EFFECTS OF LEGUME-BASED INTERCROPPING ON SOIL FERTILITY AND CASSAVA AND MAIZE PRODUCTION IN NORTHERN VIETNAM

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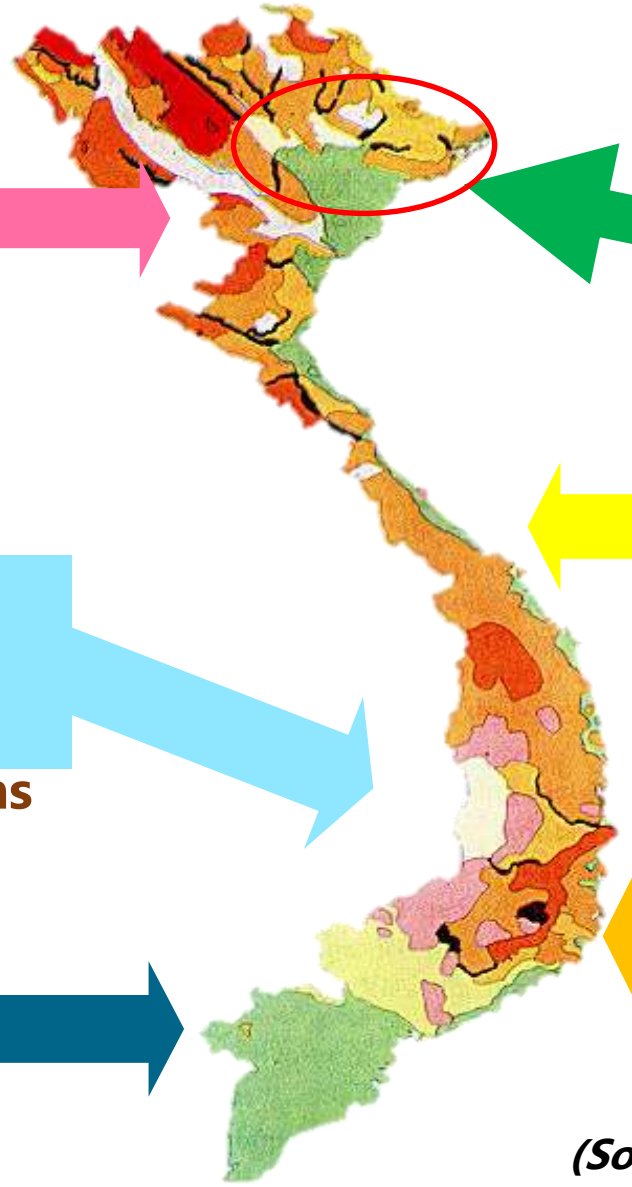
Red River Delta
Cassava: 6.7K ha; 105,100 tons
Maize: 91.3K ha; 438,100 tons

North Mountainous
Cassava: 117K ha; 1,485,500 tons
Maize: 519.3K ha; 1,909,700 tons



North Central Coastal
Cassava: 174.9K ha; 3,027,500 tons
Maize: 210.4K ha; 925,200 tons

Central Highlands
Cassava: 149.5K ha; 2,542,000 tons
Maize: 240.9K ha; 1,293,900 tons

Southeastern
Cassava: 96K ha; 2,485,100 tons
Maize: 79.3K ha; 488,900 tons

Mekong Delta
Cassava: 6.5K ha; 99,300 tons
Maize: 38.1K ha; 225,200 tons

(Source: General Statistics Office of Vietnam, 2016)

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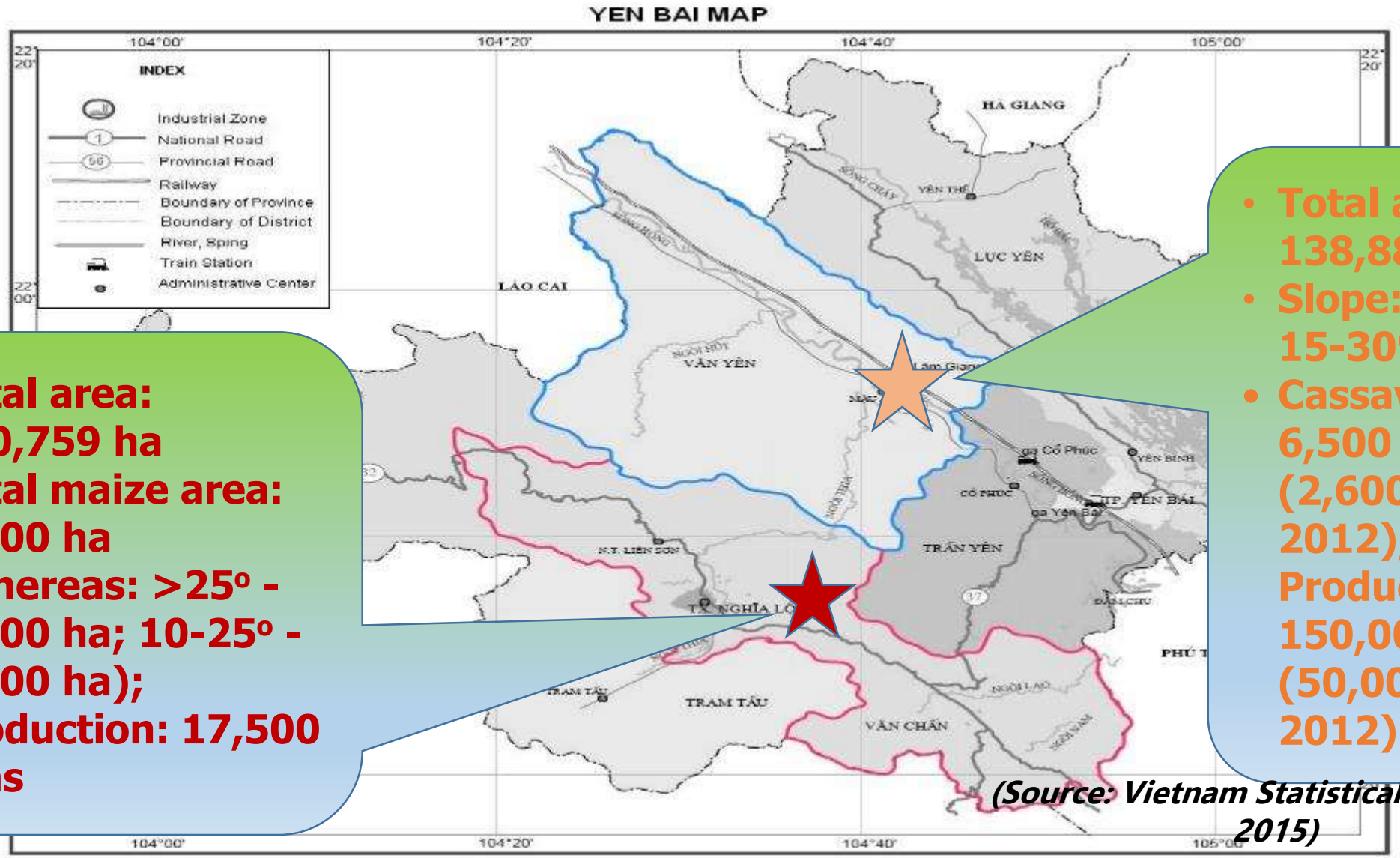

- **Total area: 120,759 ha**
- **Total maize area: 6,000 ha (whereas: >25° - 2,200 ha; 10-25° - 1,200 ha); Production: 17,500 tons**

- **Total area: 138,884 ha**
- **Slope: mostly 15-30%**
- **Cassava area: 6,500 ha (2,600 ha in 2012); Production: 150,000 tons (50,000 ha in 2012)**

(Source: Vietnam Statistical Year Book 2015)

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Mono-cropping systems

Growing mostly on slope areas

Low awareness on sustainable agriculture of Ethnic people

Insufficient organic matter

Soil erosion

Imbalance of mineral nutrient input to the soil

Core Problems

Low yield and production & poor soil fertility

Sustainable management (Intercropping systems)

Enhancing biological dinitrogen fixation in legumes

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OVERALL OBJECTIVE

To evaluate legume-based intercropping systems effects on cassava yields (Van Yen district) and maize yields (Van Chan district) and total economic benefits as well as on the soil quality.

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Specific Objectives

Assess the current nitrogen fixation and root mycorrhizal infection rate in legume species intercropped with maize or cassava in both locations

Optimize field-level nitrogen fixation by inoculation of the legume species with effective rhizobia strains (incl. good performance-inoculants)

Identify and field-test other legume species to use in intercropping systems

Measure the impact of legume-based intercropping on crop yields and land productivity ratios

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Study Areas

- The study will be conducted over 2 years (2017–2018) in two locations, Van Yen and Van Chan districts, Yen Bai province, Vietnam.
- There's a cassava intercropping system with cowpea in Van Yen and maize intercropping systems with 4 legumes (cowpea, mung bean, soy bean and peanut) in Van Chan.
- The experiments will based on on-farm research design with each farmer's field as one plot.

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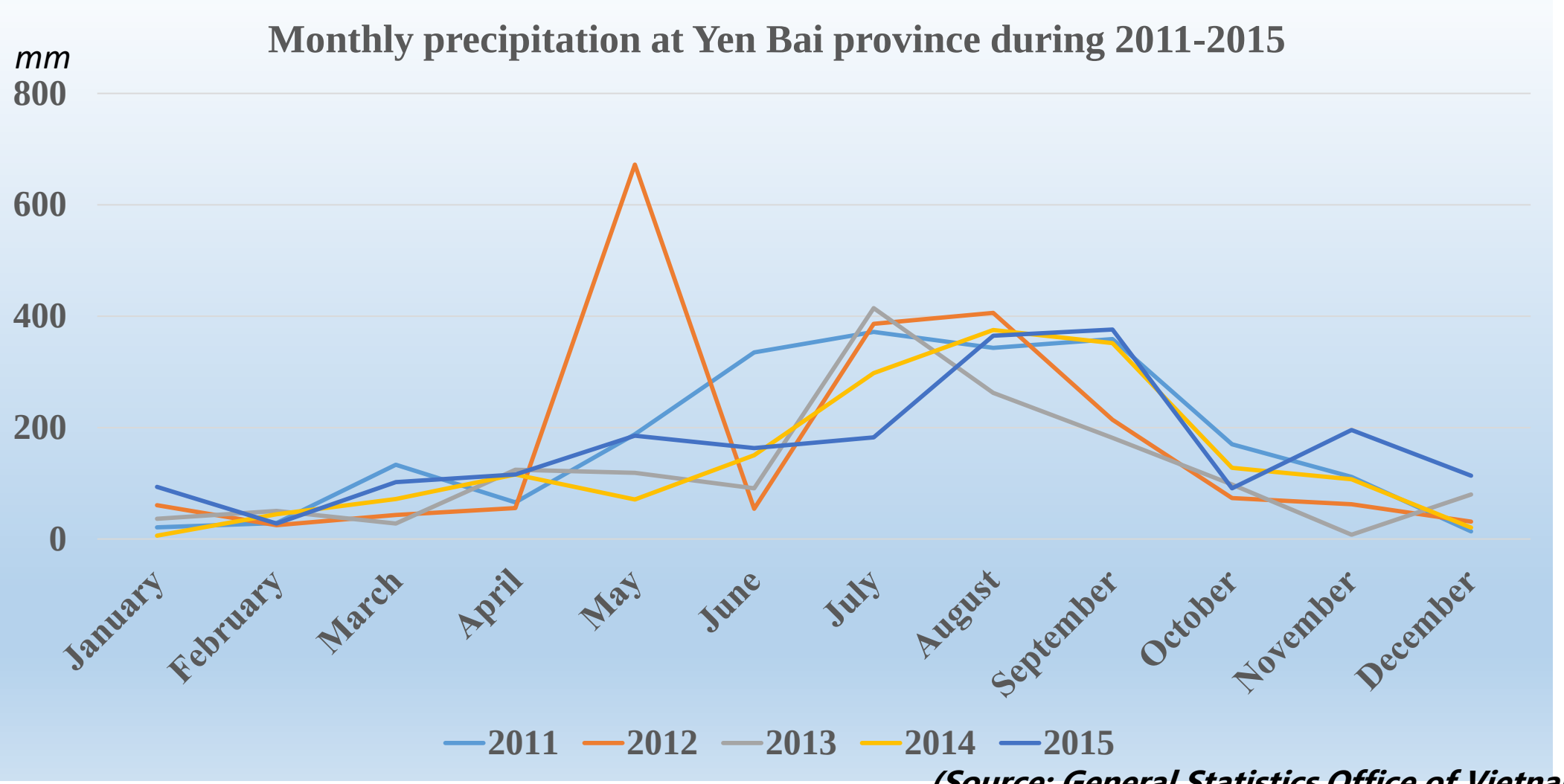
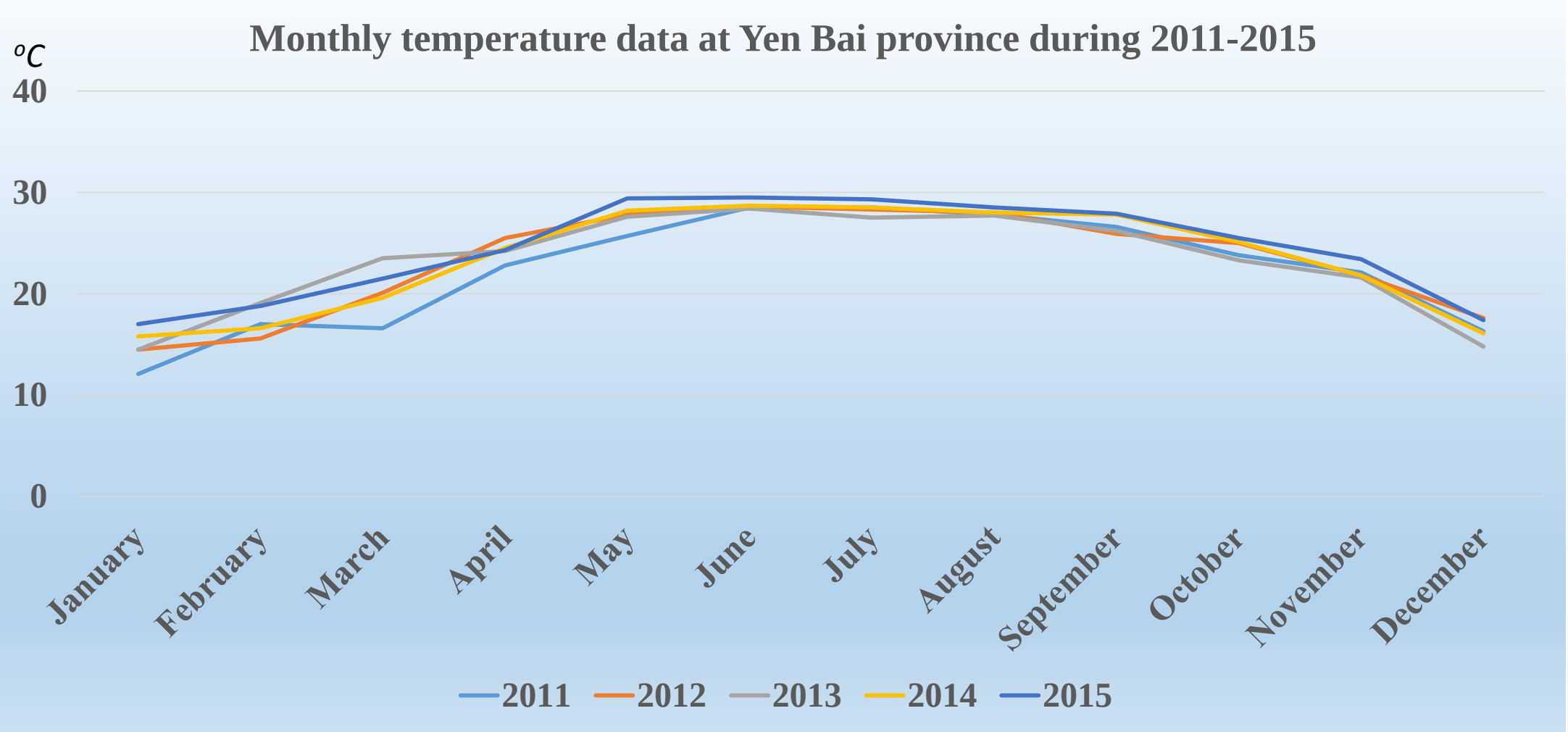


(Source: General Statistics Office of Vietnam, 2016)



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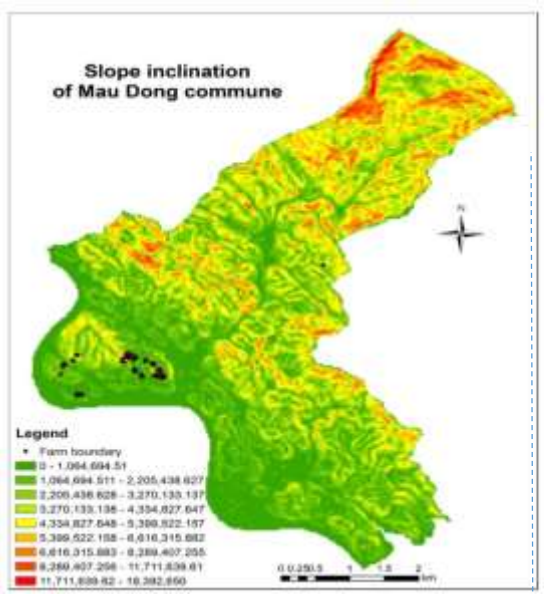

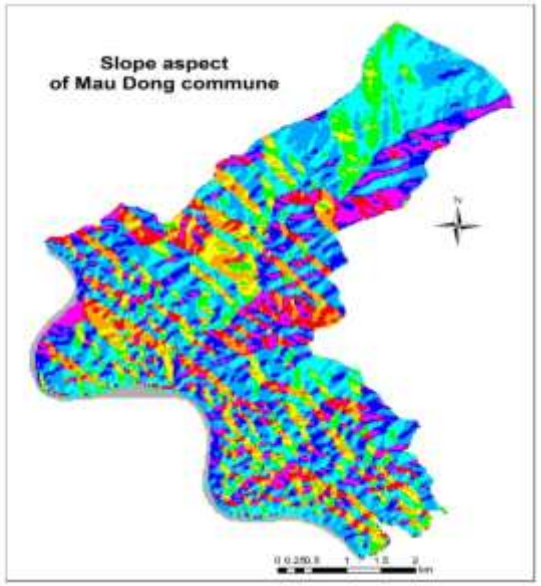

Gentle slope (< 5°)

Moderate slope (5-15°)

Steep slope (> 15°)

- **There are 13 selected plots in 5 areas for cassava intercropping system at Mau Dong commune, Van Yen district. The total area is 3.7 hectares.**
- **There are 2 fields each including 4 legume-based intercropping systems (maize + cowpea; maize + mung bean; maize + soy bean; maize + peanut) in Van Chan district. The total area is 0,5 ha.**

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Cassava/Maize	Legumes	Soil
1. Germination percentage (%)	1. Germination percentage (%)	Soil samples will be collected at the 0-20 cm depth (with flow directions along the slopes) and be analyzed: bulk density, texture, pH, N total, P available, K^+, OC, Na^+, Mg^{2+}, Ca^{2+}.
2. Plant height (cm)	2. Land covering percentage (%)	
3. Root yield (ton ha^{-1})	3. Grain yield (ton ha^{-1})	
4. Total biomass (g)	4. Total biomass (g)	
5. Root samples will be collected to assess the rate of mycorrhizal root infection (trypan blue method).	5. Root samples will be collected to assess the natural nodulation by native rhizobia and the rate of mycorrhizal root infection (trypan blue method).	
6. Harvest index	6. Amount of atmospheric N fixed symbiotically by the legumes in symbiosis with native rhizobia (^{15}N natural abundance method)	

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- **Providing date on the evaluation of CA based cropping systems effects on maize yields (Van Chan district) and cassava yields (Van Yen district) and total economic benefits as well as on the soil quality with respect to legume intercropped.**
- **Giving information useful for farmers willing to sustain both crop and legume yields through a better protection of soil.**

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Collected data

- **Soil: 87 soil samples from 2 locations were collected to analyze soil quality parameters as mentioned in Methodology part.**
- **The total of about 500 plant samples were collected, including:**
  - **Maize/Cassava roots and legume roots were collected to assess the mycorrhizal infection and nodulation.**
  - **Crop and legume leaves were also collected, then will be analyzed in order to measure the biological nitrogen fixation using ^{15}N natural abundance method.**

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2017	2018
April: Collecting soil samples	**January-March: Identification of the farms where the fieldwork will be done.**
June-July: Field assessment of the nodulation of legumes. Collecting the root systems of legumes and aerial biomass.	**April—May: Collecting soil samples. Execution of another batch of microcosm studies, with a select subset of legume species.**
July-August: Collecting the record of the legume yields in each field.	**June-July: Field assessment of the nodulation of legumes. Collecting the root systems of legumes + aerial biomass.**
August-December: Preparation of the samples of above biomass for 15N measurements; root staining for assessing root mycorrhizal infection rate.	**July-August: Collecting the record of the legume yields in each field.**
November-December: Collecting the record of the crop yields in each field.	**August-December: Preparation of the samples of above biomass for ^{15}N measurements; root staining for assessing root mycorrhizal infection rate.**
December: Meetings with the main farmer associations + local authorities to discuss about the results and about the relevance to scale up more the intercropping system legume + crops.	**December: Complete statistical analysis of the data obtained in 2017 and 2018 to assess the impact of the intercropping system on the crop yields.**