VIET NAM

CLEAR | Consolidated Livelihood Exercise for Analysing Resilience

WFP World Food Programme

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2018

ABOUT THIS REPORT

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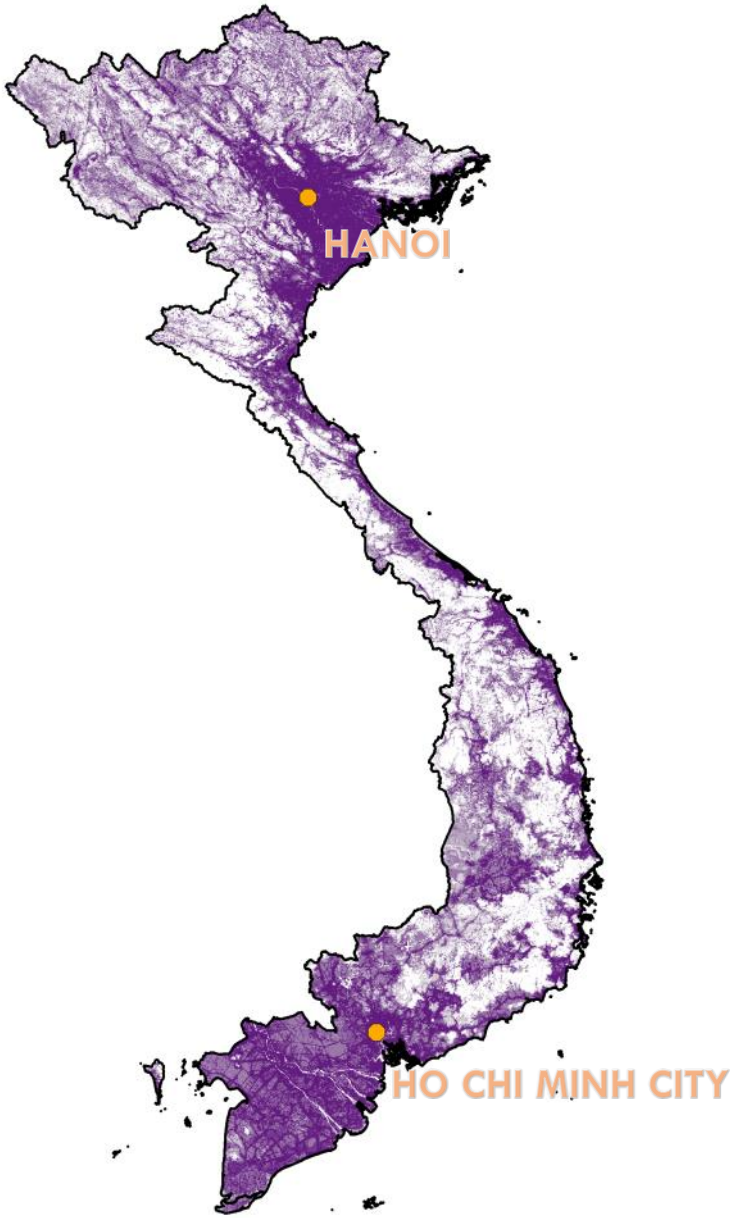
VIET NAM: reference map



POPULATION DENSITY (people/km^2)

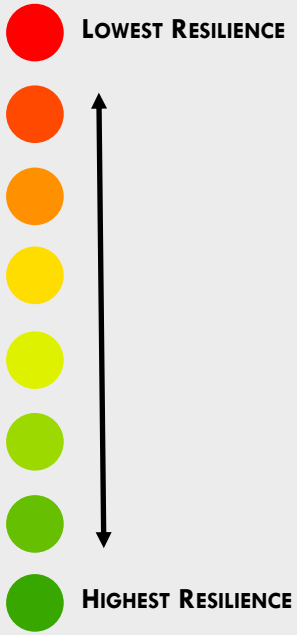
0	1-5	6-10	11-50	51-100	>100

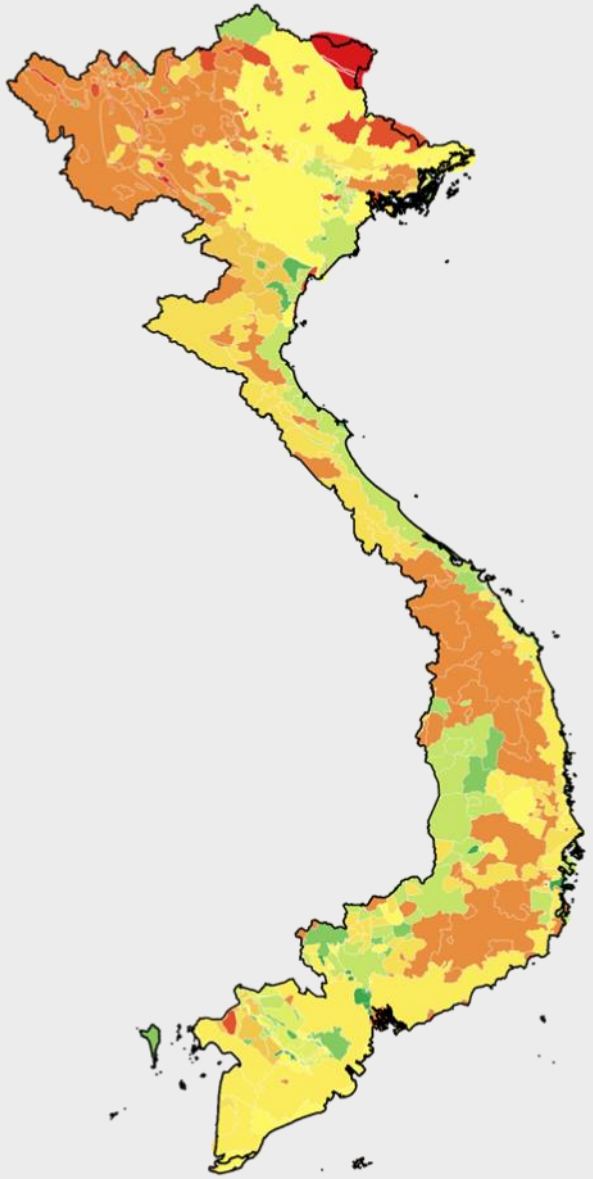
Source: LandScan (2013)

Contents

KEY MESSAGES

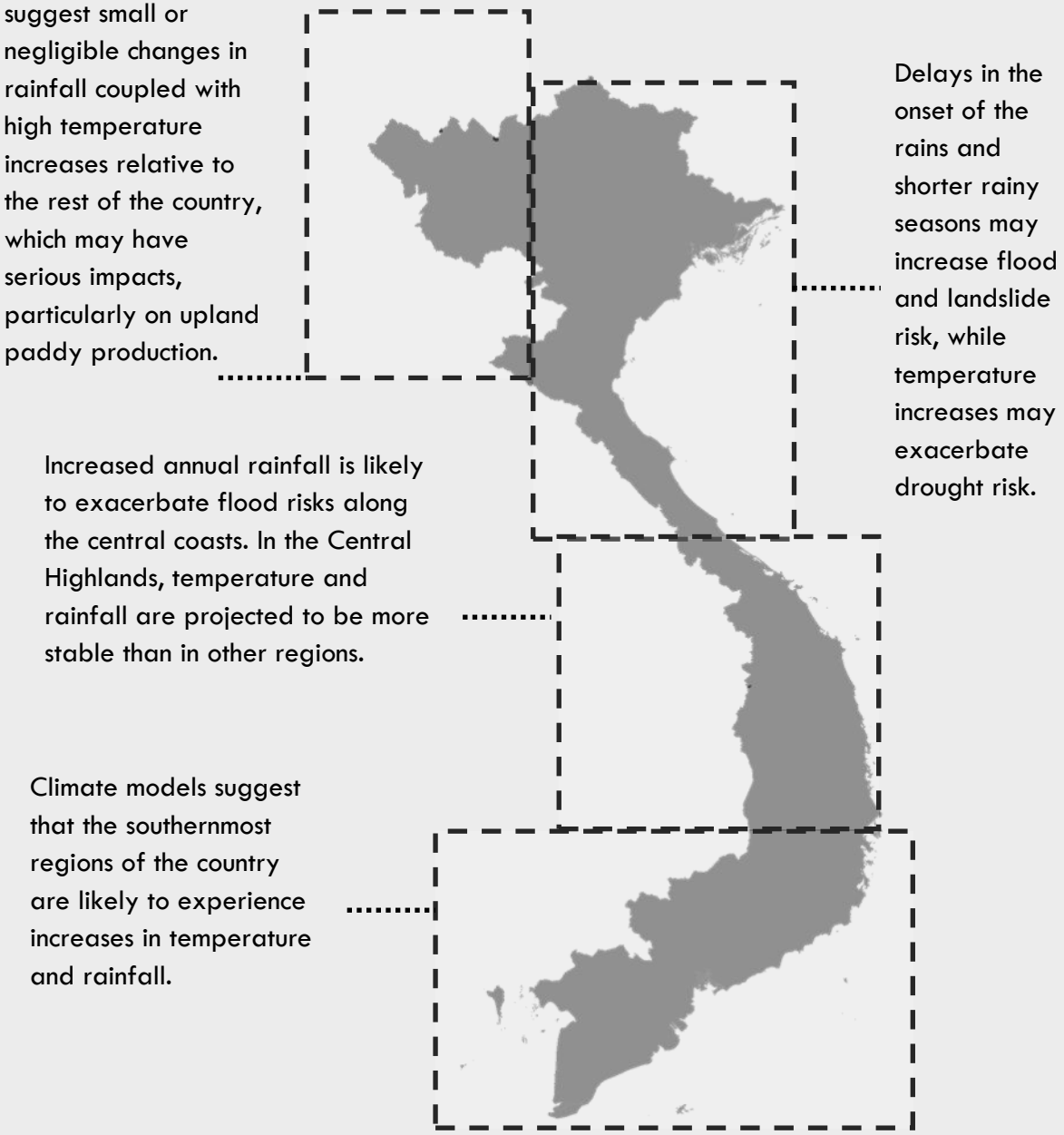
- Livelihoods in Viet Nam are highly diverse owing to a complex topography, the flows of the Mekong and Red Rivers, and a 3,200 km long coastline. Over 80 unique livelihood zones with a specific profile have been identified.
- The livelihoods with the greatest climate resilience are generally those with better access to financial resources, larger livelihood diversity and lower reliance on climate-sensitive activities such as rainfed agriculture.
- Generally, communities in the northern mountainous regions and the Central Highlands have low climate resilience due to higher poverty levels and lower livelihood diversification.
- Communities with upland paddy livelihoods are among those with the lowest climate resilience in Viet Nam. These communities (shaded in red) are located in northern areas, particularly along the north-eastern border with People's Republic of China, and in the Mekong River Delta.



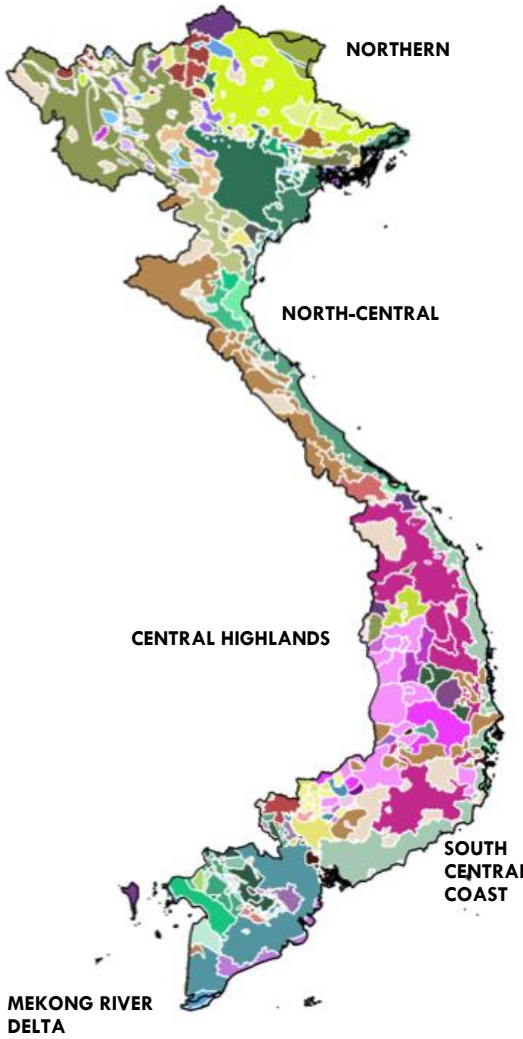


Climate change is one of the key challenges faced by rural communities. Three main trends have the potential to adversely affect livelihoods.

- **Long-term rainfall patterns:** annual rainfall is predicted to increase overall throughout most of Viet Nam, but the extent of the increase varies by region. Coastal areas in the northern and south-central regions are expected to have the greatest increase, while some areas of the north will have a small or negligible increase. Given lower resilience in the north -western mountainous regions, investments in irrigation and water harvesting technologies or livelihood diversification may help improve resilience capacity.
- **Seasonal variability**: delays in the onset of the rainy season and increases in annual rainfall in the northern and north-central regions of the country may exacerbate flood and landslide risk.
- **Future climate**: in northern regions, climate models suggest increases in temperature of up to 1.7 degrees Centigrade coupled with negligible to small increases in rainfall, which may exacerbate drought risk and reduce agricultural potential. Along central coastal areas, climate models project increases in rainfall of up to 25 percent and small increases in temperature compared to the present, which may exacerbate flood risks. Given the significance of these regions for cash crops and paddy production, the risks to both communities and the country as a whole are significant.



LIVELIHOOD ZONES



Northern

- Red River Delta lowland paddy
- Northern aquaculture (fisheries & shrimp production)
- Northern aquaculture (fisheries & shrimp production) & tourism
- Northern aquaculture (fisheries & shrimp production) & livestock rearing
- Northern cash crops (medicinal herbs) & tourism
- Northern cash crops (coffee & tea)
- Northern cash crops (rubber)
- Northern cash crops (sugarcane)
- Northern cash crops (tea)
- Northern intensified agriculture
- Northern large-scale livestock rearing & upland paddy
- Northern lowland paddy
- Northern lowland paddy & cash crops
- Northern lowland paddy & orchards
- Northern lowland paddy & vegetables
- Northern maize
- Northern mountains upland paddy
- Northern mountains upland paddy & aquaculture
- Northern mountains upland paddy & beekeeping
- Northern orchards & cash crops (tea)
- Northern orchards & small-scale upland paddy
- Northern upland paddy
- Northern upland paddy & cash crops (spices)
- Northern upland paddy & cash crops (tea)
- Northern upland paddy & maize
- Northern upland paddy & cash crops (medicinal herbs)
- Northern upland paddy, livestock rearing & cash crops (spices)
- Northern upland paddy, vegetables & fruits
- Northern vegetable production
- Mining
- Northern border economic zones
- Handicrafts

North-central

- North-central coastal lowland paddy
- North-central coastal lowland paddy & fisheries
- North-central coastal lowland paddy & cash crops (sugarcane)
- North-central coastal lowland paddy & livestock rearing
- North-central coastal lowland paddy & cash crops (coffee, sugarcane)
- Forestry & cash crops: rubber
- Forestry & NTFPs
- Forestry & small-scale lowland paddy
- Protected areas: Small-scale paddy production

South Central Coast

- South-central lowland paddy
- South-central lowland paddy & cash crops (cassava & tobacco)
- South-central lowland paddy & cash crops (sugarcane)

Central Highlands

- Central highlands aquaculture (fisheries & shrimp production)
- Central highlands cash crops (cashew & pepper)
- Central highlands cash crops (cashew & rubber)
- Central highlands cash crops (coffee, rubber & maize)
- Central highlands cash crops (coffee, rubber & pepper)
- Central highlands cash crops (maize & sugarcane)
- Central highlands cash crops (pepper)
- Central highlands cash crops (rubber & pepper)
- Central highlands cash crops (rubber & tobacco)
- Central highlands cash crops (rubber, cacao & pepper)
- Central highlands cash crops (cashew & pepper) & livestock rearing
- Central highlands cash crops (cashew & pepper) & orchards
- Central highlands cash crops (mixed) & lowland paddy
- Central highlands livestock rearing
- Central highlands livestock rearing & cash crops (pepper)
- Central highlands livestock rearing & upland paddy
- Central highlands orchards
- Central highlands orchards & cash crops (rubber)
- Central highlands orchards & upland paddy
- Central highlands upland paddy & maize
- Central highlands upland paddy & vegetables

Mekong River Delta

- Mekong River Delta flood irrigation paddy
- Mekong River Delta flood irrigation paddy & aquaculture (shrimp production & fisheries)
- Mekong River Delta flood irrigation paddy & cash crops (root crops)
- Mekong River Delta flood irrigation paddy & industrial activity
- Mekong River Delta flood irrigation paddy & orchards
- Mekong River Delta flood irrigation paddy & livestock rearing
- Mekong River Delta flood irrigation paddy & tourism
- Mekong River Delta orchards
- Mekong River Delta orchards & tourism
- Mekong River Delta upland paddy
- Mekong River Delta aquaculture (fisheries & shrimp production)
- Mekong River Delta cash crops (root crops)
- Mekong River Delta cash crops (root crops) & coconuts
- Mekong River Delta flood irrigation paddy & aquaculture (fisheries & shrimp production)
- Mekong River Delta tourism & aquaculture (fisheries & shrimp production)
- Mekong River Delta vegetable production
- Protected areas: Small-scale aquaculture (fisheries & shrimp production)

Other

- Tourism
- Urban areas
- Industrial zones

Livelihoods in Viet Nam are highly diverse, owing to the complex topography of the country, the flows of the Mekong and Red Rivers, and the rapid economic development in the country over the last few decades.

Rural livelihoods, which provide an income to around two-thirds of the population, continue to be highly climate-sensitive. Paddy production is significant, contributing to over 80 percent of total agricultural output. Paddy production occurs in three main areas: the Mekong River Delta, the Red River Delta, and the mountainous areas of north-western Viet Nam.

The Mekong River Delta, traditionally referred to as the "Rice Bowl" of Viet Nam, is by far the largest paddy-producing region in the country, accounting for around 38 million metric tons of rice (55-60 percent of total paddy production). Over 80 percent of the population in the 12 provinces of the Mekong River Delta are engaged in paddy production, and rice contributes 75 percent of caloric consumption to households in this zone, highlighting the crucial significance of paddy. The flow of the Mekong River allows for irrigation and multiple harvests (predominantly in autumn and winter, but in some areas, up to three harvests occur, including in the spring).[1]

The Red River Delta is the second largest paddy-producing region in the country, contributing around 15-20 percent of production. As with the Mekong River, the Red River allows for two harvests—mainly in spring and autumn.[2] Within both delta systems, paddy production is often supplemented with aquaculture and other minor cash crops and fruit trees.

The third most significant paddy-producing region of Viet Nam is the northern mountainous area, where communities engage in upland paddy production (accounting for 5-10 percent of national paddy production). Unlike in the Mekong and Red River Deltas, in the mountainous regions, agriculture is primarily rainfed and critically depends on the performance of the rainy season. To address the potential impacts of climate risk, communities in these regions have supplemented their livelihoods with maize, apiculture, orchards and spices.

Along the north-central coastal regions, communities engage in paddy production and fishing or aquaculture (near the lagoons) — mainly for household consumption.

Further south, in the south-central highlands, communities engage in cash crop production. The dominant cash crops in addition to paddy are coffee (particularly in higher elevation areas, where colder climates offer ideal conditions for coffee production), cashew, pepper and fruit trees. Increasingly, rubber and cassava are found in mid-elevation zones. Maize is also grown, primarily for sale, by some households in these regions.

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 profitable sources of income.

In recent years, the increase in mining concessions has offered new livelihood options to some communities, but the availability of these options 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 (primarily rubber) will likely change land use patterns, which in turn, will affect rural livelihoods. Meanwhile, as young labourers migrate from the countryside to cities in large numbers, rural areas will be increasingly exposed to shortages of skilled and educated labour.

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[1] ODI. 2013. Agriculture in the Central Mekong Delta. London: ODI

[2] Nga, B.T. and Xuan, N.T., Performance of Rice Production in the Red River Delta of Viet Nam: A Case Study in Y Yen District, Namdinh Province. People, 8(2), pp.4-78.

RESILIENCE PROFILE

Ultimately how livelihoods are affected by a climatic shock also depends on their resilience capacity. Climate resilience in Viet Nam is influenced by three main factors: 1) poverty and access to wealth, 2) livelihood diversity —access to diverse livelihood activities enables households to continue to generate income when the primary activity is affected by a shock; and 3) climate sensitivity of livelihoods — reliance on purely rainfed agricultural systems renders households more vulnerable to climate variability.[3] Resilience patterns can be mapped by aggregating these indicators.

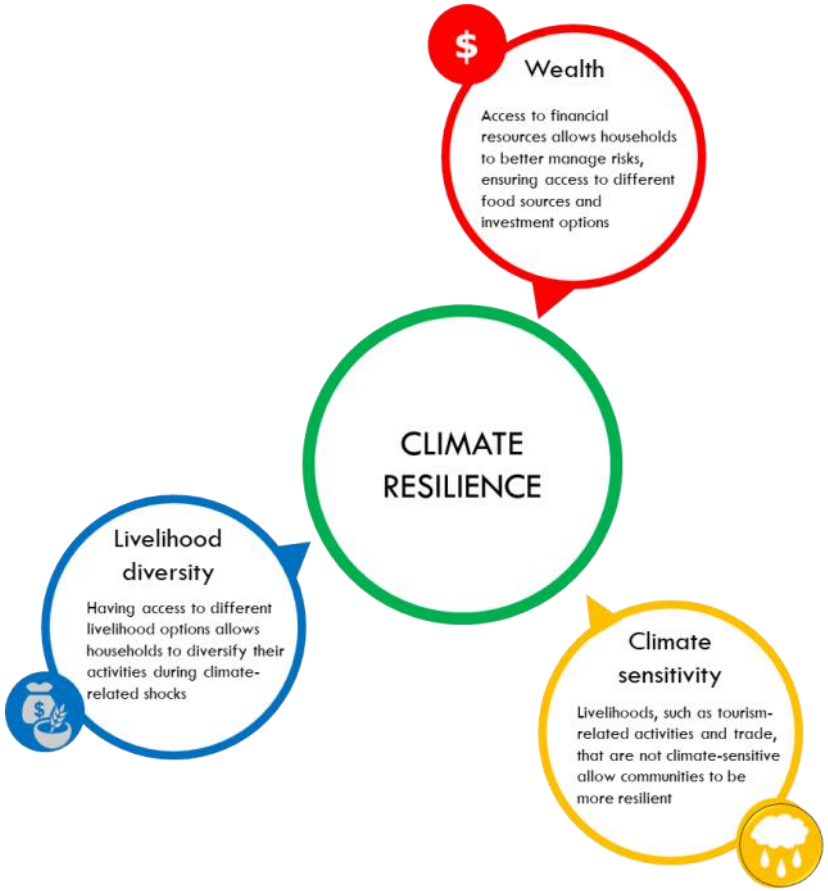
Livelihoods in Viet Nam follow distinct patterns of resilience related to these factors. Apart from urban livelihoods, communities relying on coastal lowland paddy and fishing as well as cash crops in the innermost regions of the Central Highlands enjoy greater levels of resilience owing to better access to financial resources and lower climate sensitivity of income.

In contrast, mountainous communities that depend primarily on upland paddy production (often in combination with other crops) in the north-western regions and the Central Highlands experience lower levels of climate resilience — upland paddy production is highly climate-sensitive, and households with this livelihood generally experience higher rates of poverty.

Finally, the plains along the Mekong and Red River Deltas experience medium levels of climate resilience. Despite greater access to wealth, the high reliance solely on paddy production and the relatively high climate-sensitivity of lowland paddy production also reduce resilience capacity. In these regions, increasing livelihood diversity is likely to improve resilience levels. Support is needed for these communities to transition from climate sensitive livelihoods to climate neutral ones.

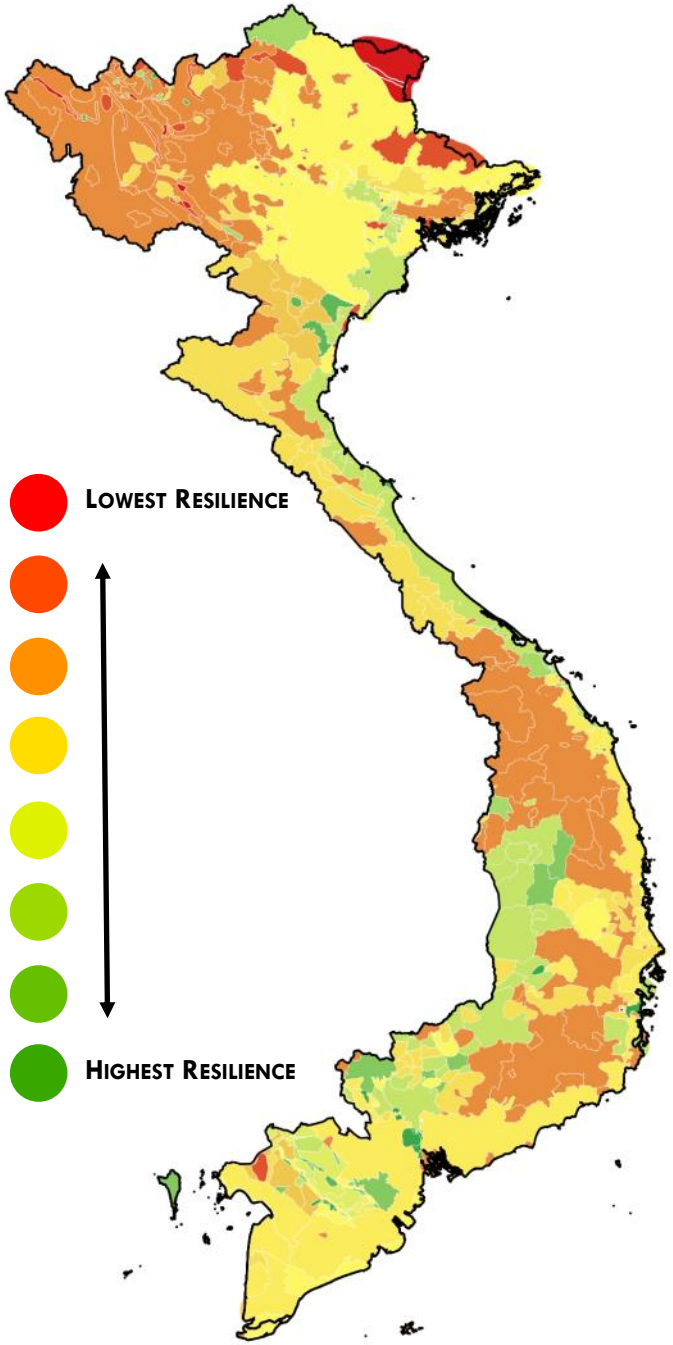
[3] Described as 'resilience criteria' on Page 4. These criteria were determined in community discussions (see Annex I for a description of the method).

RESILIENCE CRITERIA



RESILIENCE BY LIVELIHOOD ZONE

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



INCOME & POVERTY

Income 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. Income also allows communities to purchase food when agricultural production is not sufficient.

In Viet Nam, access to wealth is closely associated with connectivity to markets[4]. Communities connected to major urban areas fare better than those in remote mountainous areas of northwestern Viet Nam and the Central Highlands.

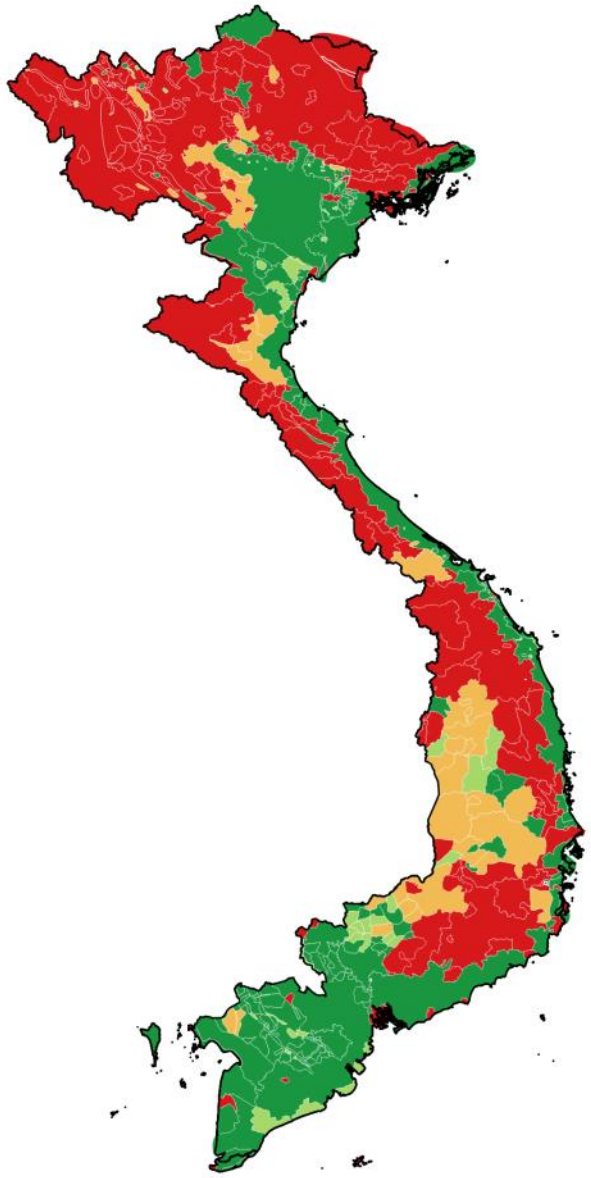
Poverty levels are lowest among three major livelihood groups: urban areas, where industrial activity and diversity of livelihood options offer opportunities for increased financial stability and savings; lowland paddy zones (especially in the Mekong and Red River Deltas) and the coastal fisheries and livelihood regions, where access to national and regional markets drives economic development.

In contrast, the poorest livelihood groups engage primarily in highland paddy agriculture (in the northwestern regions) or in cash crop production (in the Central Highlands). These communities tend to belong to ethnic minorities and often live in mountainous regions with limited infrastructure and limited land for agricultural production.

Poverty trends are likely to change with increasing livelihood diversification and continued modernization of the Vietnamese economy. Increasing reliance on mining, industrial crops, and other emerging livelihood activities holds great promise for increasing incomes, but there remain concerns about the potential environmental implications of these activities.

[4] Minot, N., Baulch, B. and Epperecht, M., 2006. Poverty and inequality in Vietnam: Spatial patterns and geographic determinants (No. 148).

Rapid economic transformation and growth in the last two decades have resulted in an impressive reduction of poverty: from 58 percent in 1993 to 12 percent in 2011. However, Viet Nam still faces many challenges in its attempts to reduce poverty. Ethnic minorities and other vulnerable groups, such as female-headed households, tend to be disproportionately affected by poverty. Continued assistance through livelihood support programmes, creation of productive assets and enhancing access to essential services will help reduce poverty and increase community resilience.



POVERTY BY LIVELIHOOD ZONE

Source: Based on Small Area Estimation of Poverty (Minot, N., Baulch, B. and Epperecht, M., 2006. Poverty and inequality in Vietnam: Spatial patterns and geographic determinants. Paper No. 148).

- HIGH INCOME LEVELS
- MODERATE INCOME LEVELS
- LOW INCOME LEVELS
- VERY LOW INCOME LEVELS

LIVELIHOOD DIVERSITY

Diversification of livelihood activities helps to enhance resilience — households with diverse livelihood profiles are more capable of responding to shocks in case the primary activity is affected. Diversification away from single or double-crop production is especially significant as it allows households to increase dietary diversity (for example, higher consumption of animal products) as well as the number of income sources.

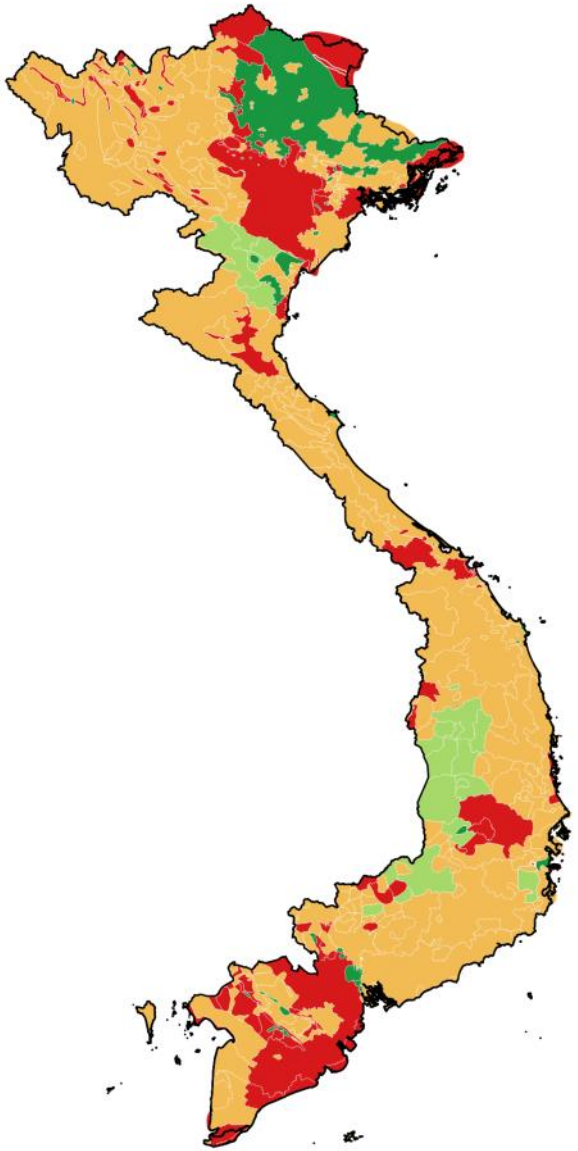
Outside of urban areas, livelihoods in Viet Nam are heavily reliant on paddy production, which provides the main source of income to nearly 1.4 million people. They are also reliant on aquaculture and fishing, and production of cash crops. Generally, rural households rely on one or two main livelihood activities as highlighted by the relatively low levels of livelihood diversity.[5]

In recent years, production of cash crops has become more common and has helped to diversify livelihoods, particularly in the Central Highlands. Households engage in production of cashew, coffee, tea, rubber and pepper, and often combine production with some cereals (paddy or maize) or livestock rearing to supplement their income.

In general, the most diversified livelihoods are located in urban areas of Hanoi, Ho Chi Minh City and Danang. An exception is the zone that includes northern lowland paddy, vegetables, orchards and cash crops, in which communities have diversified from a single livelihood activity to a more diversified livelihood system.

[5] World Bank (2015) Poverty reduction in Vietnam: Remarkable progress, emerging challenges.

Continued reliance on single or double cropping in most areas of the country means that communities are unable to rely on additional livelihood activities when the primary activity is affected by a shock. The main drivers of livelihood diversification are tourism, industrial activities, and urbanization, though a number of communities are increasingly supplementing their primary livelihood source with livestock rearing and cash crops. Training in production of different crops (such as coffee and tea) has also helped to diversify some livelihoods.



LIVELIHOOD DIVERSITY BY LIVELIHOOD ZONE

Source: Based on field and partner consultations (2018).

- HIGH DIVERSIFICATION
- MODERATE DIVERSIFICATION
- LOW DIVERSIIFICATION
- VERY LOW DIVERSIFICATION

CLIMATE SENSITIVITY

Changes in climatic patterns, both long-term and seasonal, can have a detrimental effect on livelihoods that depend on climate-sensitive income, such as agricultural labour, sale of rainfed 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.

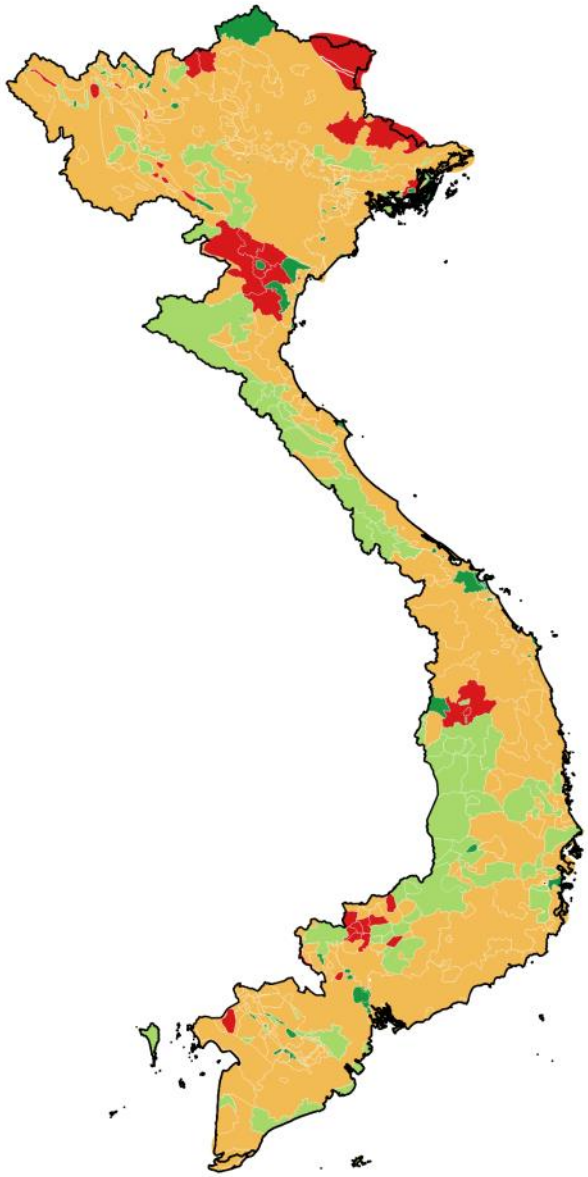
Income is particularly sensitive for farmers dependent on rainfed paddy, which requires regular rainfall in order to grow, while irrigated paddy is limited to areas around rivers. Maize and cassava crops are more tolerant to irregular rainfall but are still affected by low rainfall. Root crops such as sweet potato and taro are slightly less sensitive to rainfall.[6]

More diversified, non-crop based livelihoods such as fishing are less sensitive to climate variability and can be carried out both during the dry and wet seasons.

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. For these communities, other shocks such as price volatility may be more significant threats to overall resilience.

[6] IIASA and FAO (2012) Global Agro-ecological Zones. GAEZ3.0

Generally, rural livelihoods in Viet Nam are highly sensitive to climate, owing to reliance on rainfall. However, the main agricultural areas of Viet Nam — the Mekong and Red River Deltas — enjoy access to sufficient river waters which enable production of double and even triple crops. But delays in the onset of the rainy season or disruptions in the monsoon continue to affect the incomes of rural communities. Households engaging in less climate-sensitive activities such as tourism or mining are less reliant on rainfall and are therefore less vulnerable to climate variability.



CLIMATE SENSITIVITY OF INCOME BY LIVELIHOOD ZONE

Source: Based on analysis of crop sensitivity by IIASA and FAO (2012) Global Agro-ecological Zones. GAEZ3.0

- **Low sensitivity**
- **Moderate sensitivity**
- **High sensitivity**
- **Very high sensitivity**

RAINFALL CLIMATOLOGY

The average annual rainfall ranges across Viet Nam from a minimum of 1,300 mm in some northern areas to a maximum of over 3,000 mm in central areas. This rainfall peak is linked to the topography of the country, coinciding with the highest mountains of the Annamese range. Away from these extremes, most of the country has annual average rainfall amounts of around 2,000 mm.

Livelihood zones in the central parts of the country therefore receive the greatest amounts of rainfall. These groups depend largely on non-paddy cash crops, such as coffee, pepper and rubber. The high amounts of rainfall are both beneficial and detrimental to communities living in the Central Highlands. The high rainfall amounts and fertile lands provide optimal conditions for coffee production, but some communities have reported increased risk of landslides and degradation of sloping lands.

The lowland paddy areas of the Mekong and Red River Deltas receive around 1,500-2,000 mm of annual rainfall and can supplement their water requirements with the flows of the Red and Mekong Rivers, respectively.

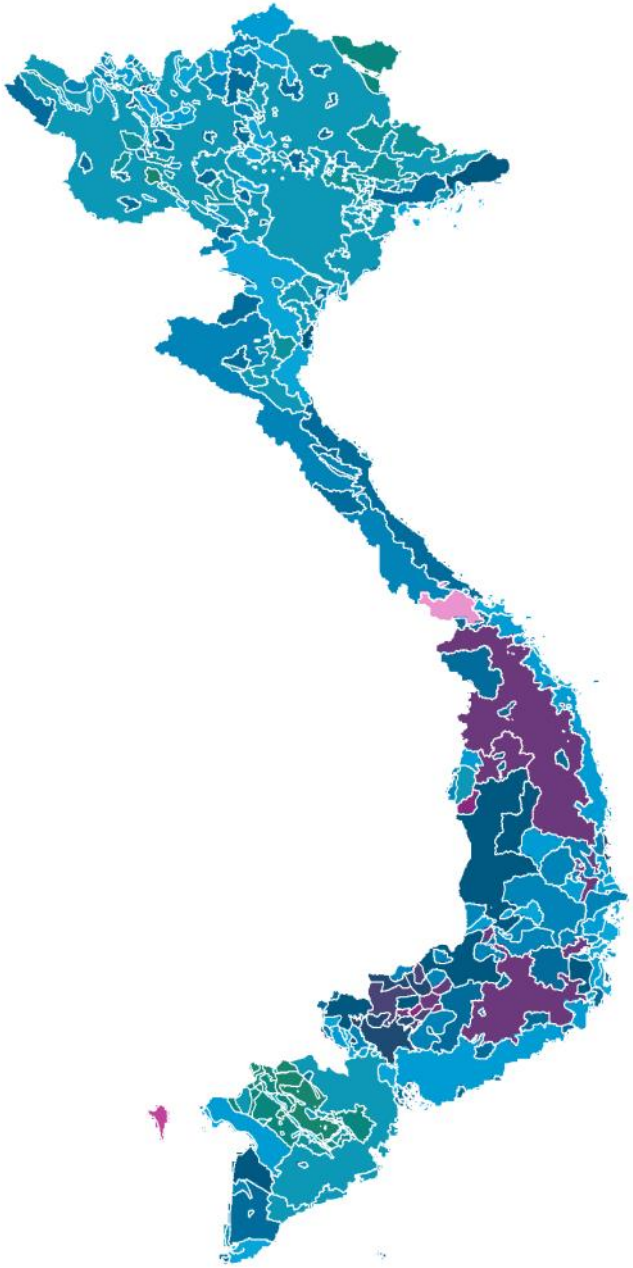
Livelihood groups in the northwestern and northern parts of the country, which largely depend on upland paddy production, receive the least amount of rainfall in the country (around 1,300 mm of annual precipitation). This can be problematic given the lack of alternative water sources for agricultural activities.

RAINFALL CLIMATOLOGY (1982-2015)

<1,000MM/YEAR

2,000MM/YEAR

>3,000MM/YEAR



RAINFALL CLIMATOLOGY BY LIVELIHOOD ZONE (1982-2015)

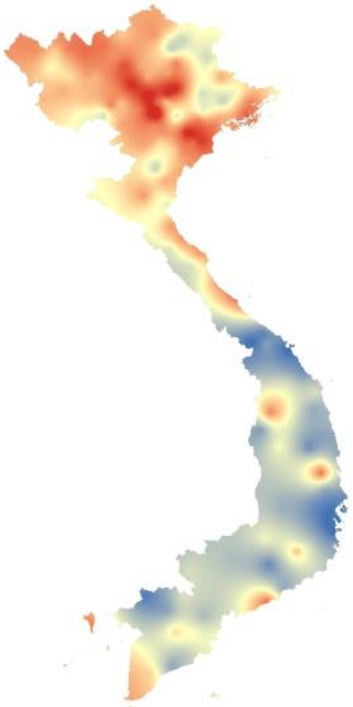
Source: Rainfall analysis using data from CHIRPS, processed by WFP/VAM (Vulnerability Analysis and Mapping Service, World Food Programme)

RAINFALL TRENDS

From 1958-2014, there has been a pattern of decreasing rainfall in most areas of northern Viet Nam, particularly where paddy farming and cash crops are the predominant livelihoods (darker red shades, Page 14). However, rainfall in the inland areas of the North Central Coast region have remained mostly stable. In contrast, there has been a pattern of mostly increasing rainfall in southern Viet Nam, with the exception of small pockets of decreasing rainfall in the upland paddy zones of the Central Highlands and the aquaculture zones of the Mekong River Delta.

In the more recent past, rainfall trends have been more complex. Since 1995, there has been a noticeable decline in the rate of increase of annual rainfall across the entire country, and decreasing trends have become more widespread, particularly in the northwestern parts of the country.

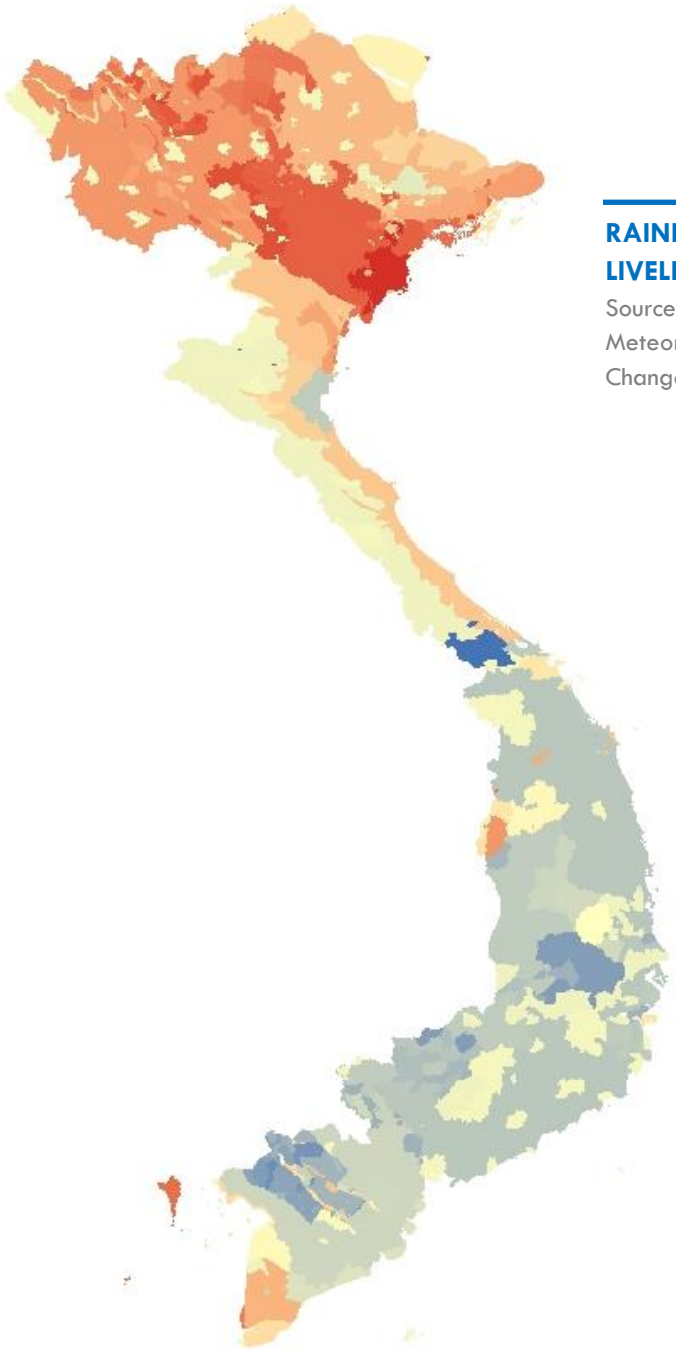
The northern third of the country shows more widespread and intense decreasing annual rainfall tendencies in the areas closer to the border with Lao People's Democratic Republic. Meanwhile, there is significant inter-annual variability with some years showing major decreases in rainfall. Efforts to prepare for years with lower and higher rainfall should be prioritized.



RAINFALL TRENDS (1958-2014)

LARGE INCREASE:
24 PERCENT (MM/YEAR)

LARGE DECREASE:
-17 PERCENT (MM/YEAR)



RAINFALL TRENDS BY LIVELIHOOD ZONE (1958-2014)

Source: Viet Nam Institute of Meteorology, Hydrology and Climate Change, 2016.

ONSET OF RAINY SEASON

Overall, there is a noticeable tendency for later onsets of the rainy season in the northern regions of the country (except for some border areas with China) and earlier onsets in the southern regions. In the northern regions, the tendency for later onsets of the season are maintained in the more recent record, but in the southern regions, the tendency for earlier onsets is slower in the more recent time frame.

These tendencies are in broad agreement with the trends in annual rainfall shown earlier. In southern regions, earlier onsets of the growing season correspond with trends of increasing annual rainfall. In northern regions, later onsets are associated with no overall change in annual rainfall.

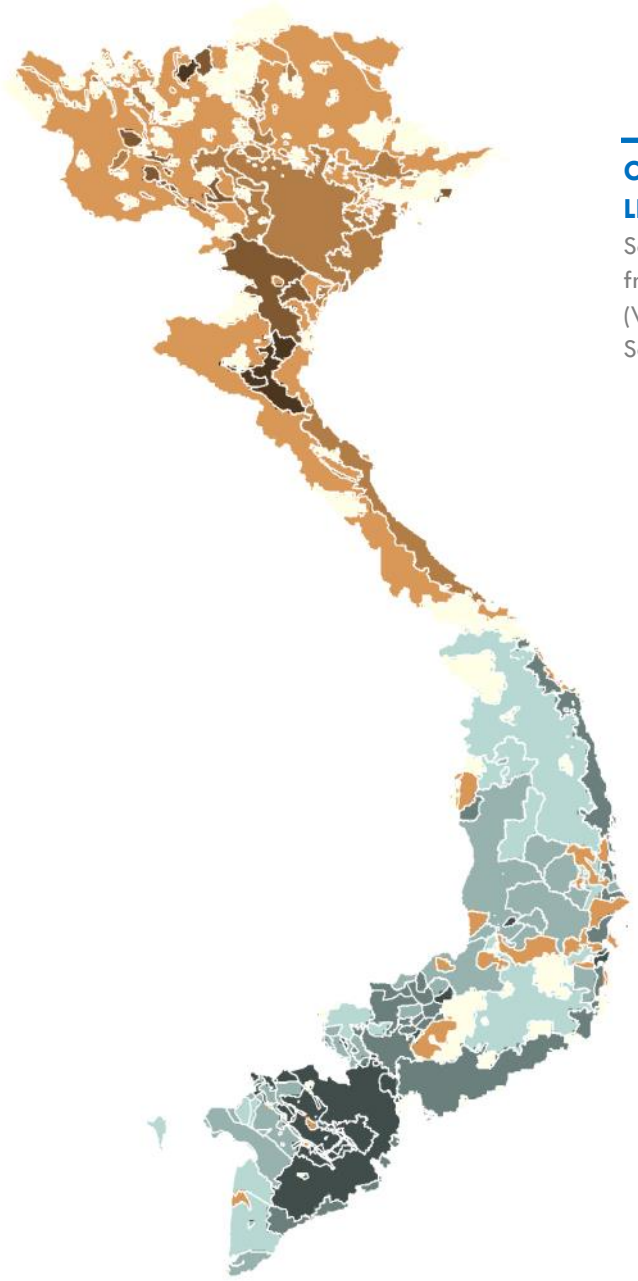
Some central provinces (Thua Thien Hue, Quang Tri, Quang Binh) have a tendency for later onsets with an increasing annual rainfall. Here the increase in annual rainfall must come from mid- or late- season periods, compensating for decreases in early season rainfall.

A continuation of delays in the onset of the rainy season in the northern and north-central regions would be detrimental to paddy production, particularly in areas that depend on upland paddy production and which lack alternative irrigation methods. Moreover, shorter seasons accompanied with more intense rainfall can increase flood risk throughout the northern and north-central regions of Viet Nam.

Conversely, earlier onsets of the rainy season are associated with increasing rainfall. In the short-term this may be beneficial for paddy production, which has relatively high water requirements, but a continuation of these trends may exacerbate flood risk.

ONSET OF SEASON TRENDS (1985-2015)

ONSET OF SEASON TRENDS (1995-2015)



ONSET OF SEASON TREND BY LIVELIHOOD ZONE (1985-2015)

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

DELAY IN ONSET OF SEASON
5-10 DAYS LATER/10 YEARS

NO CHANGE

EARLIER ONSET OF SEASON
5-10 DAYS EALIER/10 YEARS

SEASONALITY

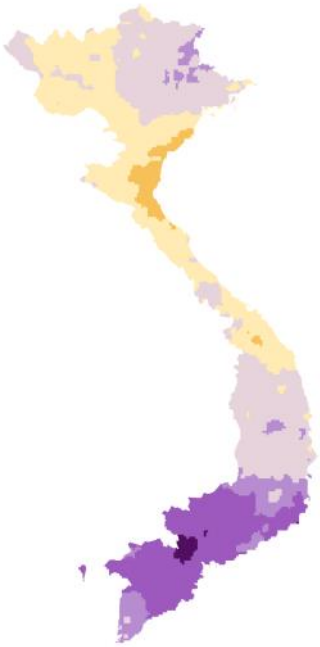
In addition to variability in the onset of the rainy season, changes in seasonality of rainfall (i.e. how evenly spread rainfall is throughout the season) can also affect livelihoods by impacting the magnitude of flood events.

Over the longer-term historical period (1985-2015), there has been more evenly spread rainfall in southernmost Viet Nam and less evenly spread rainfall in northern Viet Nam. The rest of the country shows only slight changes in rainfall uniformity.

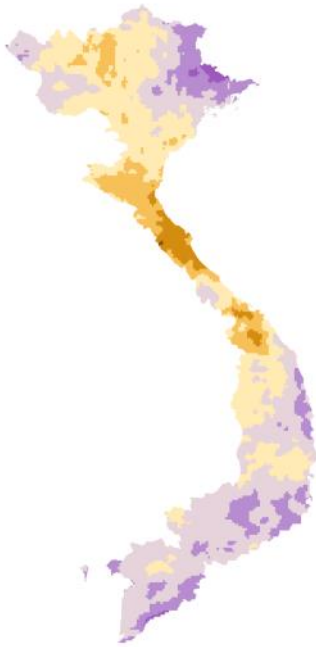
In the more recent period (1995-2015), the northeastern regions of Viet Nam have experienced more evenly spread rainfall. The trend of more evenly spread rainfall is maintained in the southern regions near the Mekong River Delta.

Elsewhere, there is a clear tendency towards less evenly spread rainfall, particularly in the north-central regions. If increases in rainfall take place during the wetter months, this will contribute to less evenly spread rainfall. This in turn translates to higher flood risk in the north-central areas that depend on paddy production and fisheries.

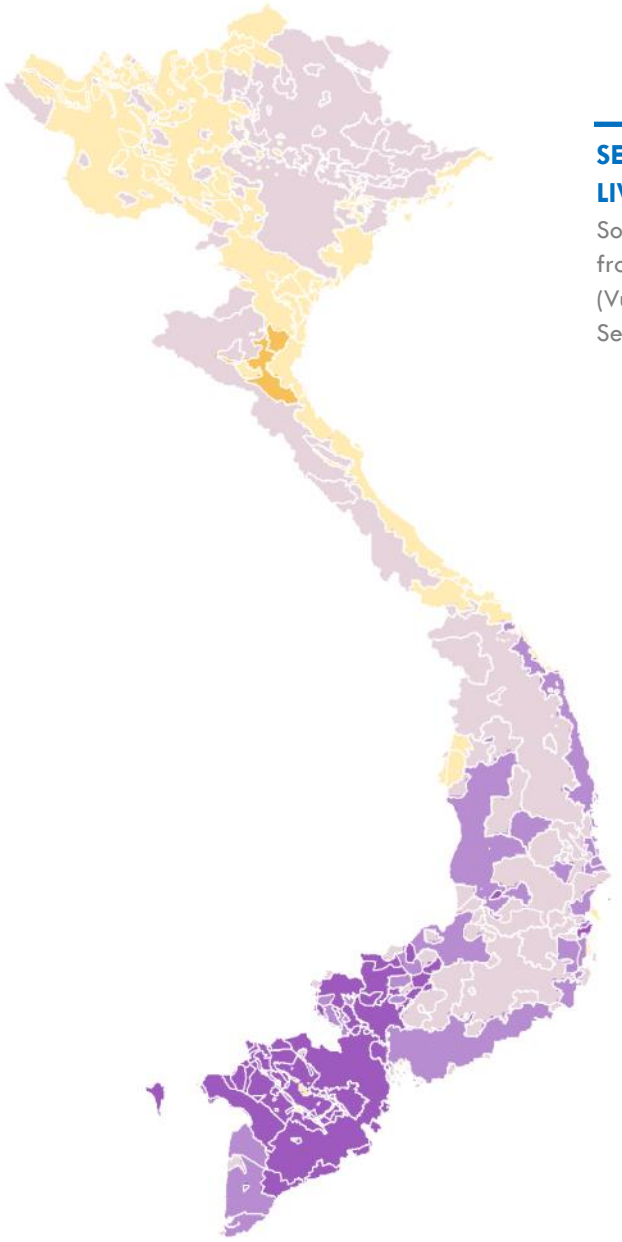
In sum, most of the country has experienced an increase in more evenly spread rainfall, except in the north-central regions where the opposite trend — less evenly spread rainfall — has been observed.



SEASONALITY TRENDS (1985-2015)



SEASONALITY TRENDS (1995-2015)



SEASONALITY TREND BY LIVELIHOOD ZONE (1985-2015)

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

STRONG DECREASE IN SEASONALITY
(MORE EVENLY SPREAD RAINFALL)

MINOR CHANGES

STRONG INCREASE IN SEASONALITY
(LESS EVENLY SPREAD RAINFALL)

FUTURE CLIMATE

Projections of future climate change in Viet Nam are associated with large uncertainties due to the highly complex topography of the country and the climatic influences of the Pacific Ocean. However, general climate models show that Viet Nam will experience long-term increases in both temperature and rainfall, which could have significant implications for livelihoods and food security.[8]

Trends under a changing climate include:

- ✓ Temperature increases of up to 1.7 degrees Celsius by 2050 [9]. The northern regions are projected to experience the largest increases in temperature.
- ✓ General rainfall increases in most parts of the country, in particular in the Red River Delta, central coasts and localized areas of the Southeast and Mekong River Delta.
- ✓ Rising sea-levels throughout most of coastal Viet Nam and in the Mekong and Red River Deltas. Sea-level rise of up to 100 cm by the end of the 21st century will significantly reduce the availability of land for paddy production, which occurs in these areas. In addition, saltwater intrusion will likely affect productivity of fruit trees, critical for these regions.
- ✓ More intense typhoons affecting the central parts of the country.

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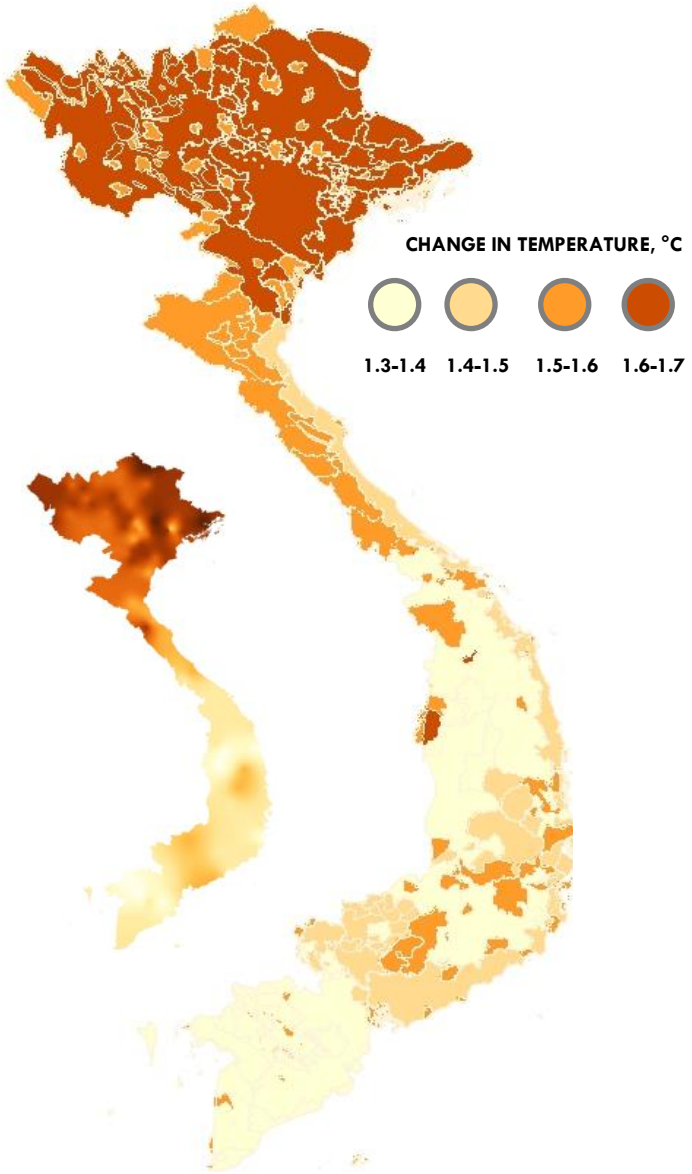
[7] Viet Nam Ministry of Natural Resources and Environment (2016). 'Climate Change and Sea Level Rise Scenarios for Viet Nam.

[8] IPCC (2013) Fifth Assessment Report. Cambridge: Cambridge University Press.

[9] Viet Nam Institute of Meteorology, Hydrology and Climate Change (IMHEN, 2016). Climate change models are based on Representative Concentration Pathway (RCP) 4.5, an emissions stabilisation scenario.

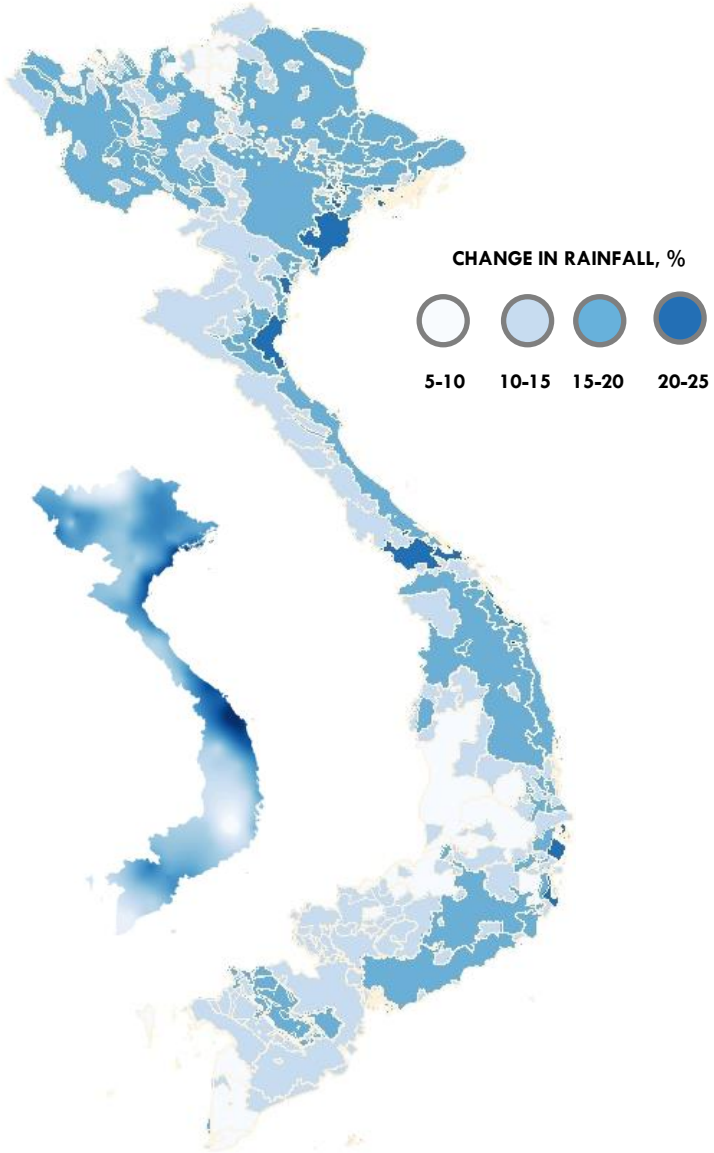
PROJECTED CHANGES IN TEMPERATURE BY LIVELIHOOD ZONE (2050, RCP 4.5)

Source: IMHEN, made in 2016 with baseline temperature data from 1986-2005.

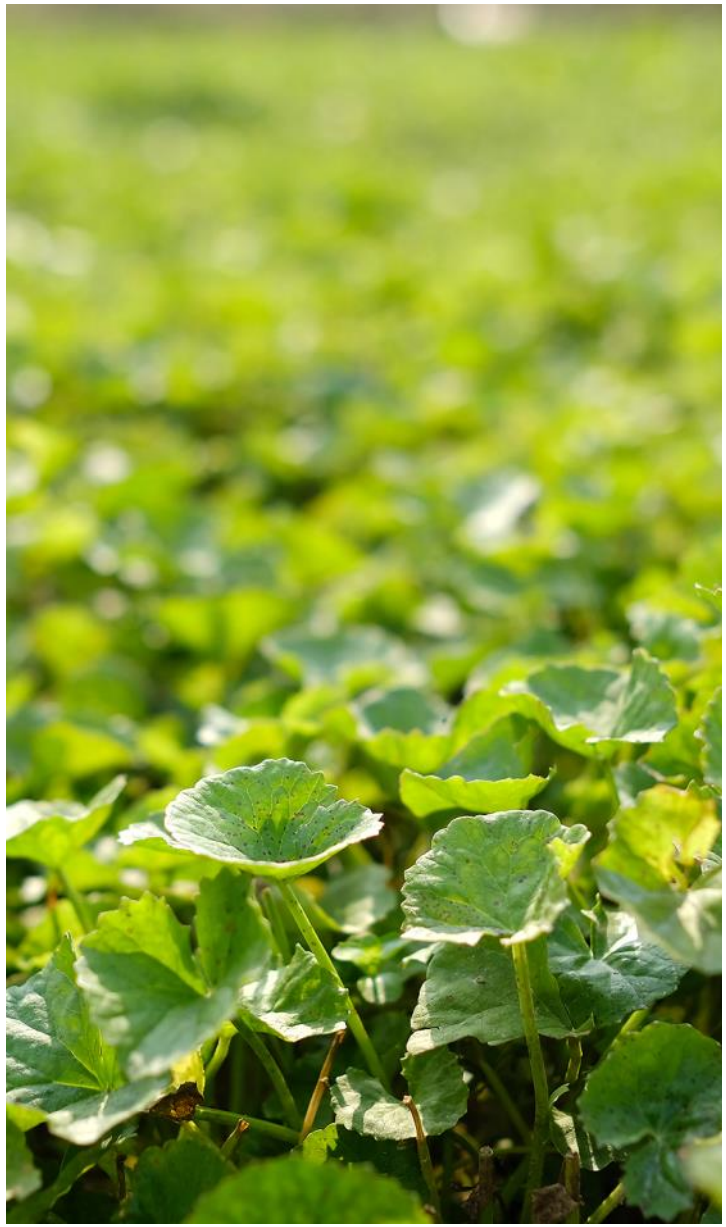


PROJECTED CHANGES IN RAINFALL BY LIVELIHOOD ZONE (2050, RCP 4.5)

Source: IMHEN, made in 2016 with baseline temperature data from 1986-2005.



CROP SUITABILITY



Changes in temperature and rainfall will also affect the suitability of key crops — particularly rainfed paddy, coffee, maize and root crops.[10, 11]

Rainfed and flood irrigation paddy practices are varied, and therefore, evaluating the potential of climate change on paddy production is difficult. However, climate models suggest that modest increases in annual rainfall coupled with large temperature increases may lower the productivity of lowland paddies in the northern coastal regions of Viet Nam, while increases in temperature in the Mekong River Delta will likely reduce production potential.

A combination of modest increases in rainfall and large increases in temperature in Central Highlands may reduce suitability of major cash crops, particularly coffee. Coffee production in these regions has been a major source of income, and potential reductions in suitability would have significant ramifications for income security.

Maize production in higher-elevation areas across the north and central regions of Viet Nam are likely to be affected by mixed climate dynamics — modest increases in rainfall but large increases in temperature— which may result in increased drought risk.

Finally, major root crop production areas in northern Viet Nam and in the Mekong River Delta are likely to experience some increases in annual rainfall but increased drought risk which may affect the potential for production.

Anticipating shifts in crop suitability and adapting to these changes through livelihood diversification will be an essential strategy for climate change adaptation.

[10] IIASA/FAO (2012) Global Agro-Ecological Zoning, GAEZ3.0. Laxenburg/Rome: IIASA/FAO.

PADDY

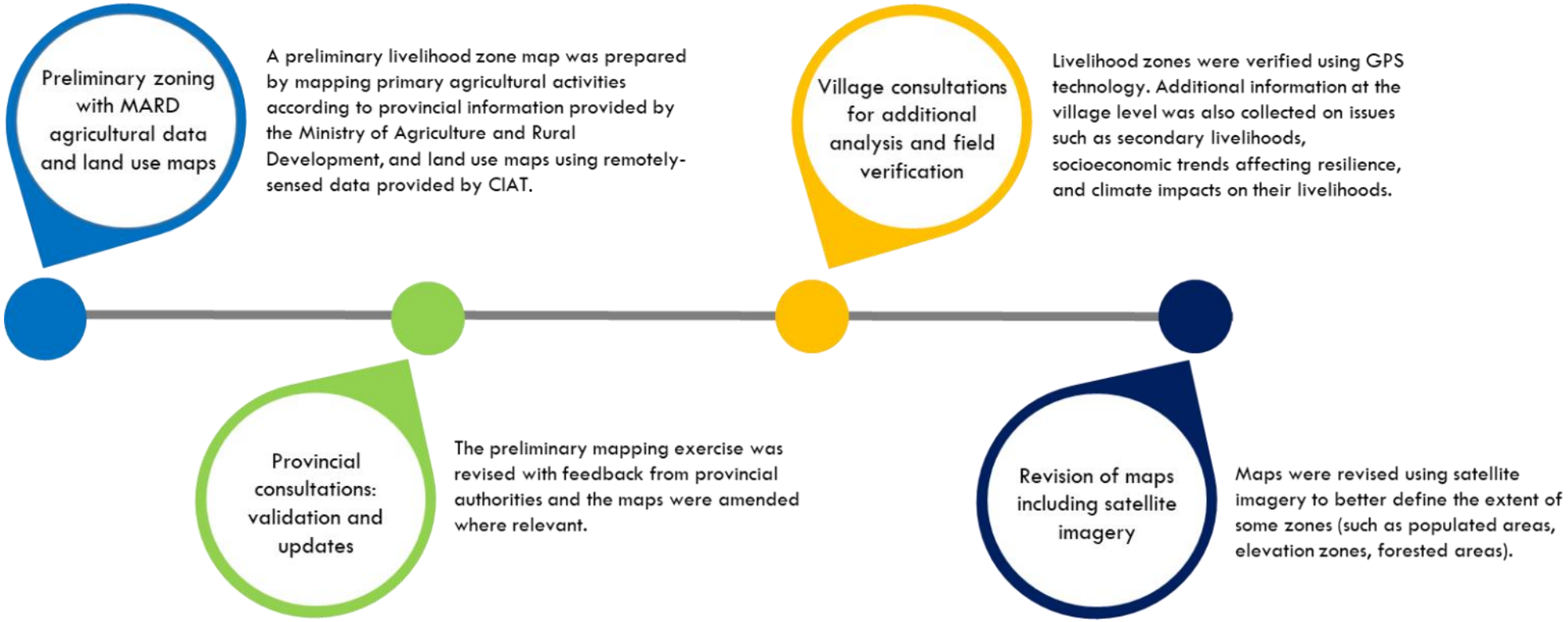
COFFEE

MAIZE

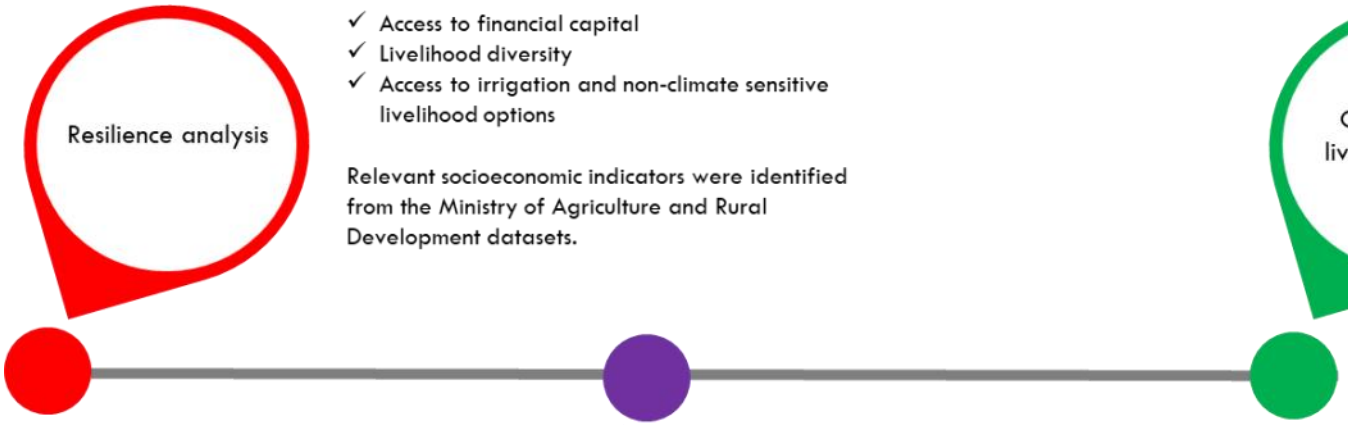
ROOT CROPS

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

ANNEX | METHOD: Livelihood mapping



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

Relevant socioeconomic indicators were identified from the Ministry of Agriculture and Rural Development datasets.

Resilience 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.

Climate change and historical rainfall models were processed from datasets made available by Viet Nam Institute of Meteorology, Hydrology and Climate Change (IMHEN, 2016). Climate change models are based on Representative Concentration Pathway (RCP) 4.5, an emissions stabilisation scenario.

Climate analysis

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.

Overlay with livelihood zones

* Software used for the mapping exercise: ArcGIS 10.2.2

ANNEX | METHOD: Areas sampled

PROVINCES SAMPLED*

* Sampling: A total of 30 provinces were sampled in face-to-face, focus group discussions carried out by five teams. Provinces were selected to represent areas with diverse geographies, topography, distance to the coast, distance to major cities and population densities.

ANNEX | METHOD: Resilience analysis

INCOME | Data from the 2011 Household Income and Expenditure Survey were used to map income patterns across livelihood groups. The analysis was corroborated by information from the 2013 ADB Least Developed Sucos project. Information from these two sources was aggregated at livelihood zone level to identify livelihood zones with the lowest and highest incomes. Rankings from 1 (lowest income) to 4 (highest income) were allocated based on quartiles of mean income levels.

LIVELIHOOD DIVERSITY | Livelihood diversity was quantified based on field observations and corroborated by agricultural production statistics from the 2010 population census. The livelihood diversity maps indicate the overall trend for the zone — within a zone, there may be communities that engage in less or more diverse livelihoods. Rankings from 1 (least diverse) to 4 were allocated based on the average number of household activities in each zone.

CLIMATE SENSITIVITY | Climate sensitivity was mapped according to crop sensitivity to climate variability (changes in rainfall and/or temperature conditions) according to the Global Agro-ecological Zones (GAEZ3.0) analysis prepared by IIASA and FAO. Ranking from 1 to 4 is as follows, from most sensitive to least: paddy, maize, cassava, sweet potato, other root crops, coffee, and fruits (see below).

Upland paddy	Lowland paddy Maize Cassava	Cash crops Root crops Coffee Fruits Livestock	Tourism Industrial activities Urban activities

CLIMATE RESILIENCE | Climate resilience is calculated by adding the ranking values of each climate resilience criterion, indicated above.

ANNEX | LIVELIHOOD PROFILES

LOWLAND PADDY

Paddy is the primary crop in Viet Nam, and lowland paddy is by far the most common livelihood activity in Viet Nam, with nearly half of the country's working population engaged in lowland paddy production. The main production areas are, in order of contribution to paddy output: the Mekong River Delta — where flood irrigation paddy is combined with poultry (ducks), aquaculture, orchards and livestock rearing, the Red River Delta, and the coastal areas — where communities often supplement their livelihoods with fishing and aquaculture.

The availability of water from the Mekong and Red Rivers allows for double and even triple cropping in the respective deltas, while coastal lowland communities tend to grow only one crop per agricultural season.

UPLAND PADDY

Upland paddy is the second most common livelihood activity and is primarily practiced in the mountainous areas of the northern regions as well as in some parts of the Central Highlands. In these areas, the terrain is more difficult; as a result, agricultural output is lower than in lowland areas. Production of upland paddy is often combined with small-scale livestock rearing (cattle and poultry). In the northern regions, an increasing number of communities supplement their livelihoods with activities as diverse as beekeeping, maize production, handicrafts and cash crops.

CASH CROPS

Cash crops are another major source of income for Vietnamese households. Dominant cash crops include cashew, coffee, tea, rubber, sugarcane, root crops, spices, and to a lesser extent, maize. The major cash crop zones are located in the Central Highlands, where a cooler climate allows for the production of coffee, tea and rubber. Smaller cash crop zones are also located in the northern mountainous regions and in the Mekong River Delta, although in these regions production of cash crops is often secondary to paddy production.

ORCHARDS

Orchards are found in various parts of Viet Nam, from the northern mountainous regions to the Central Highlands and the Mekong River Delta. Major fruit production areas are highlighted in the map on the left. Communities who engage in fruit production typically grow banana, pineapple and citrus, often in combination with subsistence crops. Fruit production has increased steadily over the last decade and is likely to be an important livelihood in the coming years, especially given the high economic value of some fruits and the potential for harvesting at various times of the year.

FISHERIES AND AQUACULTURE

With more than 3,000 km of coastline, Viet Nam has great potential for fishing, and the fisheries sector has been a priority for the Vietnamese government. Communities along the north-central coast are highly dependent on fisheries (or aquaculture near lagoons) while also engaging in lowland paddy production.

In inland regions, aquaculture is common, particularly in the northern mountainous regions and in the Mekong River Delta. Aquaculture has focused on both small-scale rice-fish and livestock-fish production systems as well as larger-scale intensive culture and marine cage culture in the lagoons of central Viet Nam.

LIVESTOCK REARING

Though livestock rearing is practiced throughout the country, major livestock areas are found in the south-central regions of Viet Nam. Pig, cattle and poultry are the main animals grown in the country. An increasing demand for animal products and meat has led to an increase in livestock production, with production of meat and eggs growing at a rate of 6 percent per annum since 1990, and production of milk growing at a rate of 3 percent per annum.

FORESTRY

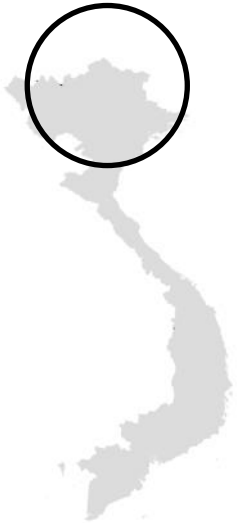
In protected areas, communities often engage in small-scale forestry activities, such as collection of timber and non-timber forest products. Because of restrictions on timber extraction and land use, communities also supplement their livelihoods with small-scale paddy production or aquaculture. Forest products provide the main source of income, while paddy and aquaculture provide the main source of food.

TOURISM

Tourism is an increasingly important revenue source for communities, with households in major urban areas, Halong Bay, Sapa, Da Nang and surrounding areas, and Phu Quoc deriving almost all of their income from tourism-related activities. The increasing interest in rural tourism has also led to communities in different regions of Viet Nam to benefit from international tourism.

MINING

In recent years, the increase in mining concessions, particularly in northern Viet Nam, has provided communities with alternative sources of income. While communities benefit from a stable income source, particularly in the dry season, there are increasing concerns about potential environmental impacts on land productivity for surrounding communities.



BORDER ECONOMIC ZONES

Various special border economic zones are located along the border with People's Republic of China. In these areas, communities engage in trade of basic goods and profit from constant influx of customers. Institutional agreements between Viet Nam and PR China are likely to promote continued cross-border trade with the intention of promoting the economic development of border towns.

URBAN AND INDUSTRIAL AREAS

The main urban areas of Hanoi and Ho Chi Minh City as well as industrial areas found throughout the country are characterized by diverse livelihood activities and a high influx of money. These are among the livelihood groups that are most resilient to climate risks.

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