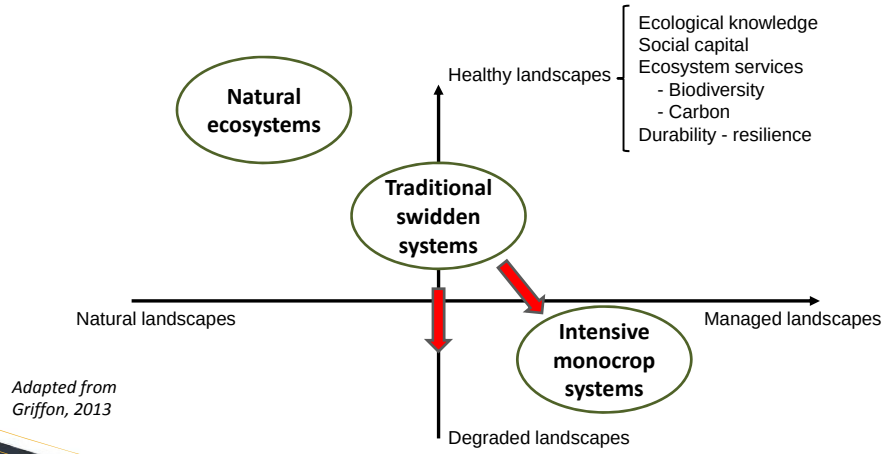
Sustaining rainfed cereal production in northern Laos using legume crops

EFICAS workshop, Monday, March 27th 2017, Luang Prabang

Outline

- **Agrarian transitions** and possible **pathways** towards eco-friendly production systems
- The case of **Pigeon pea** in Luang Prabang Province
- The case of **rice bean** in Kham basin, Xieng Khouang province

Agrarian transitions and possible **pathways** towards eco-friendly production systems



Adapted from Griffon, 2013

Conceptual framework

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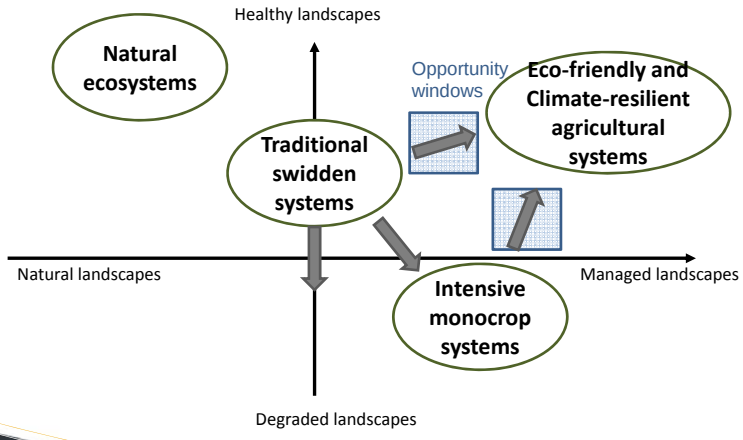
Griffon M. (2013) Qu'est ce que l'agriculture écologiquement intensive ? - Édition Quae, Paris

Agrarian transitions and possible **pathways** towards eco-friendly production systems



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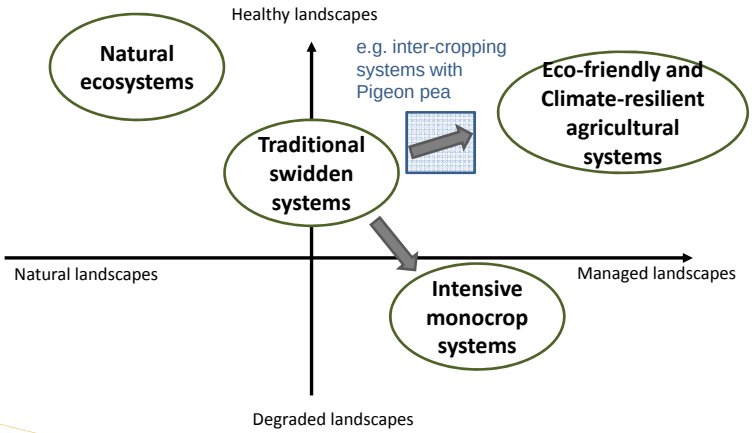
The case of **Pigeon pea** in Luang Prabang Province



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Pigeon pea (*Cajanus cajan*)

- An erect short-lived perennial (2-5 years) **legume crop**
- Can be used for human and animal **consumption** (24% protein content in grains), silkworm or **stick lac** production; can also be used as **shade crop**, cover crop or windbreak
- Can contribute to **improve the soils** through its root system, **nitrogen fixation** by *Rhizobium* and the **biomass** produced
- **Many data from India and Africa; still limited data/studies in Laos** (Roder *et al.*, Lao-IRRI, 2001)






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Main issues/questions related to the intercropping of pigeon pea (Pp) with rainfed cereals (e.g. rice, maize)

- Impact on cereal production (*main farmers' fear*)?
  - Competition between the cereal and Pp for nutrients, water, light etc.?
  - Pp increases damage risk by birds and rodents?
- Labor requirements for Pp establishment and management?
- Impact on soil fertility?
- Beyond soil fertility management, what benefits from Pp cultivation?

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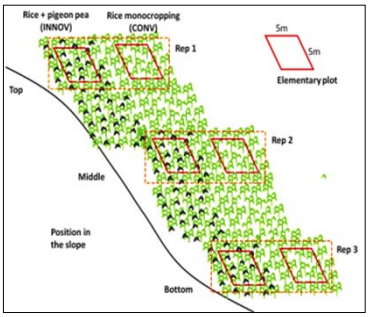
On-farm experiments conducted to assess the benefits from rice+Pp intercropping systems

- Experiments conducted in 6 farmers' fields and 2 villages (Houayvat and Pouthong)
- Paired-plot experimental design (comparison of conventional rice monocrop. vs rice+Pp); 3 replicates /plot (n=36)
- Pp sown at low density (2m x 1,5m; ~3,000 seeding holes/ha) 20 to 30 days after sowing (DAS) of rice
- Assessment of:
  - Pp impact on rice productivity (land and labor)
  - Pp pea growth and N-fixation activity



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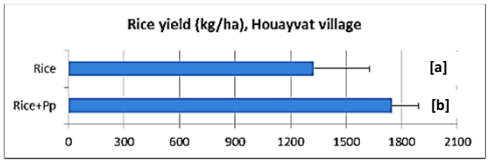
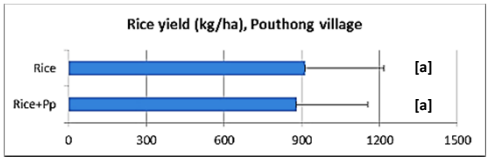
Main results

- Impact on rice productivity





Letters between brackets indicate significant differences according to Kruskal-Wallis test (P<0.05), Bonferroni correction.

- Significantly **higher rice yields (+24% increase) under Rice+Pp system** as compared to rice monocropping in Houayvat village; no statistically different in Pouthong village
- **Labor force poorly affected** by intercropping with only **1 man.day/ha** increase observed under intercropped system as compared to monocropsystem.

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Main results

- Pigeon pea growth

From limited growth…

~100 kg/ha of Pp dry biomass at 100 DAS (~3-4 months) (n=180 plants)

… to a fast growing improved fallow!

***~25 T/ha** of Pp dry biomass at 640 DAS (~21 months) (n=3 plants, on-going)*

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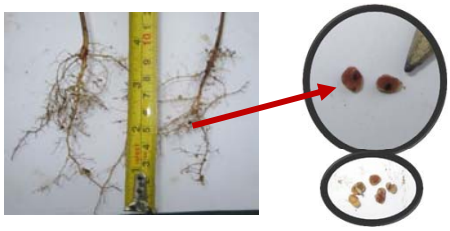
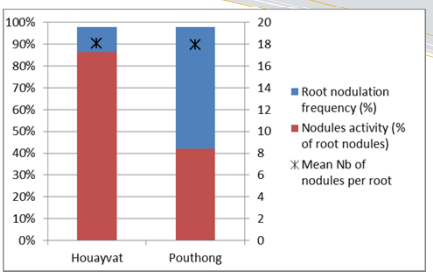
Main results

- Pigeon pea N-fixation activity





- Root nodulation occurs **spontaneously** in both sites with **98% of Pp forming root nodules** 100 DAS
- **Low number of nodules** per root at 100 DAS (mean value of 18.1 nodules/ pivot root)
- N-fixing activity assessed using nodule inside-color scoring method (reddish-pink color indicates an active, healthy nodule)
- Higher N-fixing activity observed in Houayvat (86%) as compared to Pouthong (42%)
- Possible factors? Differences in soil qualities (e.g. fertility, soil microbial communities), environmental factors (e.g. difference in rainfall/ temperature patterns); additional monitoring needed to better document the evolution of Pp root nodulation, nodules N-fixing conditions and N-fixing activity evolution over time.

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Issues/constraints related to the adoption and dissemination of pigeon pea-based intercropping systems

- Animal free roaming
  - Pp plants damaged by free roaming animals after rice/maize harvest
  - 108 ha sown in 2015 (8 villages), only 71 ha (65%) remaining in 2016

> Increased negotiations and supports to prevent animals roaming in Pp areas (e.g. identification of priority areas for Pp cultivation to limit scatter plots, livestock and Pp areas fencing, support for improved pasture establishment)

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Issues/constraints related to the adoption and dissemination of pigeon pea-based intercropping systems

- Benefits beyond soil fertility improvement?
  - Sensitization and food contest for an increased use of Pp pods and grain in **daily consumption**
  - Support for **stick lac production** and sale *(e.g. provision of inoculant, training on inoculation and inoculant maintenance, facilitation with traders for lac sale, guaranteed prices)*
- Rodents
  - Important pressure at sowing when the sowing of Pp is delayed as compared to rice or maize sowing

    > Test of simultaneous sowing in 2017

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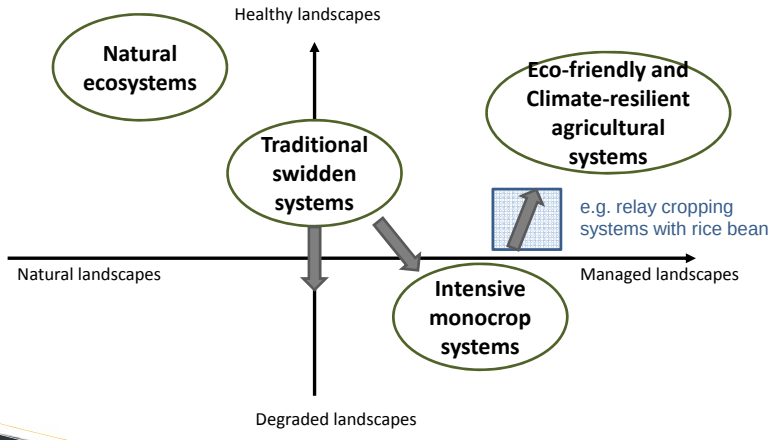
The case of **rice bean** in Kham basin, Xieng Khouang province



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Context: The 'maize boom' in Xieng Khouang Province

- ~12 years of continuous plow-based maize mono-cropping

Context: land degradation issues

- Soil erosion

- Increased weed pressure

- Increased pesticide use

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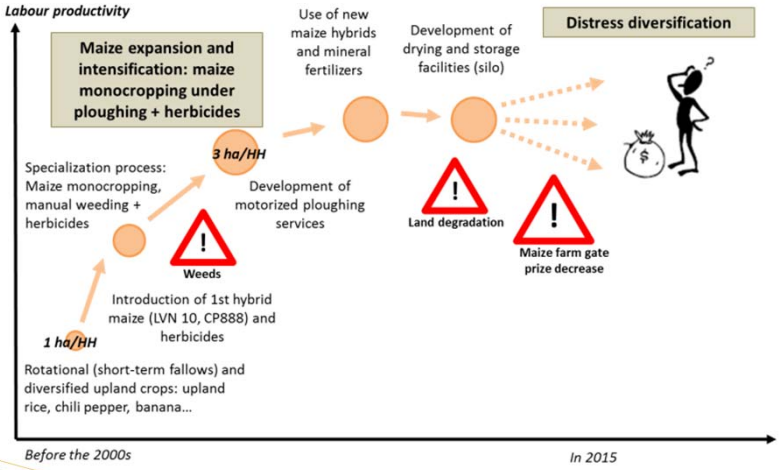
Context: Decrease in maize productivity and profitability



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Rice bean (*vigna umbellata*)

- An annual vining **legume crop**
- A **photosensitive short-day plant** that will be harvested in January - February under northern Laos climate conditions regardless of its sowing date.
- Can be used for human and animal **consumption**
- Can contribute to **improve the soils** through its **nitrogen fixation** and the **biomass** produced
- Can contribute to **weed management** (long cycle creeping crop)
- Best associated with maize **at maize male flowering stage** to avoid competition with maize
- **Existing data** from previous initiatives (PRONAE, Agrisud)

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Main issues/questions related to the relay cropping of rice bean after maize

- Impact on maize production?
  - Competition between maize and rice bean
  - Rice bean increases damage risk by rodents on maize?
- Labor requirements for rice bean cultivation?
- Beyond soil fertility management, what benefits from rice bean cultivation?

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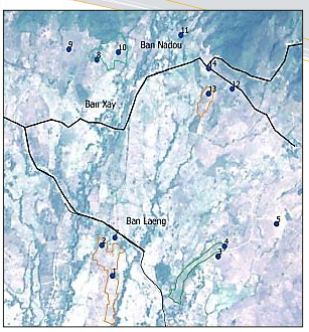
On-farm experiments conducted to assess the benefits from maize/ rice bean relay cropping systems

- Rice bean was sown in line (1-single row in the middle of maize inter-row, holes every 0.3m, 3-5 grains/hole, 15-20 kg/ha) at maize male flowering stage.
- Assessment of maize vs maize + rice bean productivity and profitability
- Experiments conducted in 4 farmers' fields, 2 villages (Leng and Xai-Nadou) with a paired-plot experimental design



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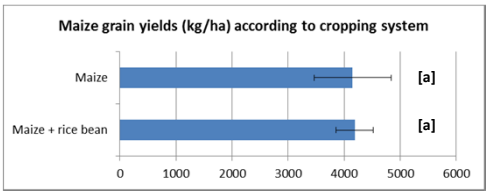
Main results

- Rice bean impact on maize productivity



Letters between brackets indicate significant differences according to Kruskal-Wallis test (P<0.05), Bonferroni correction.

- **No detrimental impact** of rice bean on maize yields
- **Labor force** needed for rice bean sowing is of **12 (10-16) men.day/ha**

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Issues/constraints related to the adoption and dissemination of rice bean-based relay cropping systems

- Animal free roaming (*from past experience: PRONAE, Agrisud*)
  - Rice bean eaten by roaming animals after maize harvest
  - ➢ Need for landscape approach, combination of identification and protection of rice-bean/ legume crops production areas, and definition/ negotiation of animal roaming regulations at village and village cluster levels
- Rodents
  - Rice bean eaten by rodents at maturing stage (only 2 of 21 plots harvested in 2017); traditional mice traps not sufficient to limit damages

> Need for diversified rodent control strategies including alternative trapping and repellent methods (e.g. cement, hormones) and scaling-up of cultivated areas to dilute rodent risk

senestech
Sound science. Effective solutions.

Rodent reproduction control

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Issues/constraints related to the adoption and dissemination of rice bean-based relay cropping systems

- Market
  - Potential market in Vietnam for human consumption but traders need minimum production volumes vs producers need sales guarantee
  - ➢ Need to foster communication and negotiation process between producers groups, traders, and local authorities
  - ➢ Possible tool: game boards that allow to simulate series of events (e.g. livestock damages on crops, commercial proposals by traders) to which players must respond through both individual and collective strategies
  - Potential market in Laos/ Xieng Khouang province for animal consumption (XP trading animal feed facilities)

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