops and activities that provide stable income. Land concessions for plantations (rubber, eucalyptus, and others) will likely change land use patterns, which in turn, will affect rural livelihoods.

RESILIENCE PROFILE

Climate resilience in Lao PDR is influenced by four key factors[1], namely wealth (access to financial capital), availability of land (access to natural capital), livelihood diversity (to better manage shocks), and climate-sensitivity of income (reliance on purely rainfed agricultural systems renders households less resilient to climate variability). Resilience patterns can therefore be mapped by aggregating these indicators (Page 4).

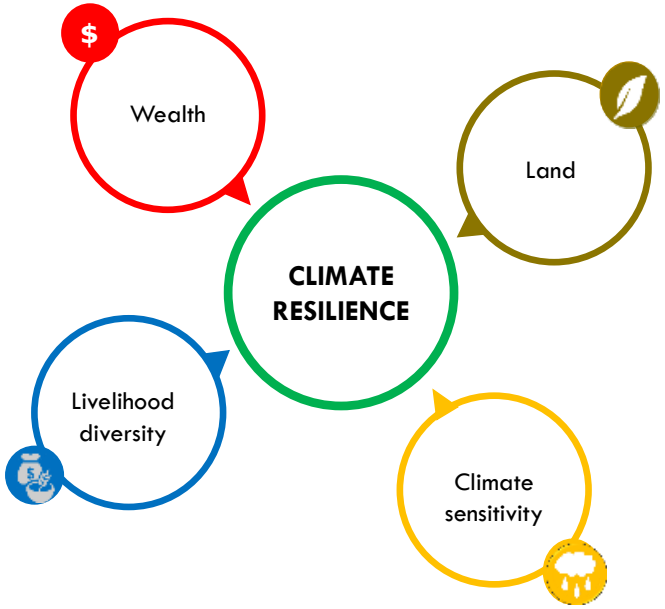
Livelihoods in Lao PDR have geographically distinct patterns of resilience based on these influences. Apart from urban livelihoods (Vientiane and Luangprabang) where communities have access to financial flows from industrial and tourism-related activities, communities along the Thai border in the southern part of Laos also enjoy some of the highest levels of resilience. This is the result of highly diversified livelihood profiles due to cross-border trade. This diversification also reduces climate-sensitivity of income.

Communities in the northern parts of the country that enjoy higher levels of resilience combine paddy production with cash crops (tea, maize, banana).

Conversely, livelihoods relying exclusively on highland paddy have the lowest levels of resilience-particularly in Sekong, Huaphanh and parts of Xaysomboon. This pattern of resilience is linked to high levels of poverty, limited access to land (around one hectare per household), reliance on monocultures, and the high climate-sensitivity of the main livelihood activities.

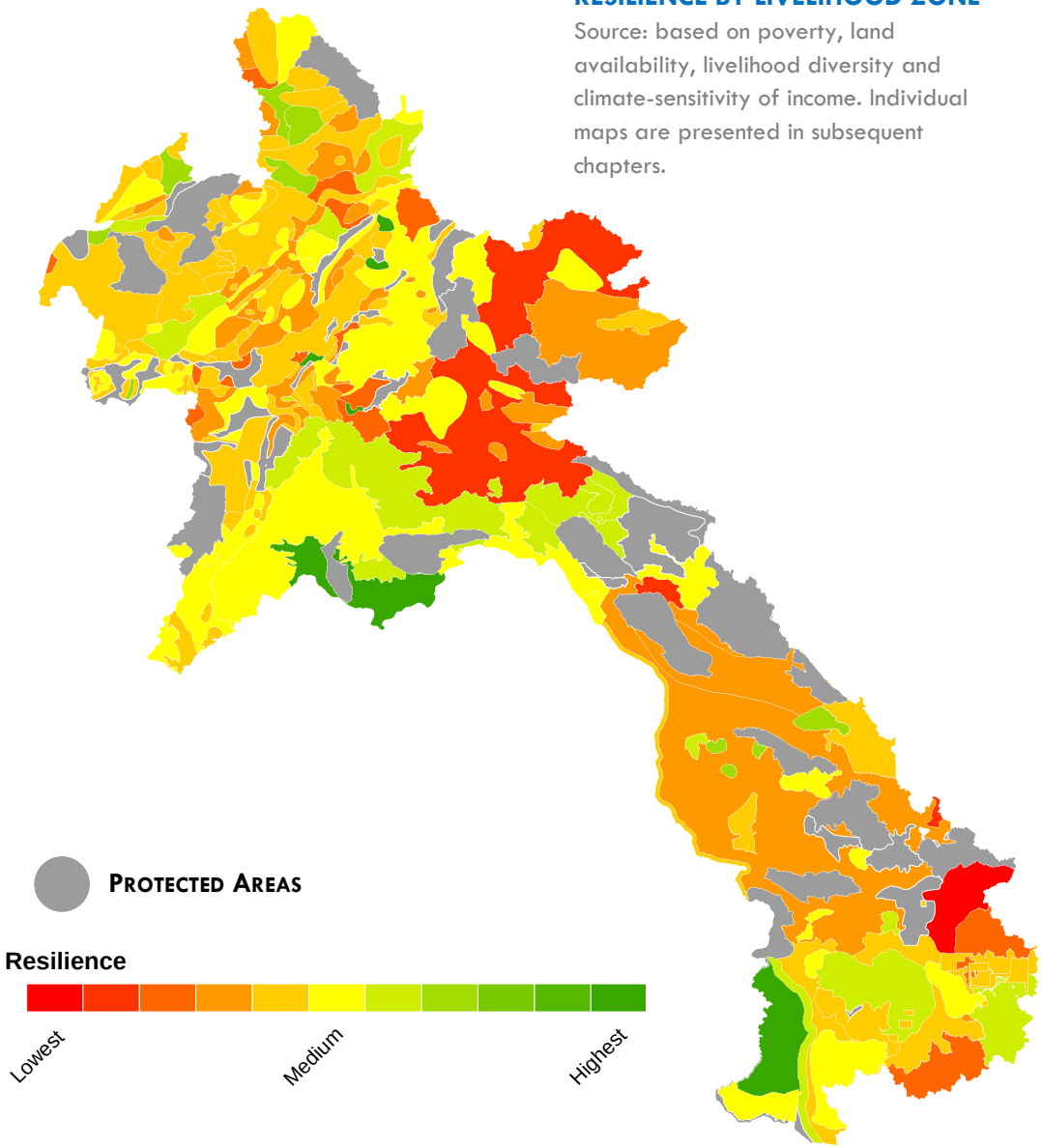
Similarly, households in the central lowland paddy areas have low levels of resilience driven by extremely limited livelihood diversity and high reliance on rainfed agriculture, together with limited land availability.

[1] Based on community discussions (see Annex I for a description of the method)



RESILIENCE BY LIVELIHOOD ZONE

Source: based on poverty, land availability, livelihood diversity and climate-sensitivity of income. Individual maps are presented in subsequent chapters.



POVERTY & ACCESS TO WEALTH

Wealth is an important factor influencing resilience levels. Availability of financial capital determines the ability of households to invest in different assets and withstand climate-related shocks.

In Lao PDR, access to wealth is closely linked to remoteness and connectivity to markets. Communities that are well connected to major towns and to the Thai border fare better than those in mountainous areas near the Vietnamese border. To some extent, engaging in cash crops increases wealth as can be seen by the low poverty rates in the Boloven Plateau commercial agriculture area.

Poverty levels are lowest among three key livelihood groups: urban areas, where industrial activity and tourism bring substantial financial resources; fishing and trader communities along the Mekong River who depend on trade with Thailand; and communities in the Boloven Plateau, who engage in high-value crop production (coffee, tea, and fruits).

In contrast, the poorest livelihood groups are predominantly reliant on highland paddy production in the southeastern parts of the country. Communities engaging in highland paddy production often live in remote mountainous areas with limited infrastructure and limited land for agricultural production which exacerbates food insecurity during drought or flood years.

Communities engaging in mining[2] -a relatively recent livelihood option for several households-also live in some of the poorest parts of Lao PDR. Though mining provides a reliable source of income there is concern about potential environmental implications which may affect rural livelihoods in the future.

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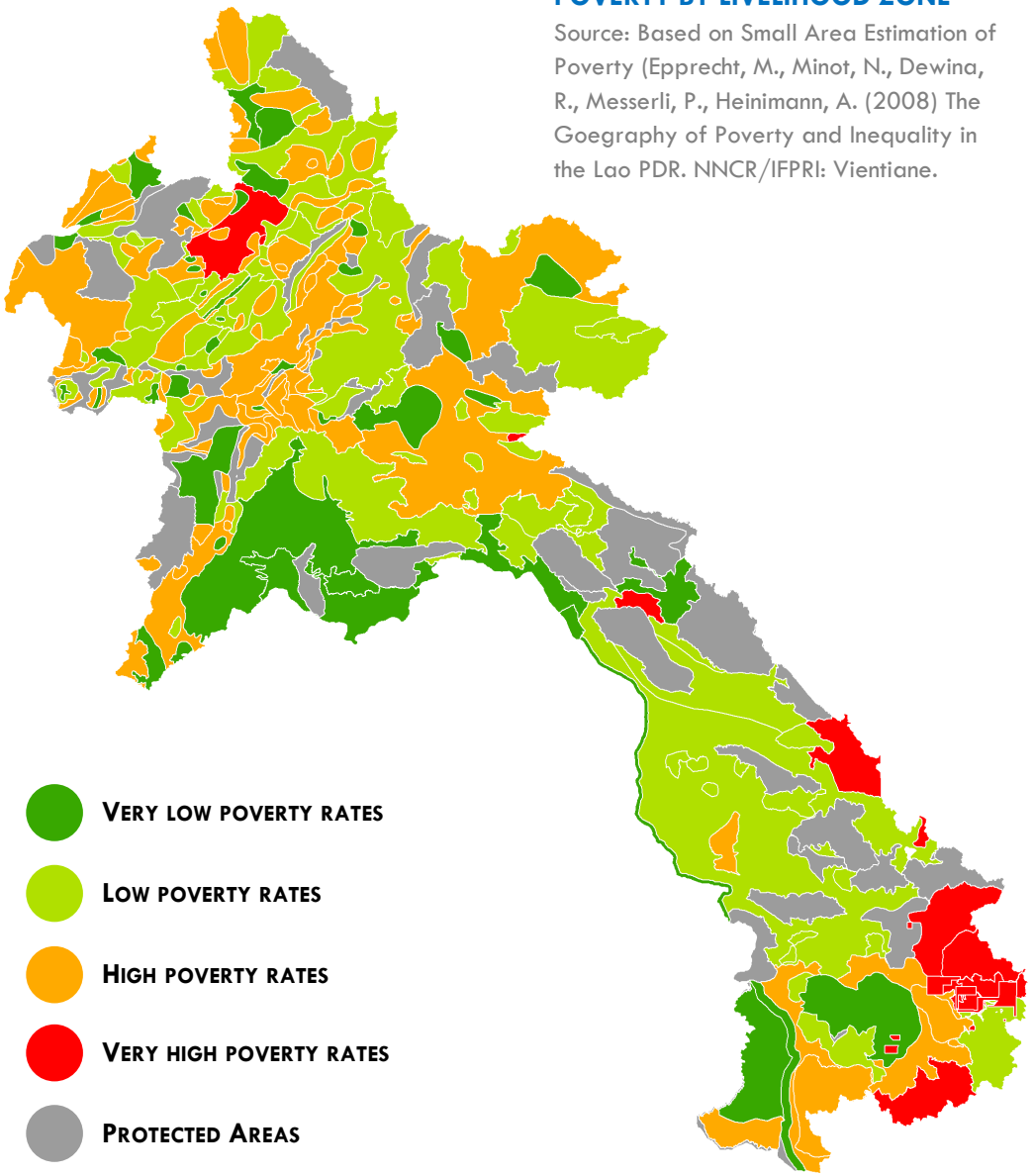
[2]Later in June 2012, Government had issued an order number 13/PM to reject any new project proposal includes mining, rubber and eucalypyus plantation projects in the whole country

Poverty trends are likely to change in the coming decades with livelihood diversification (including higher trade with neighbouring countries, tourism options, and higher diversification of livelihoods) reducing poverty to some extent. The poorest areas remain highly dependent on highland paddy and are among the most remote. Continued assistance through livelihood support programmes, creation of productive assets, and enhancing access to critical services will help reduce poverty and increase community resilience.

POVERTY BY LIVELIHOOD ZONE

Source: Based on Small Area Estimation of Poverty (Epprecht, M., Minot, N., Dewina, R., Messerli, P., Heinimann, A. (2008) The Goegraphy of Poverty and Inequality in the Lao PDR. NNCR/IFPRI: Vientiane.



ACCESS TO LAND

Availability of land determines the ability of households to produce sufficient food for home consumption as well as surplus for sale in markets. Availability of land and wealth are closely interlinked as rural communities with larger landholdings can produce rice commercially for profits.

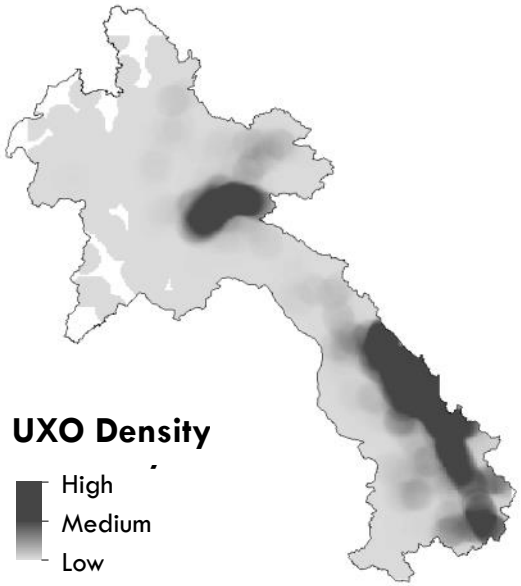
The average area of landholdings is 0.77 ha, with over 70 percent of households having access to less than 2 hectares of land[2].

Among rural households, those engaging in highland paddy farming have the lowest access to land, which is especially problematic given the need for land to sustain slash-and-burn highland cultivations. Another key challenge for highland paddy farmers is the destruction of farmland resulting from irregular rainfall patterns, which is exacerbated by the sloping land. Fishing communities along the Mekong River also have limited access to land as do households in the densely populated areas of northern Lao PDR.

One of the key factors affecting availability of land is the presence of unexploded ordinances (UXOs) which limit the places where agriculture can be practiced. Over the coming years, some of the key challenges for land availability will include construction of dams and the increase in land concessions for plantations such as rubber, cassava and eucalyptus, as well as for mining. While communities may benefit financially from engaging in such activities, the availability of land for production may be heavily compromised. In addition, under a changing climate, the suitability for agriculture and other traditional livelihoods may be heavily affected thereby further reducing the availability of land (see Pages 27-28).

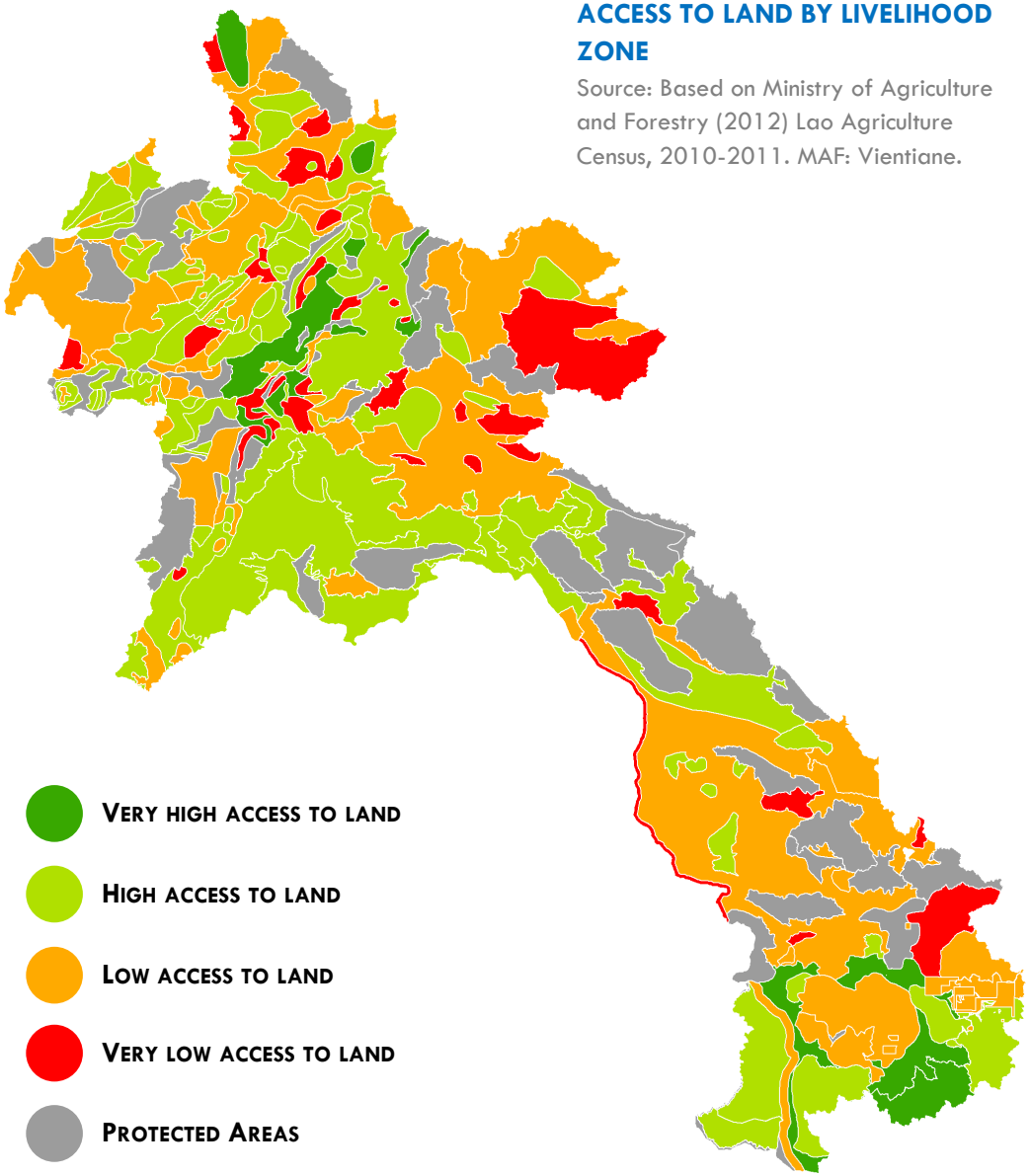
[3] Lao Census of Agriculture 2010/2011 (published in 2011)

About 5 million hectares (20 percent of the total land) in Lao PDR are suitable for cultivation. However, only a sixth of the suitable land is used accounting for less than 4 percent of the total land. Cultivated land area has been increasing since the 1970s but the increase in cultivation has not matched population growth. In addition to cultivation, agricultural land is also used for pastureland and some contain ponds for raising fish. Increasing access to land in a sustainable manner will be critical to enhancing resilience.



ACCESS TO LAND BY LIVELIHOOD ZONE

Source: Based on Ministry of Agriculture and Forestry (2012) Lao Agriculture Census, 2010-2011. MAF: Vientiane.



LIVELIHOOD DIVERSITY

Diversification of livelihood activities is a key strategy for enhancing resilience: households with diverse livelihood profiles are more capable of responding to shocks in case the primary activity is affected by a significant shock. Diversification away from paddy production is especially significant as it allows households to increase diet diversity (for example, higher consumption of animal products) as well as the number of income sources.

Overall, livelihoods remain heavily dependent on one key activity: paddy production, which accounts for over three quarters of all agricultural production in the country and is an important source of income for over 700,000 households. Subsistence rice cultivation (in combination with livestock rearing and vegetable gardening) is still dominant but an increasing number of farmers are marketing rice, indicating a transformation towards a commercial role for rice[4].

Cash crops provide an important strategy for livelihood diversification. In recent years, households have increasingly engaged in production of maize, cassava, tea and coffee. These crops provide an important secondary livelihood activity which strengthens the resilience of households.

Communities along the Mekong River engage in two key activities: fishing and paddy farming. In the southernmost part of the River, tourism provides another source of income for communities.

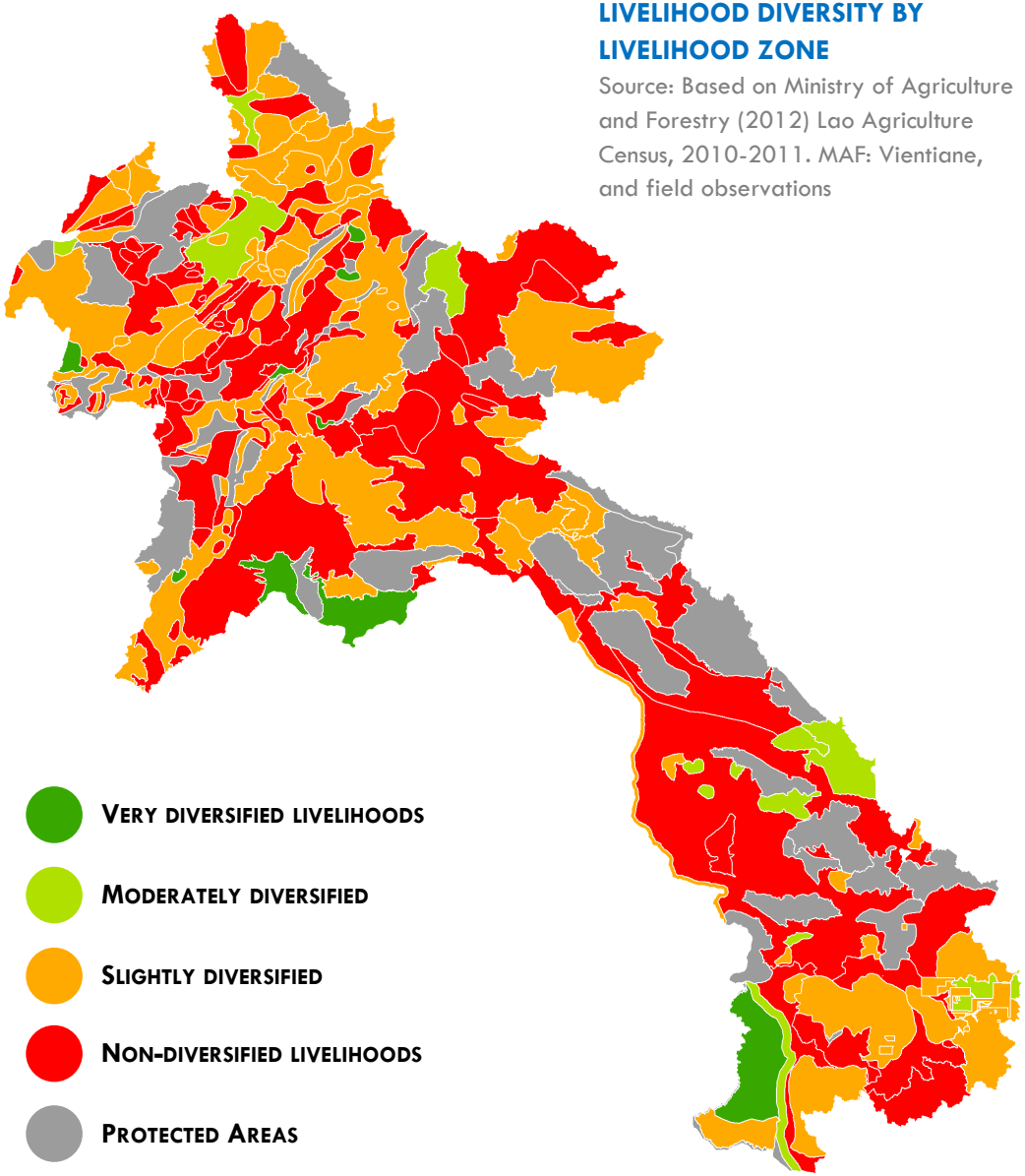
The most diversified livelihoods are located in urban areas and in the southernmost regions along the border with Thailand where households are able to engage in production of handicrafts and trade products for a higher price.

[4] IRRI, MAF, World Bank and FAO (2012) Lao PDR: Rice Policy Study

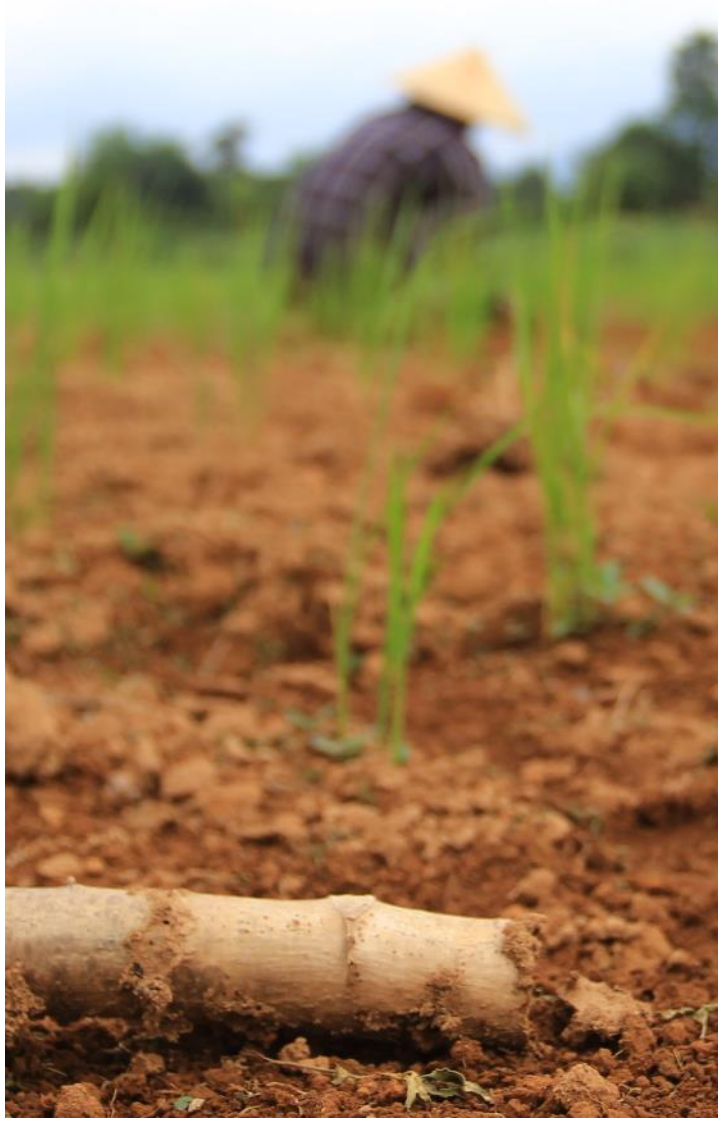
The continued reliance on a single crop (paddy) in most areas means that communities are unable to rely on additional activities to mitigate the effect of climate and non-climate related shocks. To date, the main drivers of diversification are urbanization and tourism. Training in production of different crops (such as coffee, cassava, and maize) has also helped increase livelihood diversification but further diversification is needed to enhance resilience.

LIVELIHOOD DIVERSITY BY LIVELIHOOD ZONE

Source: Based on Ministry of Agriculture and Forestry (2012) Lao Agriculture Census, 2010-2011. MAF: Vientiane, and field observations



CLIMATE SENSITIVITY



Changes in climatic patterns, both long-term and seasonal, have a detrimental effect on livelihoods that depend on climate-sensitive income, such as seasonal or daily agricultural labour, sale of rain-fed crops, and fishing.

Extreme weather events such as floods, droughts, and storms can have significant impacts on livelihoods and food security outcomes by reducing availability of food for home consumption, reducing production for sales or damaging livelihood productive assets.

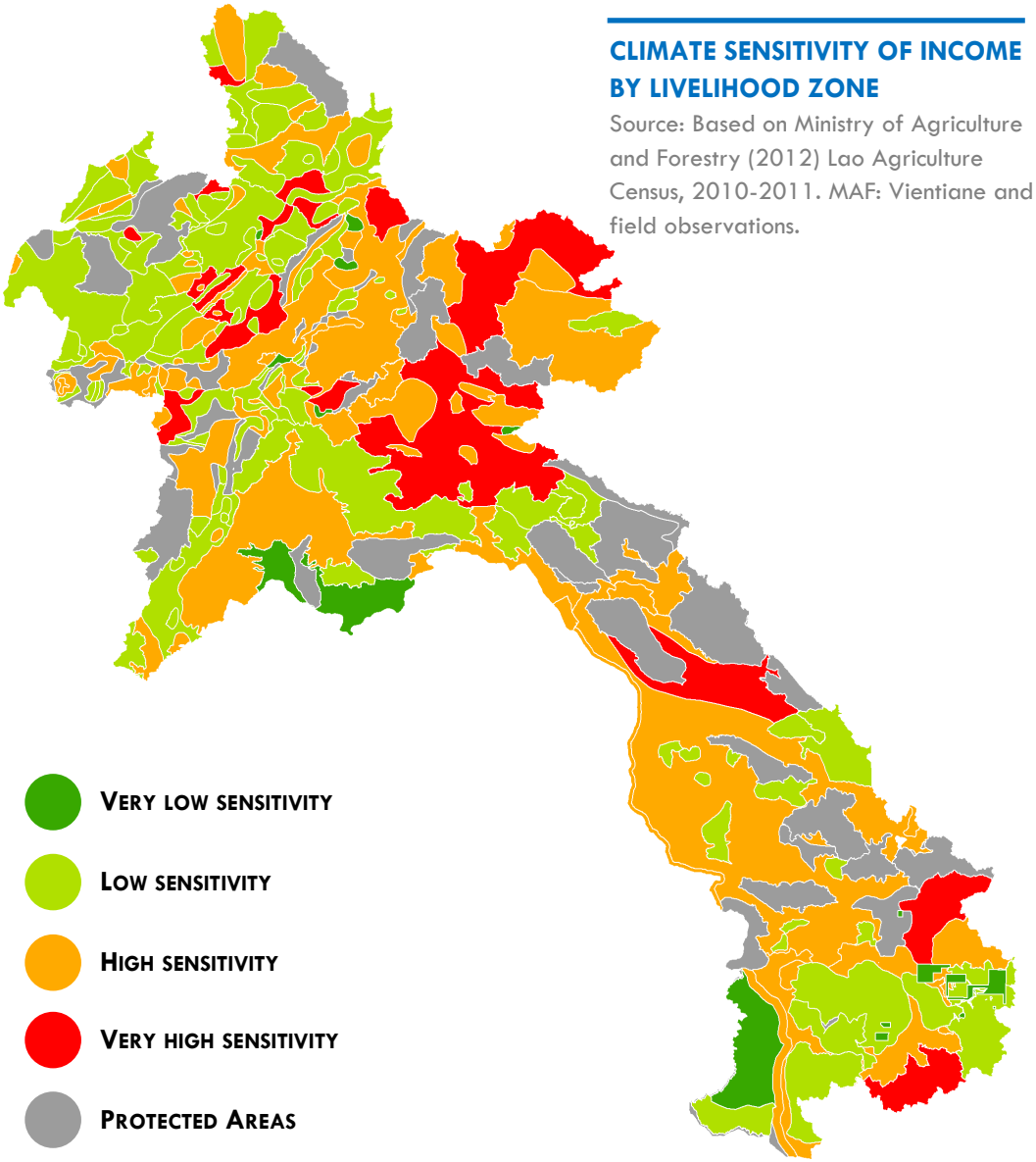
Income is particularly sensitive for highland paddy farmers. As a result of complex topography and lack of water resources, highland paddy farming is much more labour-intensive than other livelihoods and farmers require more land than other livelihood groups to meet basic food and income requirements.

Lowland paddy is slightly less sensitive as labour and land requirements are lower. Often lowland paddy is practiced near rivers or water bodies which also partly reduces reliance on rainfall.

More diversified livelihoods including fishing and non-timber forest products are less sensitive to climate risks given that these activities depend on long-term rainfall patterns-rather than on seasonal variability.

Households relying on tourism-based activities and urban activities are among the least sensitive to variations in climate given the relative stability and predictability of income sources. Here, other shocks such as price volatility, may be more significant threats to overall resilience.

The limited access to irrigation means that households are generally quite sensitive to the effects of rainfall variability: delays in the onset of the rainy season can have severe effects on planting and other agricultural activities and can have negative effects on crop yields, leading to substantial food and income losses. Households engaging in activities that do not depend directly on rainfall patterns—such as mining, harvesting of non-timber forest products, and tourism—are less climate-sensitive and are therefore less affected by climate variability.



CLIMATE SENSITIVITY OF INCOME BY LIVELIHOOD ZONE

Source: Based on Ministry of Agriculture and Forestry (2012) Lao Agriculture Census, 2010-2011. MAF: Vientiane and field observations.

RAINFALL CLIMATOLOGY

The average annual rainfall varies across Laos from 1100mm in the northeast of the country to 2000mm in the north of Vientiane capital to a maximum of over 3000mm in southeast of Laos.

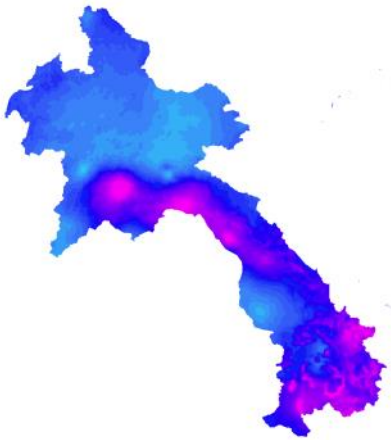
The drier areas of the country are located in the northeastern high plateaus, while the wetter regions coincide mostly with areas of strong slope: variations in elevation and topography are therefore likely linked to such high rainfall values.

Livelihood zones in the southernmost parts of the country therefore receive large amounts of rainfall, including highland paddy areas (in Sekong and Attapeu) as well as the Boloven Plateau commercial zone. The high amounts of rainfall are both beneficial and detrimental to livelihoods: for communities in the Boloven Plateau, high amounts of rainfall together with fertile land provide optimal conditions for the production of coffee and tea whereas in highland areas of Sekong and Attapeu the high amount of rainfall has been linked to degradation of sloping lands and landslides.

Lowland paddy areas in central Lao receive around 1600-2000 mm of rain on annual basis, providing sufficient water for paddy: indeed, the paddy producing areas of Savannakhet and Khammuane generally produce rice surpluses.

Livelihoods in the northern parts of the country receive, on average, the least amount of rainfall. These livelihoods include highland paddy and lowland paddy in combination with cash crops and harvesting of non-timber forest products.

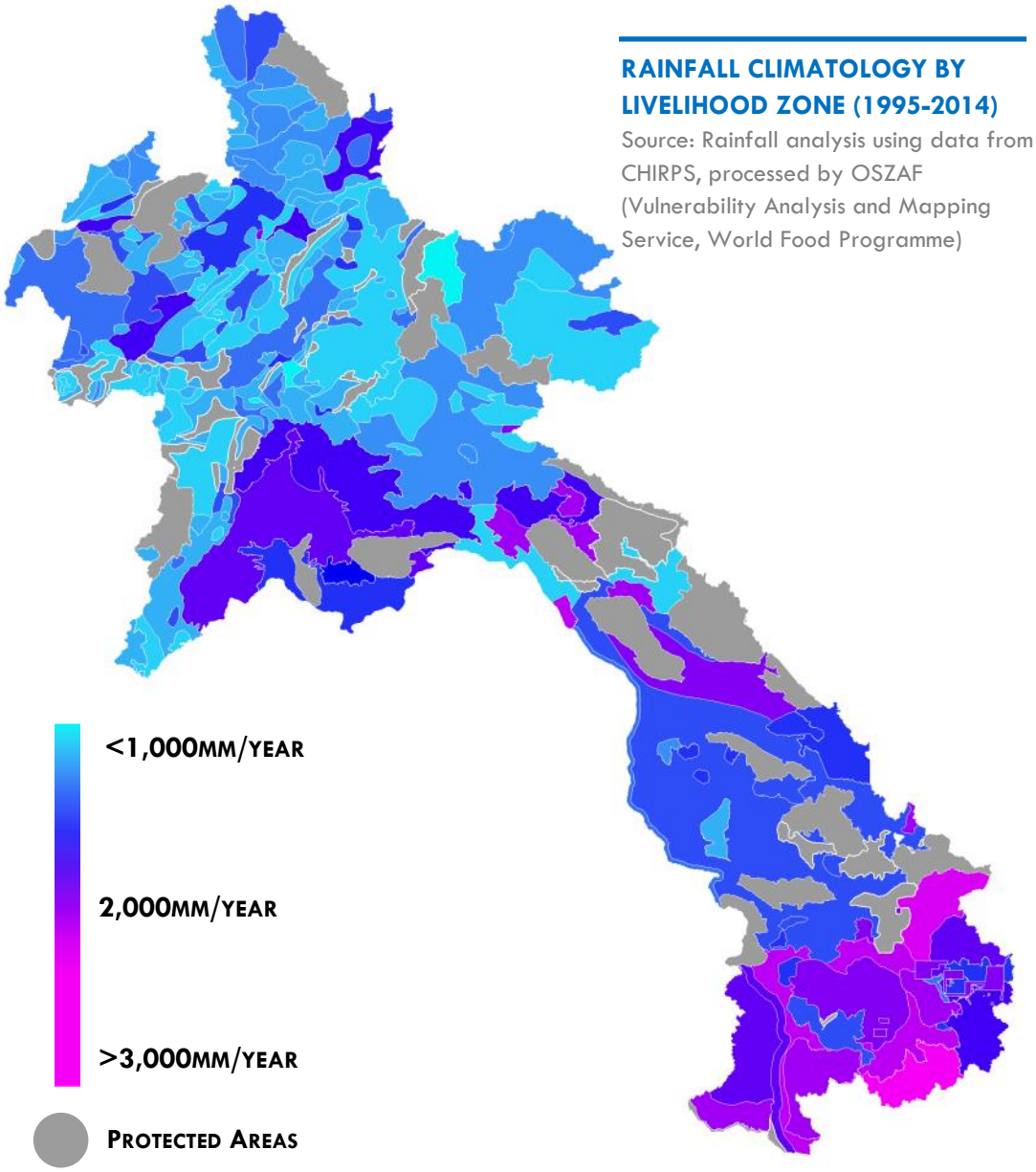
Highland paddy in the northeastern part of the country receives the list amount of rainfall overall and small scale farmers are the most dependent on predictability of the rainfall patterns. This is especially problematic given the limited availability of water resources for highland paddy production.



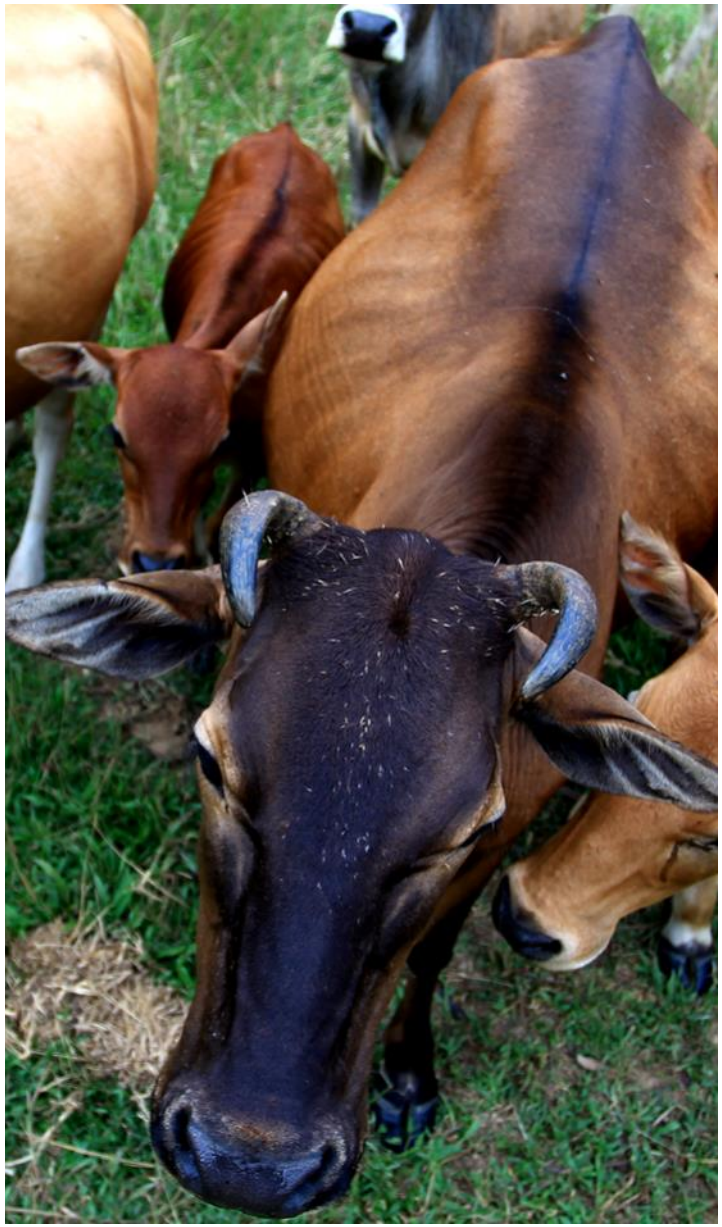
RAINFALL CLIMATOLOGY (1982-2014)

RAINFALL CLIMATOLOGY BY LIVELIHOOD ZONE (1995-2014)

Source: Rainfall analysis using data from CHIRPS, processed by OSZAF (Vulnerability Analysis and Mapping Service, World Food Programme)



RAINFALL TRENDS



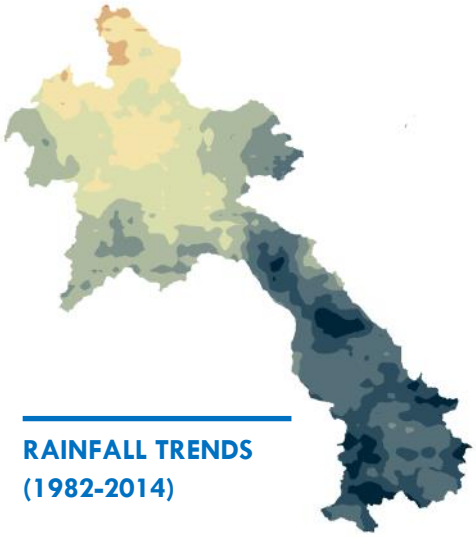
Rainfall patterns have changed significantly since 1982. There is a predominant pattern of increasing rainfall, which is particularly pronounced in the southern and central areas of the country. In the northern regions, trends are more moderate if not moderately negative (and likely non-significant).

In the more recent past (the last twenty years), the broad pattern remains similar (with increases in rainfall in the south, and stable or decreasing rainfall in the north) but with significant differences. In the southern provinces, the trend of increasing rainfall is more moderate in the shorter time scale, except in the Champasack province where it remains at the same level. Rainfall in Vientiane province has increased more significantly in the last 20 years.

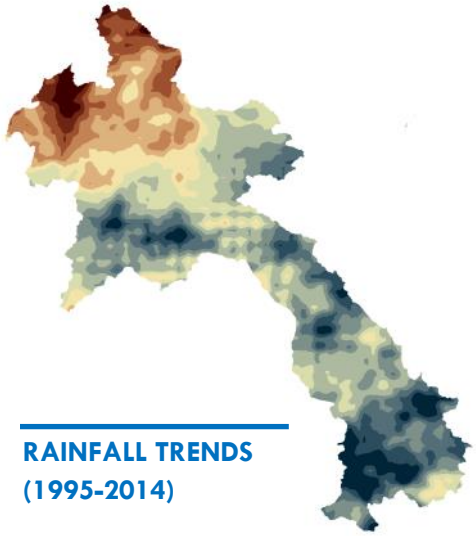
Increases in rainfall may be favorable for paddy production, but may also exacerbate flood risk (especially if rainfall occurs during a shorter but more intense period) as well as risk of waterlogging of cassava, maize, and other cash crops. Livelihood groups most at risk include those dependent on small-scale cash crops.

In contrast, much stronger decreasing rainfall trends have emerged in the northernmost provinces in the more recent past. These decreases reach important levels of more than 10mm/year, which over a 20 year time span would amount to a drop in seasonal rainfall of some 15% with significant implications for livelihoods.

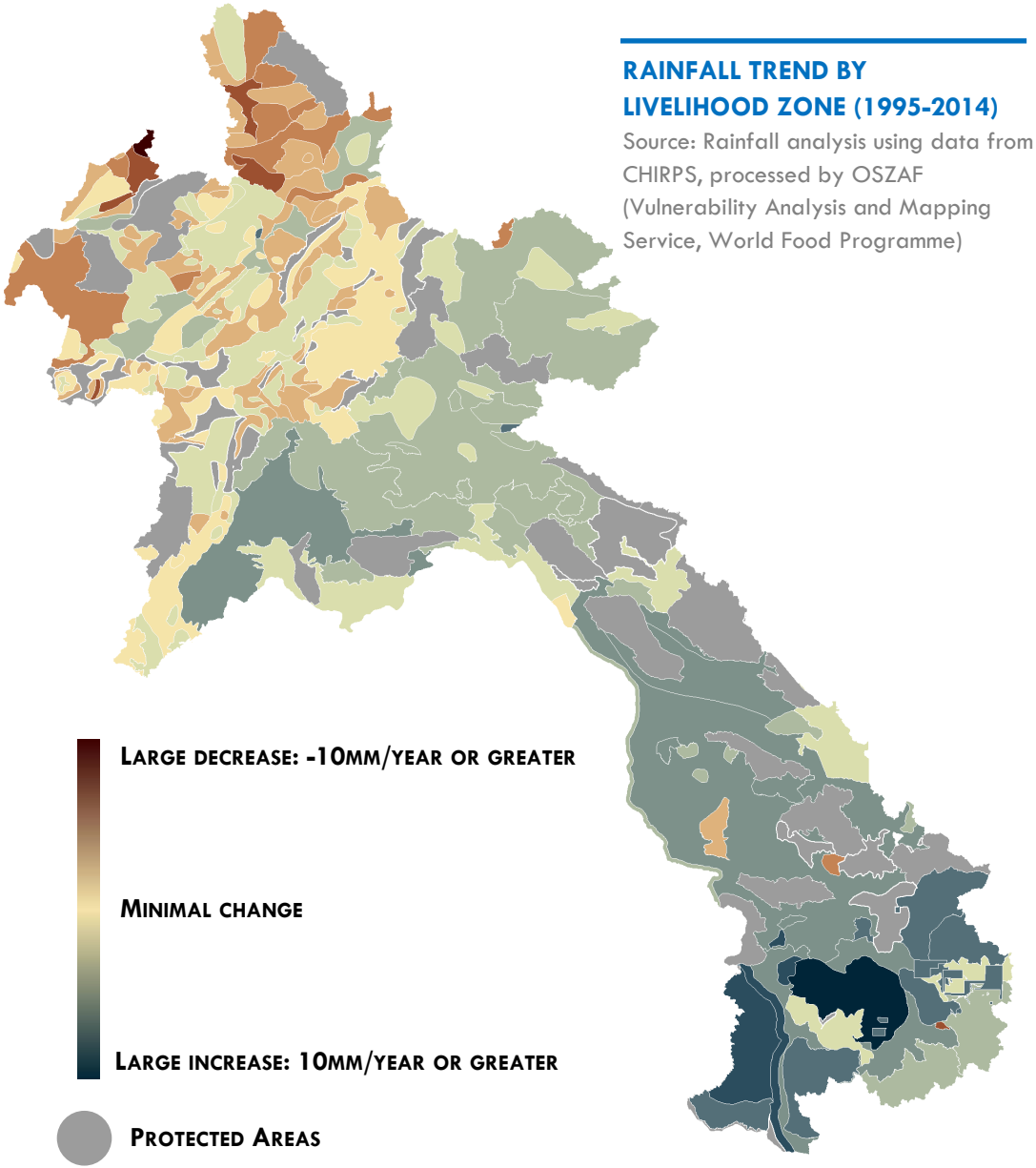
A continuation of this trend in decreasing rainfall can exacerbate drought risk and may affect the feasibility of paddy production. The main livelihoods at risk are those heavily dependent on lowland paddy production in the northern and northwestern parts of the country.



RAINFALL TRENDS (1982-2014)



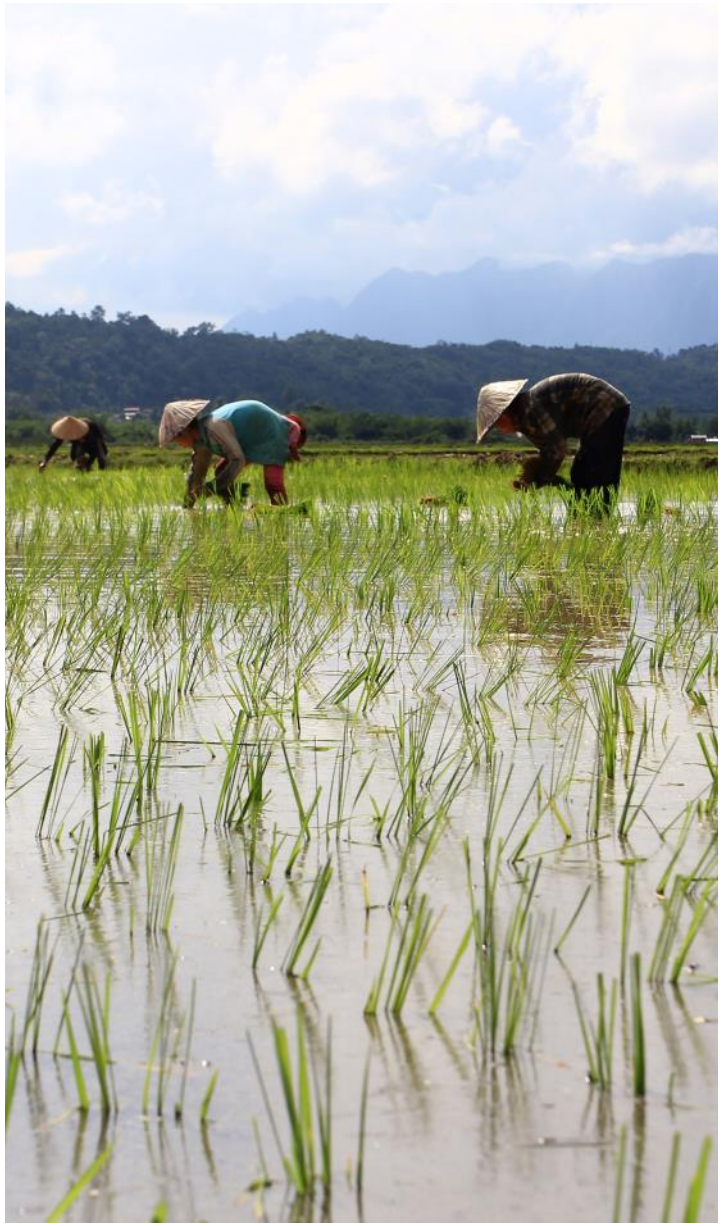
RAINFALL TRENDS (1995-2014)



RAINFALL TREND BY LIVELIHOOD ZONE (1995-2014)

Source: Rainfall analysis using data from CHIRPS, processed by OSZAF (Vulnerability Analysis and Mapping Service, World Food Programme)

START OF SEASON



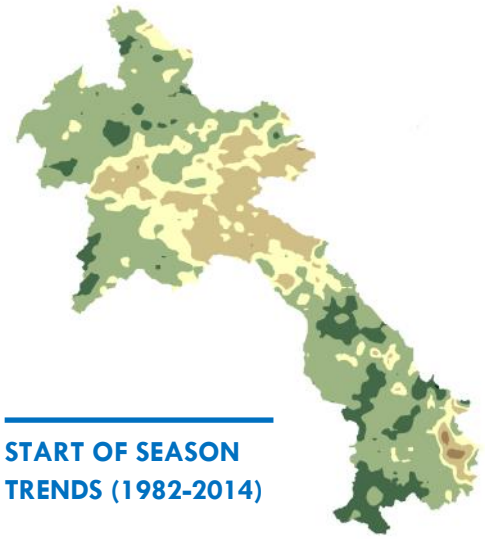
Changes in seasonal patterns may also affect livelihoods. Significant variations in the onset of the rainy season can increase uncertainty about appropriate timing for planting crops, and delays in the onset of the rainy season can exacerbate drought risk by prolonging the dry period.

Over the period 1982-2014, moderately earlier onsets of season have been observed in the central, southern, and northwestern parts of the country – this mostly corresponds to onsets that occur 5 days earlier every 10 years. In the eastern parts of the country, there is a moderate tendency for later onsets of the growing season-a delay of around 5 days per 10 years.

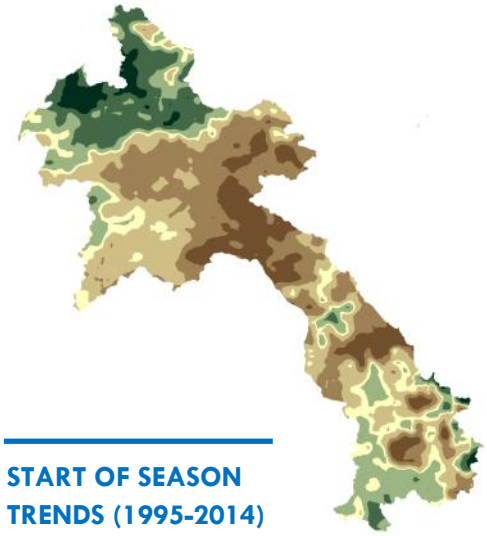
The shorter term (1995-2014) patterns are fairly different being mostly an intensification of existing patterns in the north of the country and a reversal of the trend in the southern provinces. The northernmost provinces (Luangnamtha, Phongsaly, Bokeo, Oudomxay and parts of Luangprabang) show a strong trend of earlier onsets of growing season with values of 5-10 days and more than 10 days advance per 10 years. The trends for earlier onsets in the northern provinces are associated with strong trends of decreasing annual rainfall. This highlights that the decrease in annual rainfall comes from decreases in the peak of the season (July-August) and that this maybe accompanied by increases in early season rainfall.

Conversely, the trends for delayed onset of the rainy season are associated with trends of increasing annual rainfall. Again this is unusual, but corresponds to changes in seasonal rainfall of increasing peak rainfall accompanied by decreases in the early season rainfall. This trend may result in more prolonged dry spells (higher drought risk) as well as more intense rainfall later in the season (higher flood risk).

A continuation of delays in the onset of the rainy season in central and eastern Lao PDR would have detrimental consequences for paddy production-especially in the absence of irrigation techniques. In addition, shorter but more intense rainy seasons will likely exacerbate flood risk across much of the country.



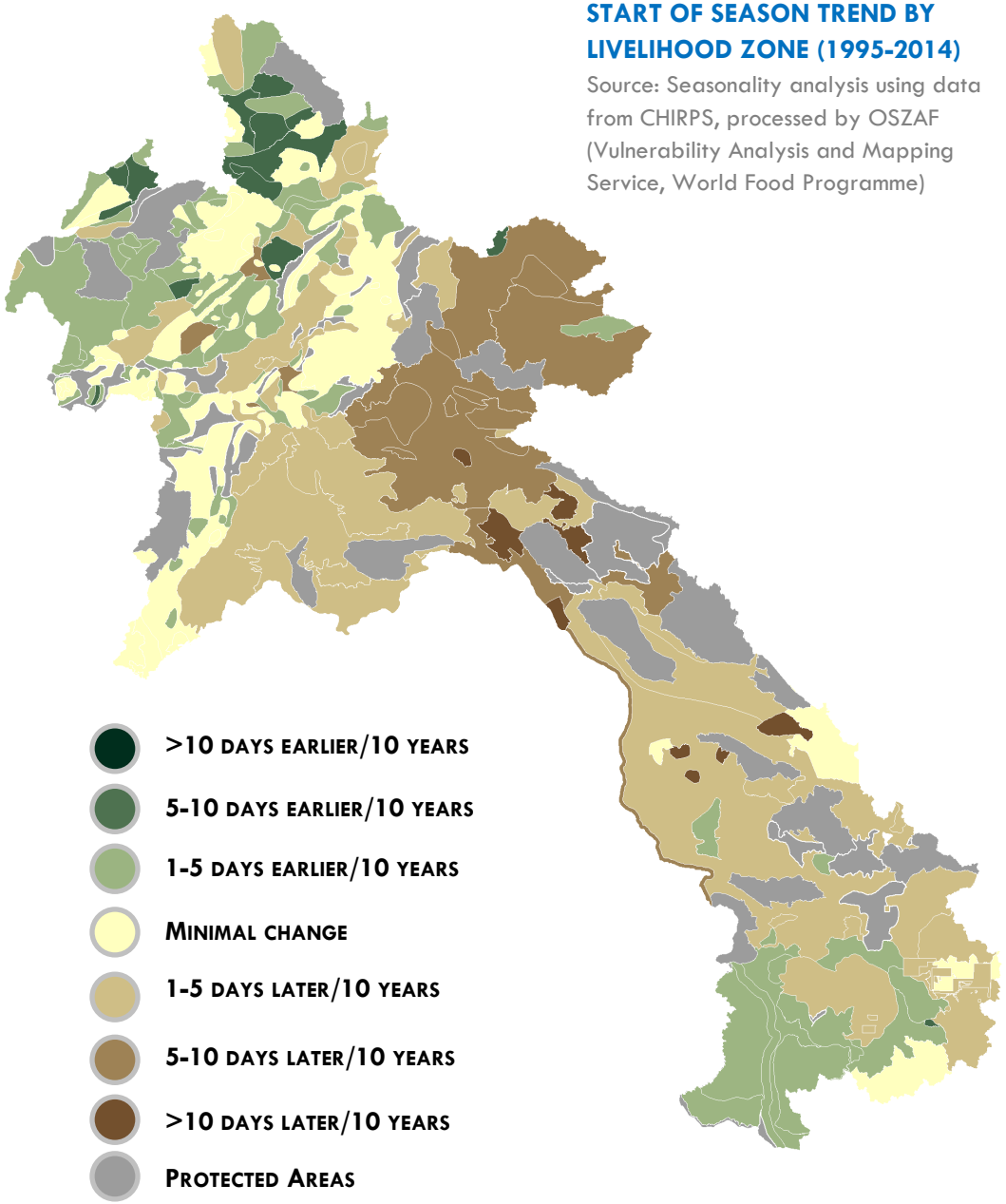
START OF SEASON TRENDS (1982-2014)



START OF SEASON TRENDS (1995-2014)

START OF SEASON TREND BY LIVELIHOOD ZONE (1995-2014)

Source: Seasonality analysis using data from CHIRPS, processed by OSZAF (Vulnerability Analysis and Mapping Service, World Food Programme)



SEASONALITY

In addition to variability in the onset of the rainy season, changes in seasonality of rainfall (i.e. how evenly spread rainfall is throughout the season) can also affect livelihoods by impacting the magnitude of flood events.

The longer-term trend (1982-2014) shows only minor temporal variations in seasonality, with a moderate decreasing tendency (more evenly spread rainfall) in the northwestern and southeastern parts of the country, and moderate increases (less evenly spread rainfall) in the eastern, central, and southwestern regions.

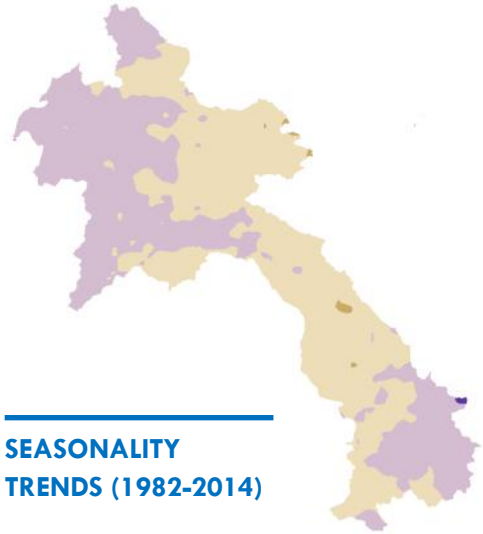
In the shorter-term (1995-2014) the pattern is slightly different: the northern regions experience decreases in seasonality associated with decreasing rainfall, while there are more pronounced increases in seasonality in the western, central and southern regions, which are associated with increased rainfall.

Decreases in seasonality in the north are associated with earlier onsets of the rainy season (see Section on Start of Season) but decreases in core seasonal rainfall during July and August.

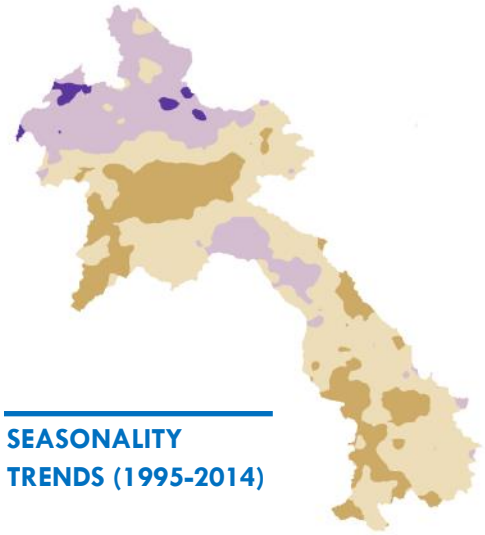
In contrast, increases in seasonality in other parts of the country are associated with delays in the onset of the rainy season, and hence the result of a tendency for decreasing March rainfall and a tendency for increasing July-September rainfall.

In other words, rainfall in northern areas is becoming more evenly spread throughout the year (increasing at the beginning and decreasing in the middle of the season). In the central and southern areas, the opposite is occurring with rainfall becoming more concentrated (lower in the beginning and end, increasing in the mid season).

These trends have significant implications for flood risk during the monsoon season: more concentrated rainfall during July-September can exacerbate flood risk, especially in low-lying areas and near major river systems.



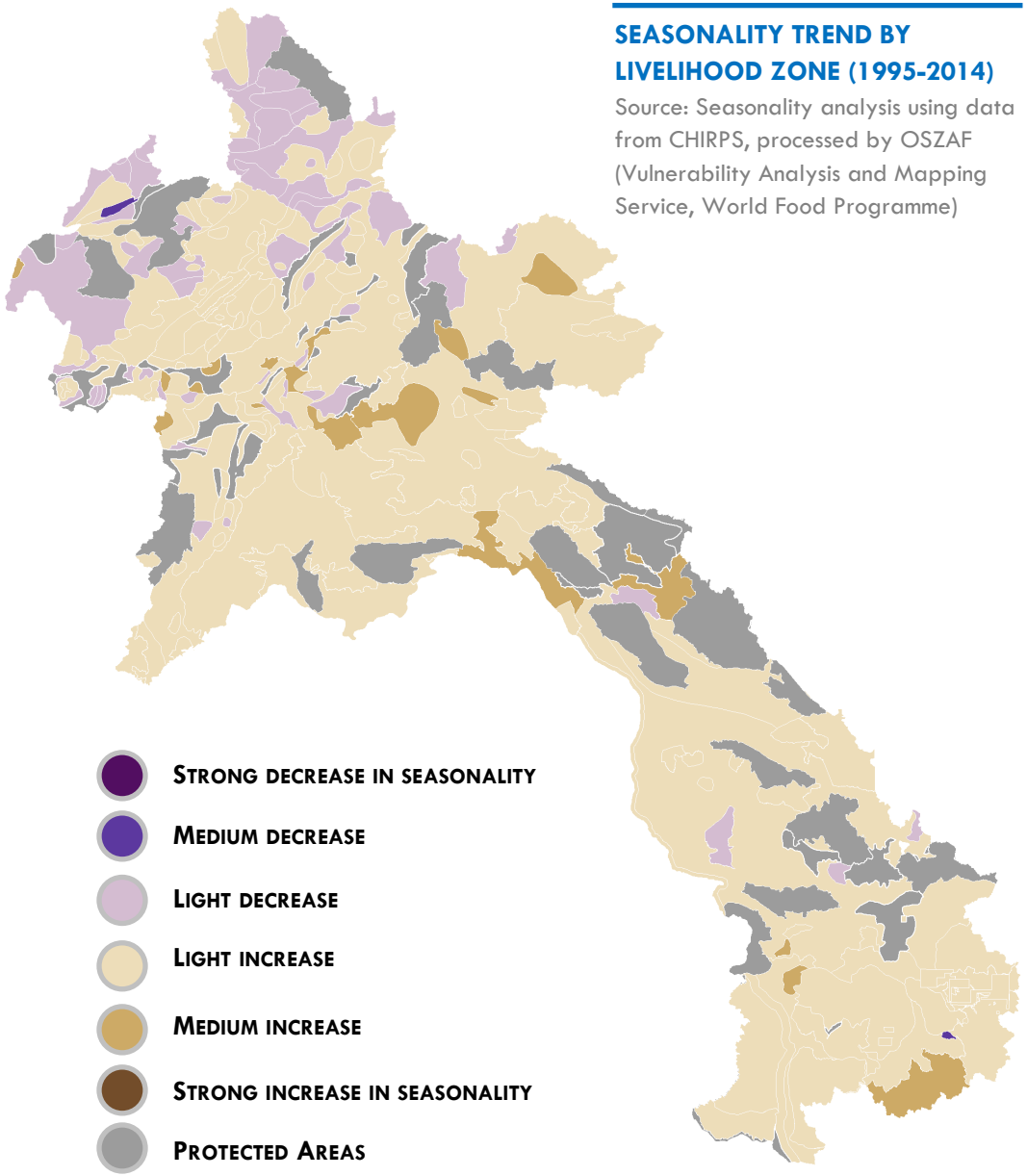
SEASONALITY TRENDS (1982-2014)



SEASONALITY TRENDS (1995-2014)

SEASONALITY TREND BY LIVELIHOOD ZONE (1995-2014)

Source: Seasonality analysis using data from CHIRPS, processed by OSZAF (Vulnerability Analysis and Mapping Service, World Food Programme)



CLIMATE EXTREMES

Lao PDR is exposed to several climate-related disasters including floods, droughts and storms. Extreme climate events can have detrimental effects on livelihoods, for example through destruction of crop yields, increases in incidence of livestock diseases, damage to livelihood assets (farming tools, fishing boats, water tanks for irrigation), and destruction of agricultural land which may take several months or years to recover.

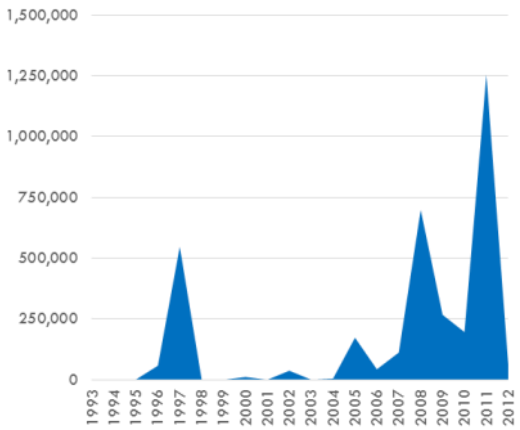
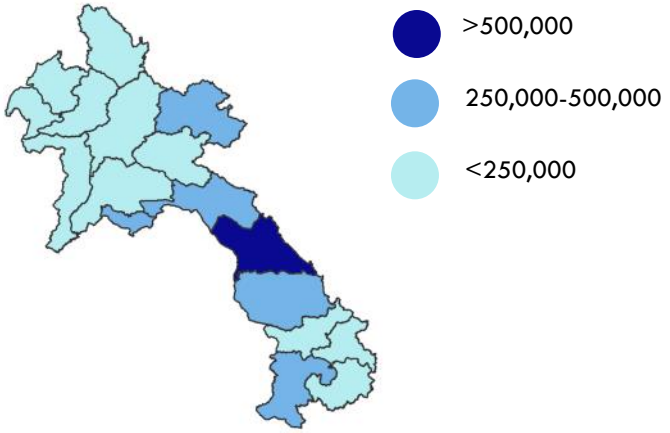
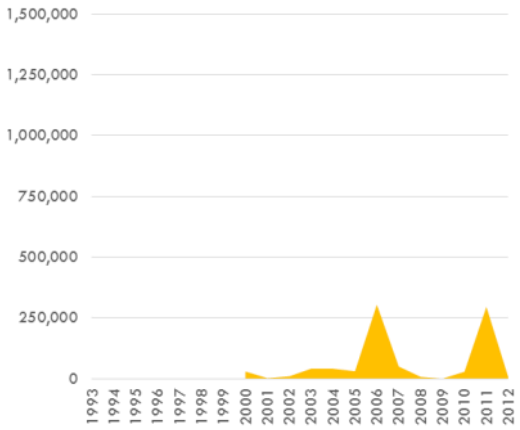
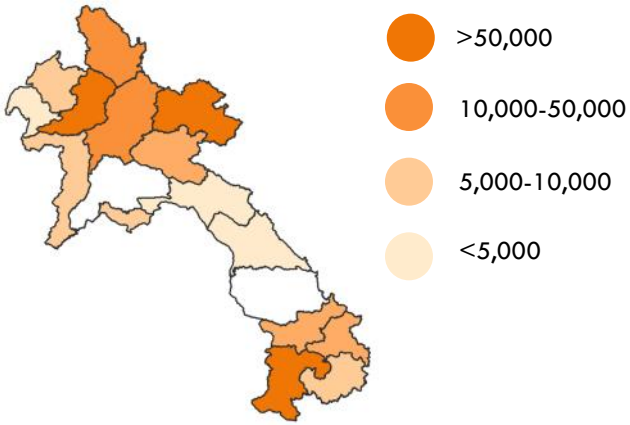
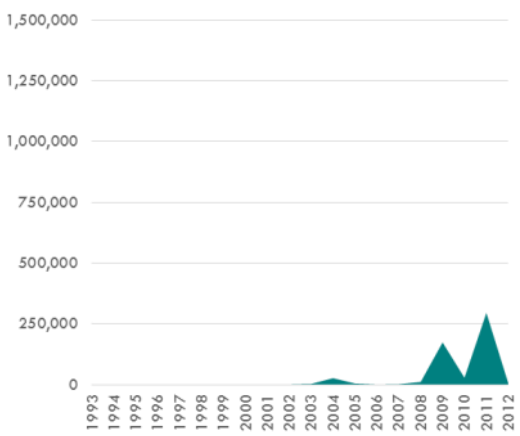
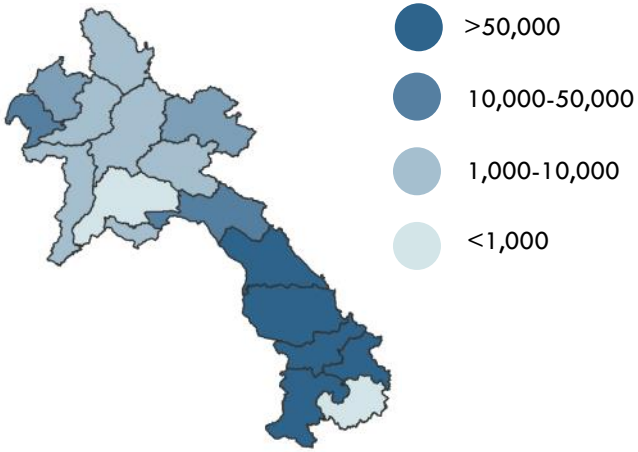
Floods, droughts and storms all have distinct geographical patterns of exposure: floods occur predominantly along the Mekong River and principally in Khammuane and Savannakhet; in contrast, droughts occur predominantly in northern parts of the country and in Champasack, while storm impacts are mostly felt in central and southern regions which are closer to the Vietnamese coast.

The number of people affected by climate-related disasters has increased from an average of 60,000 people affected on annual basis in 1993-2002 to over 320,000 on average every year in 2003-2012.[6] To some extent, the increase in number of affected people can be attributed to increases in population in highly exposed areas as well as increasing inequalities in some districts despite rapid development in recent years.

As highlighted in earlier sections on seasonality, the increase in flood and drought exposure can be largely attributed to changes in seasonality patterns with delayed onsets of the rainy season increasing drought risk and more concentrated rainfall distribution exacerbating flood risk.

Storm risk is more difficult to attribute to a changing climate. There is insufficient evidence to suggest that storm impacts are becoming more severe but there is significant concern that cyclones may become more intense and may occur over parts of Lao where they traditionally do not occur.

[6] DesInventar Lao PDR (2015) DesInventar Database. Online at http://www.desinventar.net/DesInventar/

HAZARD	Number of people affected over time	Number of people affected by province
FLOOD		
DROUGHT		
STORM		

Source: DesInventar Lao PDR (2015) | **http://www.desinventar.net/DesInventar/**

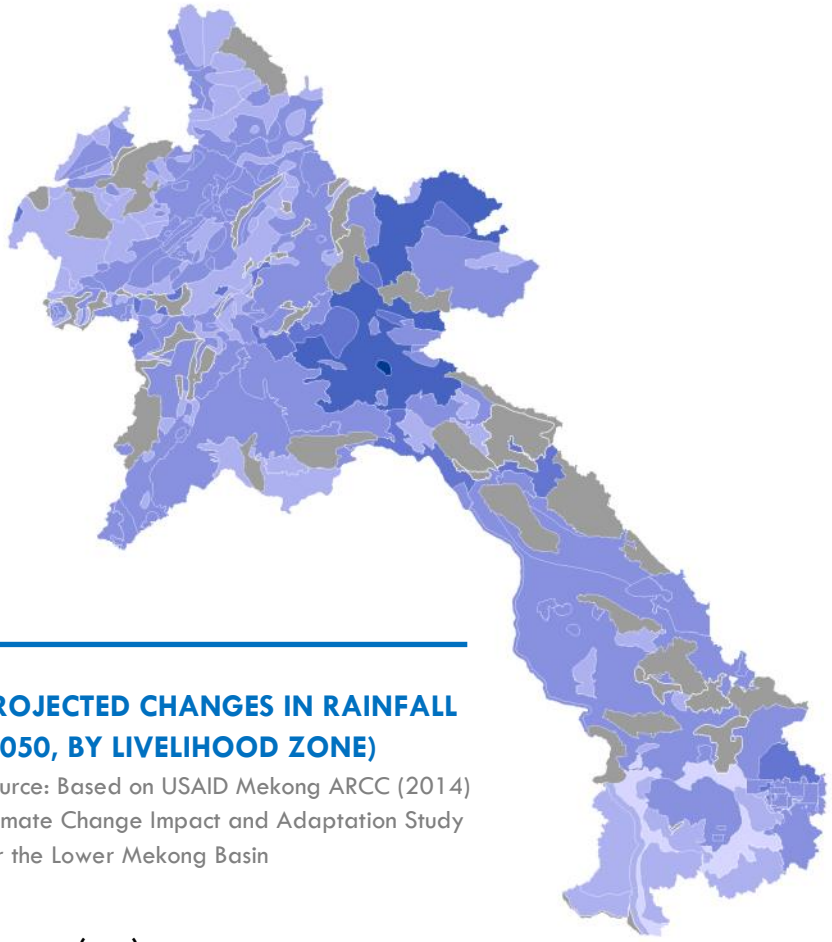
FUTURE CLIMATE

Projections of future climate change in Lao PDR are associated with large uncertainties due to lack of historical data. However, in general climate models show that Lao PDR will experience some of the largest changes in temperature and rainfall in the Lower Mekong Basin and Southeast Asia in general.

Key trends under a changing climate include:

- ✓ Large increases in rainfall over parts of central and southern Lao, leading to increased flood risk, waterlogging of soils, and higher incidence of fungal diseases;
- ✓ More frequent large rainfall events over parts of the central lowland paddy areas of Khammuane. More frequent extreme rainfall events will be associated with higher loss and damage;
- ✓ Increases in tropical storm intensity, compounding heavier rainfall in the central parts of the country.
- ✓ Increases in maximum temperature of approximately 2 to 3 degrees Celsius, especially in the southern parts of the country. This will be accompanied by an increase in average daily temperatures. The increase in both average and extreme temperatures could significantly exacerbate drought risk with devastating effects on crops and livestock.

The combination of these trends will also have an effect on the magnitude of droughts (with more intense, longer droughts affecting livelihood groups in the southern parts of the country) and floods (more severe floods occurring during July and August in central and southern parts of the country).



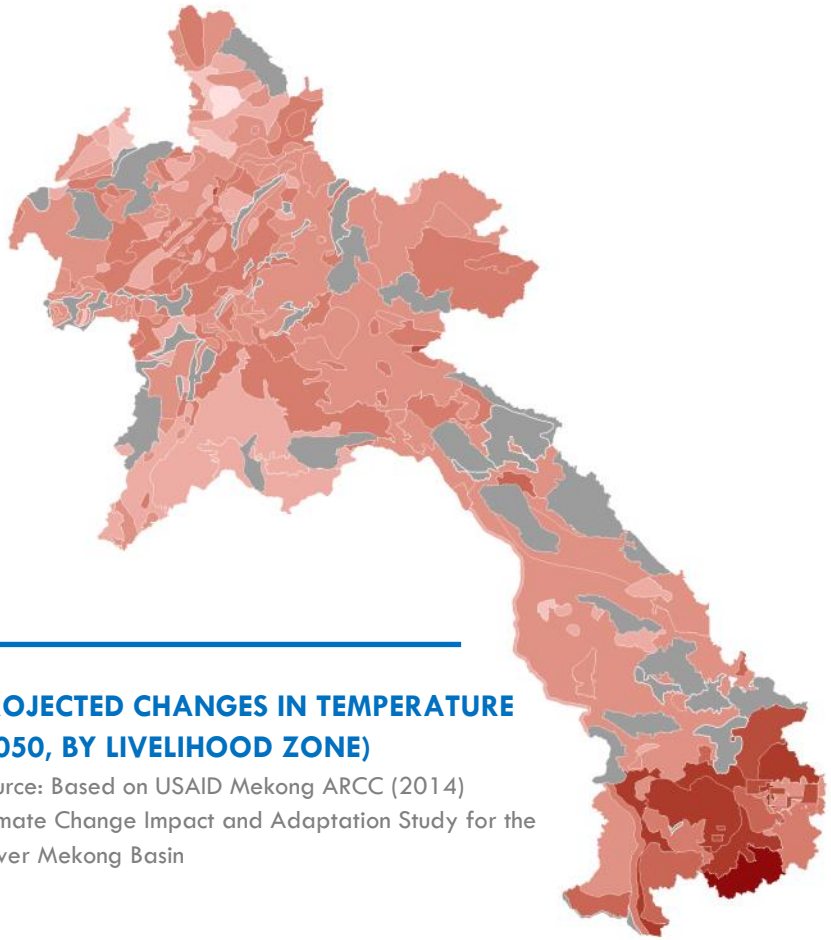
PROJECTED CHANGES IN RAINFALL (2050, BY LIVELIHOOD ZONE)

Source: Based on USAID Mekong ARCC (2014) Climate Change Impact and Adaptation Study for the Lower Mekong Basin

Increase (mm)

4 - 5 | 6 - 10 | 11 - 15 | 16 - 20 | 21 - 25 | 26 - 30 | 31 - 35 | 36 - 40

PROTECTED AREAS



PROJECTED CHANGES IN TEMPERATURE (2050, BY LIVELIHOOD ZONE)

Source: Based on USAID Mekong ARCC (2014) Climate Change Impact and Adaptation Study for the Lower Mekong Basin

Increase (degrees Celsius)

5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14

PROTECTED AREAS

FUTURE CLIMATE

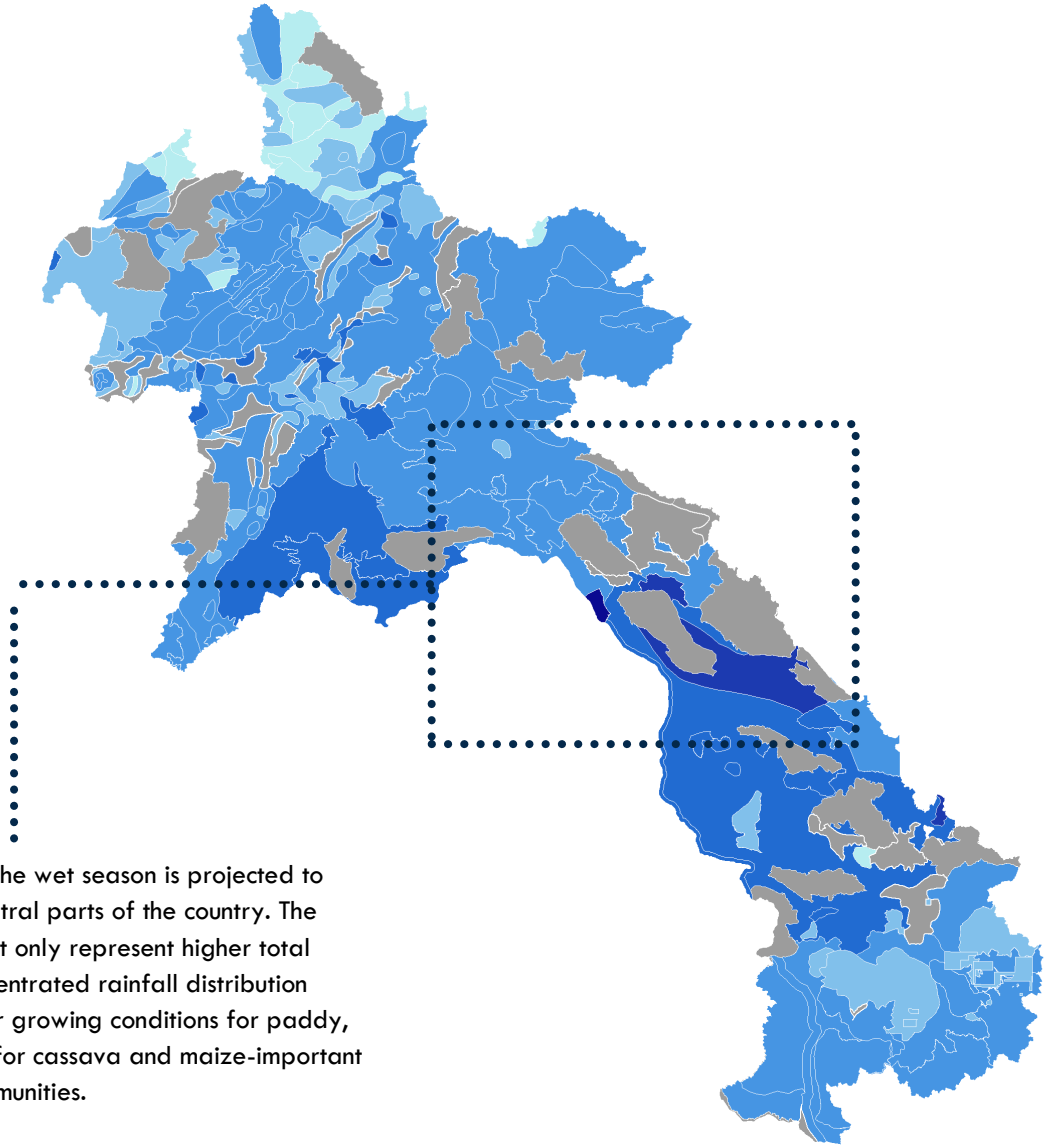
PROJECTED CHANGES IN WET SEASON RAINFALL (2050, BY LIVELIHOOD ZONE)

Source: Based on USAID Mekong ARCC (2014) Climate Change Impact and Adaptation Study for the Lower Mekong Basin

Change in wet season precipitation (%)

7 - 8 9 10 11 12 13

PROTECTED AREAS



Daily precipitation during the wet season is projected to increase significantly in central parts of the country. The increase in rainfall does not only represent higher total rainfall but also more concentrated rainfall distribution which would provide better growing conditions for paddy, but detrimental conditions for cassava and maize-important cash crops for several communities.

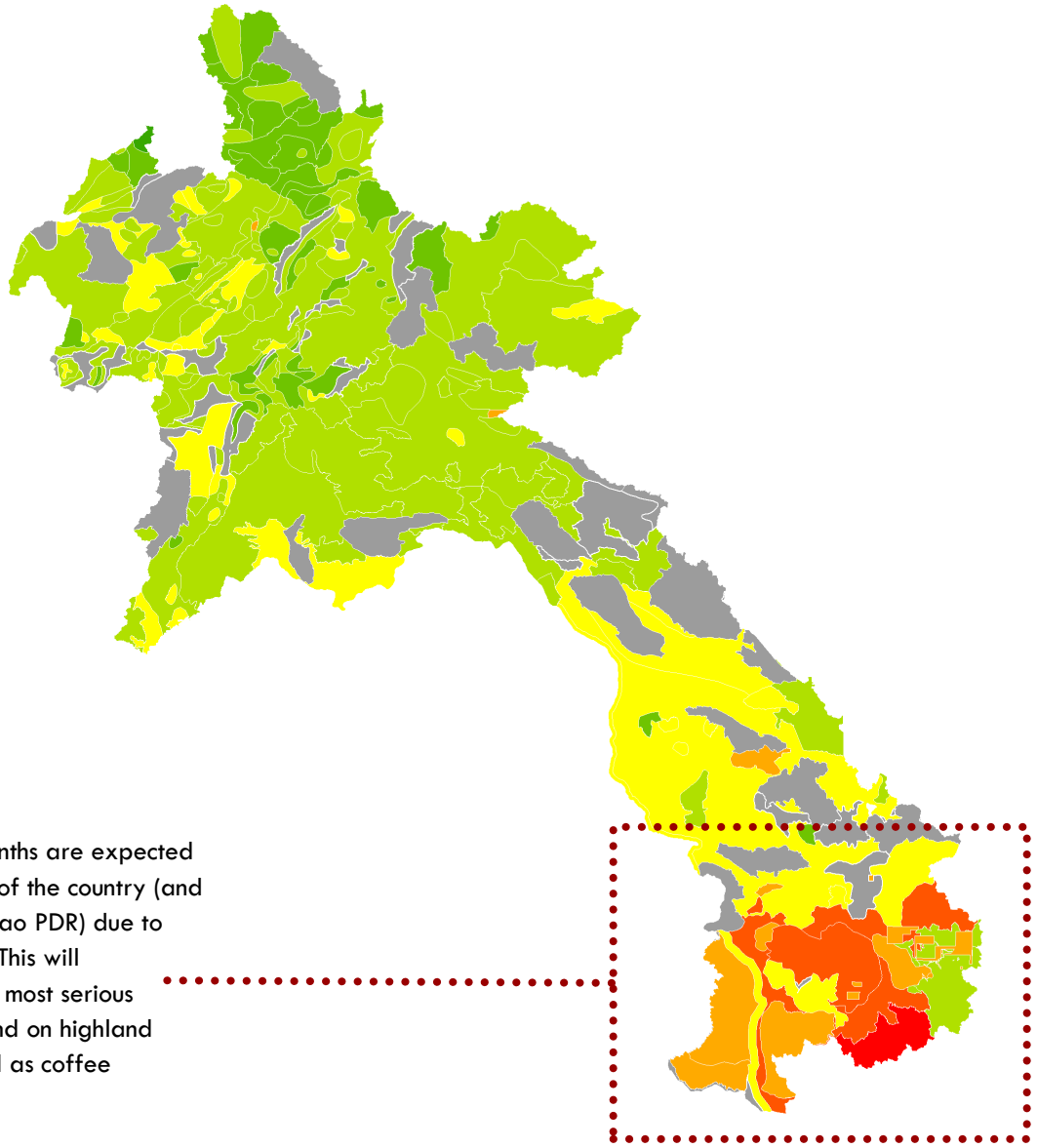
PROJECTED CHANGE IN DROUGHT MONTHS (2050, BY LIVELIHOOD ZONE)

Source: Based on USAID Mekong ARCC (2014) Climate Change Impact and Adaptation Study for the Lower Mekong Basin

Increase in drought months (%)

-14 - -10
-9 - -5
-4 - 0
1 - 5
6 - 10
11 - 15
16 - 20

PROTECTED AREAS



Despite high rainfall levels, drought months are expected to become longer in the southern parts of the country (and conversely shorter in much of northern Lao PDR) due to higher temperatures in the dry season. This will significantly affect livelihoods, with. the most serious effects likely on communities that depend on highland paddy (in Sekong and Attapeu) as well as coffee production in the Boloven Plateau.

FUTURE CROP SUITABILITY

Changes in temperature and rainfall will also affect the suitability of key crops-particularly rainfed rice, coffee, maize, and cassava.[5]

Rainfed paddy practices are highly diverse so it is difficult to assess the potential impacts of climate change on rice production. However, model evaluations suggest that while increases in precipitation will increase suitability for rice, changes in the onset of the rainy season may affect suitability for traditional paddy varieties-at least in localized areas of different livelihood zones.

Increases in both temperature and rainfall would affect suitability for coffee in southern Lao PDR. Areas of major concern include the Boloven Plateau commercial agriculture zone as well as the highland paddy and coffee zone in Sekong. In the Boloven Plateau, coffee production is the primary livelihood and a key economic driver in the region, so decreases in suitability can have significant ramifications for communities here. In Sekong, communities rely on coffee to increase their limited income and to diversify away from volatile highland paddy production.

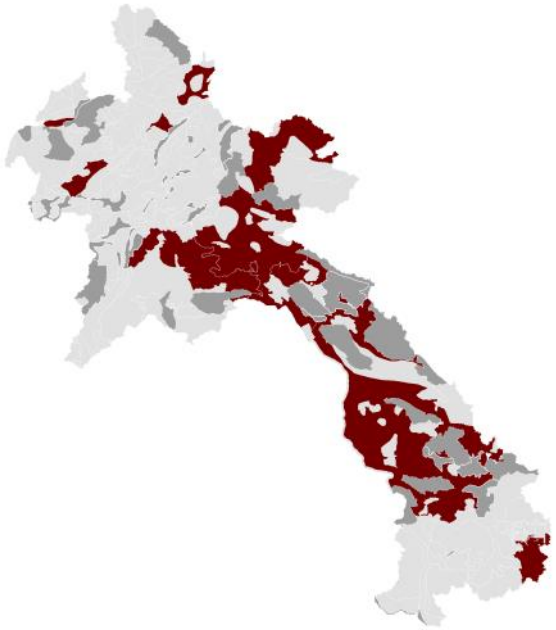
Suitability of maize will likely be compromised in the northern parts of Lao PDR, where maize contributes to livelihoods income Heavy precipitation which increases flood risk and waterlogging are already affecting maize production and will likely continue to do so in the coming decades.

Cassava, a key source of income for some communities, may be heavily affected in the central and southern parts of Lao PDR due to higher temperatures.

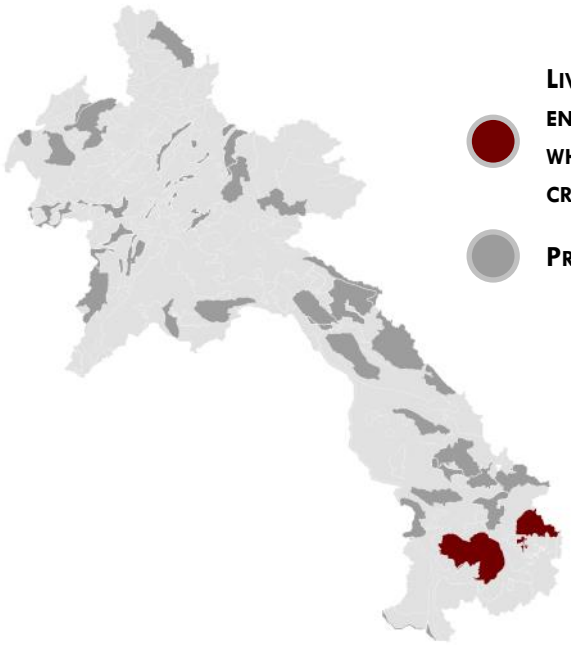
The livelihood zones that engage in production of crops that may experience decreases in suitability due to changing climate patterns are shown in the following page.

[5] USAID Mekong ARCC (2014) Climate Change Impact and Adaptation Study for the Lower Mekong Basin

RICE



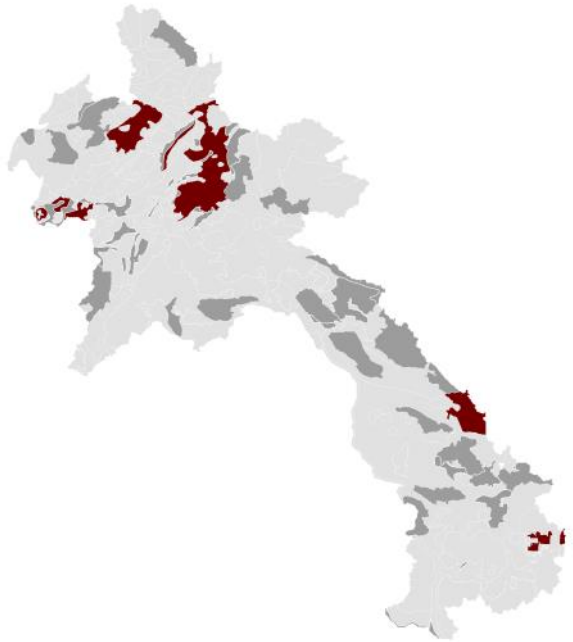
COFFEE



LIVELIHOOD ZONE CURRENTLY ENGAGING IN CROP PRODUCTION WHICH MAY EXPERIENCE DECLINES IN CROP SUITABILITY, BY CROP TYPE

PROTECTED AREAS

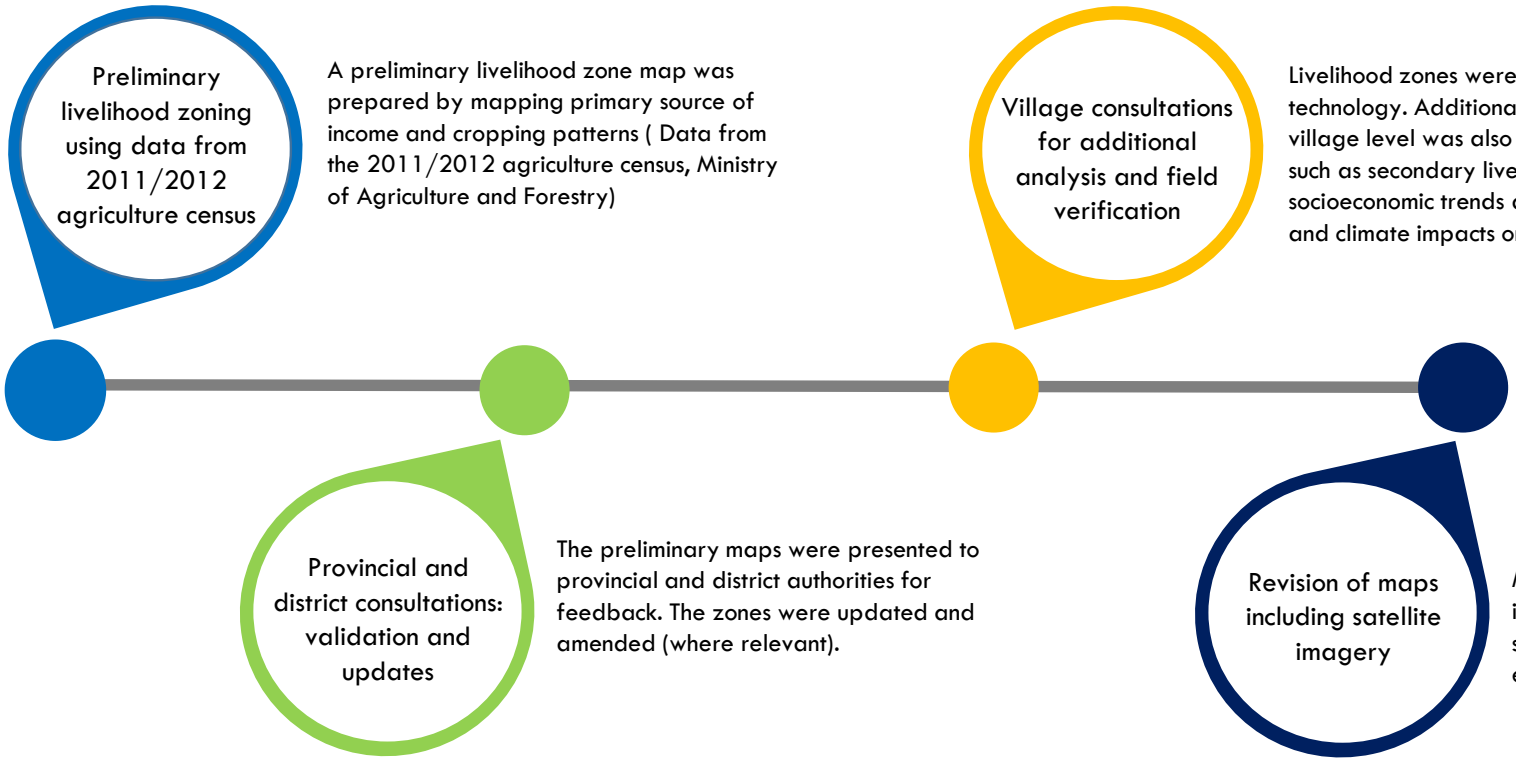
MAIZE



CASSAVA

Source: Based on USAID Mekong ARCC (2014) Climate Change Impact and Adaptation Study for the Lower Mekong Basin

ANNEX | METHOD: Livelihood mapping



* Sampling: 94 village consultations carried out and 292 GPS points collected. Villages were sampled based on topographical differences, proximity to rivers and other geographical features, and different remoteness to capture as much diversity as possible.

ANNEX | METHOD: Analysis

Communities were asked to identify factors that help better-off households manage climate-related risks. The most common responses were:

- ✓ Access to financial capital
- ✓ Access to land
- ✓ Livelihood diversity
- ✓ Access to irrigation and non-climate sensitive livelihood options

Relevant socioeconomic indicators were identified from the population census (2011) and the small area estimations of poverty (2011).

Resilience analysis

Overlay with livelihood zones

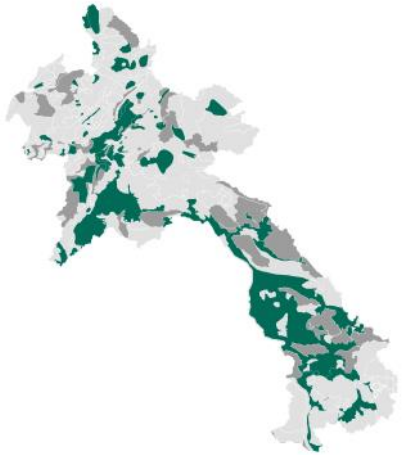
The different resilience and climate layers were overlaid with the livelihood zones to identify the zones that (i) are least resilient and (ii) experience the greatest climate-related risks.

Climate analysis

Information on climate trends (rainfall trends, variability in start of season, and rainfall seasonality was processed from the CHIRPS dataset [***chg.geog.ucsb.edu/data/chirps/***] by WFP's Vulnerability Analysis and Mapping Service in Rome, Italy. Additional climate information was obtained from the Department of Hydrology and Meteorology and ICIMOD.

* Software used for the mapping exercise: ArcGIS 10.2.2

ANNEX | LIVELIHOOD PROFILES



LOWLAND PADDY

Lowland paddy is by far the most common livelihood activity in Lao PDR. Paddy production is combined with livestock rearing (large cattle, chickens, goats) and small-scale vegetable production. Generally communities dependent on lowland paddy have higher resilience levels than those relying on highland paddy production due to better connectivity to markets and major urban areas. Six distinct lowland paddy groups have been identified and classified according to rainfall conditions: northern (Phongsaly, Oudomxay and Luangprabang provinces, medium rainfall), northwestern (Luangnamtha, Bokeo and Xayabury, high rainfall), northeastern (Xaysomboon, Xiengkhuang and Huaphanh, very low rainfall), the Vientiane Plains, central (Borikhamxay, Khammuane, Savannakhet and Saravane, medium to high rainfall), and southern (Champasack, Sekong, Attapeu, very high rainfall). The differentiation based on geography is done to account for differences in weather patterns and soil type. Despite relying on the same livelihood activity, each livelihood group has different levels of resilience as a result of different poverty rates and access to land (the central zones have lower land availability).

LOWLAND PADDY AND CASH CROPS

In addition to livestock rearing and vegetable gardening, some communities also engage in production of cash crops-primarily maize-to supplement their income and food sources. Corn is grown alongside paddy in the northern and central parts of the country. In the northern areas, reliance on maize may be a response to decreasing rainfall as maize is a more drought-tolerant crop.

LOWLAND PADDY AND LARGE-SCALE LIVESTOCK (CATTLE AND CHICKEN)

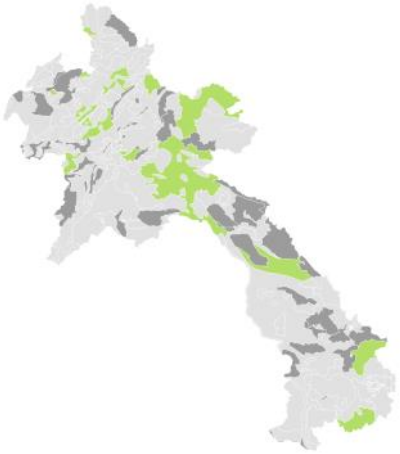
While almost all households engaging in lowland paddy production also own livestock, some communities have larger ownership of livestock which provide a substantial source of income. These are primarily located in the northernmost parts of the country as well as in central regions.

LOWLAND PADDY, CASH CROPS, LIVESTOCK AND NTFPs

Some communities have access to diverse livelihood options given availability of land and proximity to other sources of livelihoods. A number of communities in northwestern Lao PDR rely on cash crops (maize), livestock (mainly cattle and chickens) as well as non-timber forest products such as mushrooms, broomgrass and cardamom to diversify their income sources.

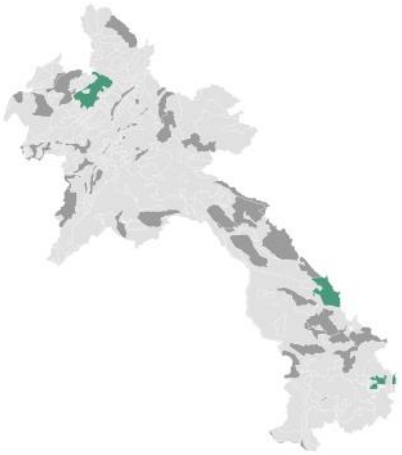
LOWLAND PADDY AND ORCHARDS (BANANA)

Another common variation of lowland paddy production includes banana production. Banana is a high-value crop and as such an important source of income for several communities, especially in the northwestern parts of the country.



HIGHLAND PADDY

Highland paddy is the second most dominant livelihood activity and is practiced in difficult terrain requiring slash-and-burn techniques. Highland paddy is mainly combined with small livestock rearing (chickens, ducks, pigs) and vegetable gardening. Communities relying on this livelihood activity are among the least resilient given limited access to land, limited livelihood diversity, and high climate sensitivity. Six distinct highland paddy groups have been identified and classified according to rainfall conditions and soil type: northern (Phongsaly, Oudomxay and Luangprabang provinces, medium rainfall and orthic acrisols-high productivity), northwestern (Luangnamtha, Bokeo and Xayabury, high rainfall and mixed ferric/orthic acrisols-high productivity), northeastern (Xaysomboon, Xiengkhuang and Huaphanh, very low rainfall and mixed orthic acrisols/pelic vertisols-medium productivity), Khammuane highland paddy (high rainfall and distric nitosols-low productivity), Sekong highland paddy (very high rainfall and orthic acrisols-high productivity), and Attapeu highland paddy (very high rainfall and mixed ferric/gleyic acrisols-high productivity).



HIGHLAND PADDY, CASH CROPS (CORN, CASSAVA) & NON-TIMER FOREST PRODUCTS

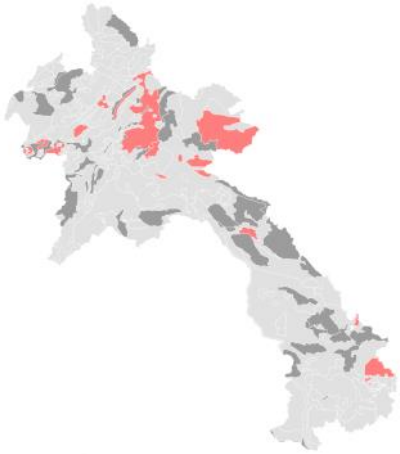
In addition to livestock rearing and vegetable gardening, some communities also engage in production of cash crops-primarily maize-to supplement their income and food sources. Corn is grown alongside paddy in the northern and central parts of the country. Collection of non-timber forest products is also an important livelihood activity.

HIGHLAND PADDY, CASH CROPS (CORN) & LIVESTOCK

Highland paddy is also practiced in combination with cash crops (mainly maize) and large-scale chicken rearing. This combination of activities is mostly practiced in northeastern Lao PDR.

HIGHLAND PADDY

LIVESTOCK REARING



HIGHLAND PADDY AND CASH CROPS (CORN, COFFEE, CASSAVA)

In several communities, highland paddy is also grown in combination with cash crops such as maize, coffee and cassava. In addition to providing an important source of income, they also help communities better manage risks of droughts and floods.

HIGHLAND PADDY AND LARGE-SCALE CHICKEN RAISING

In the northernmost parts of the country, highland paddy production is combined with large-scale chicken raising to supplement household income.

LIVESTOCK REARING AND GRAZING AREAS

Livestock rearing is a common activity throughout the country, and is practiced together with other key livelihoods such as lowland paddy. However, in the northwestern and northern areas of the country, communities with large numbers of livestock engage in livestock rearing. Some of these areas are mainly used for grazing.

SOUTHERN FISHING AND TOURISM

Along the Mekong River, the majority of communities engage in fishing. In the southernmost part of the country, fishing is complemented by tourism-based activities – especially around the Four Thousand Islands. Demand for tourism-related services is increasing and providing income for several communities.

A key concern for fishing communities over the coming years is whether the construction of dams in the Mekong River Basin will decrease fishing potential.

MEKONG LARGE-SCALE FISHING

Near the Thai border, communities mainly engage in large-scale fishing. Poverty rates are low in these communities due to the high prices of fish (driven by high demand for fish, both in Lao PDR and in Thailand).

FISHING AND TOBACCO

In the southern part of Borikhamxay and parts of Khammuane, communities engage in fishing and small-scale tobacco. Tobacco provides a major source of income during the dry season when fishing potential is limited.

BOLOVEN PLATEAU

BOLOVEN PLATAEU (COMMERCIAL AGRICULTURE: COFFEE AND TEA)

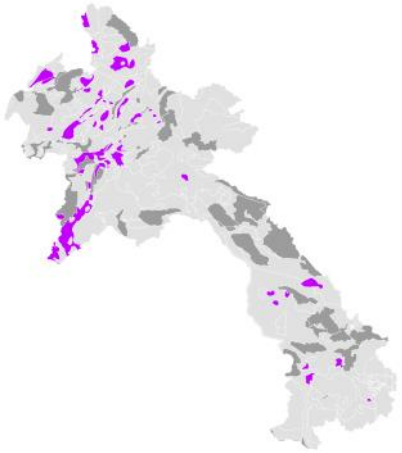
The Boloven Plateau, in southern Lao PDR, is a high-altitude plateau with highly fertile soils, good access to water resources and weather conditions that are suitable for coffee and tea production. Communities in this livelihood zone have undiversified livelihoods and almost exclusively grow coffee or tea. The high-quality of the products and the high prices associated with these mean that communities have high incomes. Tourism is increasing and is likely to become a key source of income in the coming years.

TRADE & MIGRATION

CROSS-BORDER TRADE, SEASONAL MIGRATION AND LOWLAND PADDY

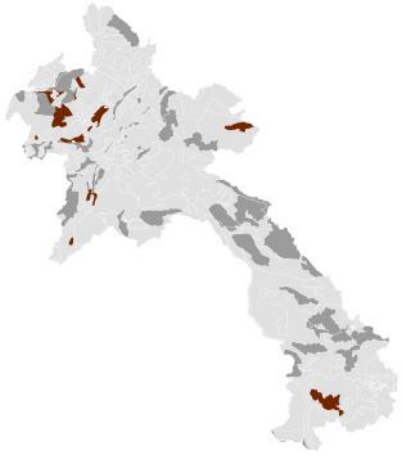
In the southernmost part of the country, west of the Mekong River, communities have good access to Thai markets and engage in cross-border of trade (of traditional handicrafts and agricultural products), seasonal migration and, to a lesser extent, lowland paddy. The diversification of activities and connectivity to international markets have resulted in low poverty rates and high resilience to climate-related risks.

CASH CROPS



CASH CROPS

Another main livelihood activity is production of cash crops, including fruits, sugarcane cassava, maize, tea and coffee. This is primarily common in the northern and northwestern parts of the country. Five major groups have been identified: northern (Phongsaly, Oudomxay and Louangprabang provinces), northwestern (Luangnamtha, Bokeo and Xayabury), central (Savannakhet), Saravane (sweet potato and cassava), and industrial and cash crops (rubber and cassava). Communities in the southernmost provinces also engage in large-scale production of fruits (pineapple, durian, banana) near high-altitude zones where weather conditions are favourable for their production. Two zones heavily dependent on fruit production were identified: pineapple and durian orchards near the Boloven Plateau and banana orchards in Attapeu.

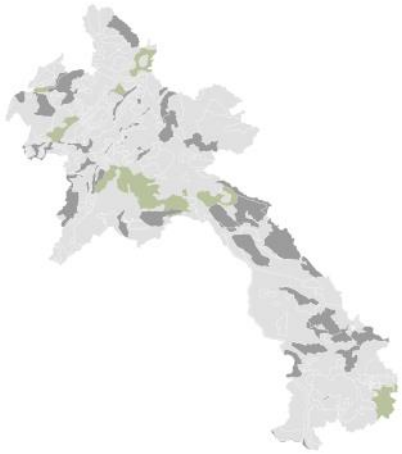


NON-TIMBER FOREST PRODUCTS

Non-timber forest products (NTFPs), such as forest fruits, broom-grass, wild tea and mushrooms are a major source of income for several communities. Harvest of NTFPs is mainly practiced by communities living in or near protected areas where permission for agricultural production is limited.

NON-TIMBER FOREST PRODUCTS AND LOWLAND PADDY

Limited production of lowland paddy is allowed in some protected areas. In these areas, harvest of NTFPs is the primary source of income with paddy providing some food. These communities earn sufficient money to buy all necessary food items from markets, to which they are well connected.



NON-TIMBER FOREST PRODUCTS AND HIGHLAND PADDY

Harvest of non-timber forest products is also practiced alongside highland paddy production. In these areas, the difficult terrain and limited access to markets is a key challenge. Communities are nonetheless able to engage in sale of high-value forest products in district or provincial markets on a less regular basis.

NTFPs

NON-TIMBER FOREST PRODUCTS AND TOURISM

In addition to limited agriculture, some communities that depend on non-timber forest products also engage in eco-tourism and tourism-related services. The recent increase in demand for eco-tourism is providing alternative sources of income for several communities.

MINING

MINING

In recent years, the increase in mining concessions is providing some communities with alternative sources of income. While communities benefit from a predictable and stable source of income, especially during the dry season, there are concerns about possible environmental impacts which may affect land productivity for surrounding communities. Later in June 2012, Government had issued an order number 13/PM to reject any new project proposal includes mining, rubber and eucalypyus plantation projects in the whole country.

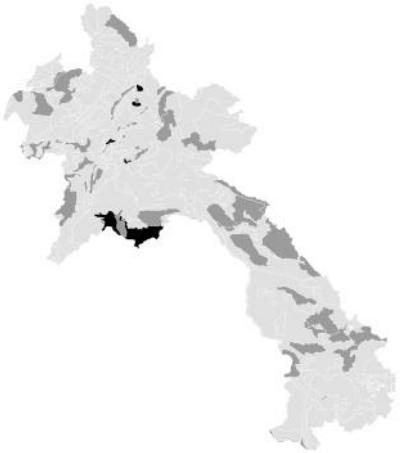
RUBBER

RUBBER PLANTATIONS (CO-OWNED BY COMMUNITIES)

In a number of areas, rubber plantations co-owned by companies and communities are an important source of income. In northern areas, especially, rubber plantations are managed by companies with communities providing land, labour and the rubber. In return, companies provide inputs (seeds, pesticides, fertilizers) and buy the product from communities.

INDUSTRIAL POULTRY AND DOUBLE-SEASON PADDY

In the outskirts of Vientiane Capital, a large number of communities engage in large-scale industrial production of poultry as well as double-season paddy owing to the availability of good irrigation networks which allows for paddy production in the dry season. Good access to the capital also allows communities to access diverse livelihoods.



URBAN AREAS

The main urban areas are Vientiane Capital and Luangprabang, where diverse industrial activities as well as high influx of money from tourism have helped diversify livelihoods. These are among the livelihoods which are most resilient to climate-related risks.

ABOUT C-ADAPT

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