Direct seeding in mulch cropping systems. Do they fit into farms of the mountainous area of Vietnam?

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Agricultural systems: 1) in the context of subsistence farming

- Upland rice with declining yields and increasing labour demand for weeding
- Low fertilizer use, low potential varieties
- Pressure on the slopes
- Forest clearing
- Forest clearing
- Erosion
- Paddy Rice < household needs
- Land allocation + Ban on Slash and Burn

Paddy fields

Slash-and-burn on degraded forest
- 3 to 5 years of rice
- then cassava
- then shorter and shorter fallow periods

Free grazing - degraded pastures

Houses
Gardens, orchards
Husbandry
Slope = source of revenue. Goals of farmers may be maximizing income on the short term, ignoring long term evolution of natural resources.

High fertilizer input, high potential cultivars, +pesticides, herbicides, mechanization

Intensive Paddy fields providing food + possibly income

Pressure on the slopes still existing, sustainability not ensured
Fragile Slopes under pressure
Cropping Systems with cover crops and / or mulch (DMC): a ticket to the doubly green revolution?
Main functions of the proposed innovative cropping systems for slopes (review from O. Erenstein (2003) + KASSA project)

- Protect soil against erosion. **Broadly proven**
- Improve nutrient cycling. Environment x management dependent
- Improve soil structure. Not many studies but all in agreement
- Produce forage. Depends on species used and management
- Reduce weed pressure. Contradictory results
- Reduce labour requirements of CS. Discussed
Known Limitations of DMCs

- Main crop / cover crop competition is critical
- Soil temperature is decreased due to mulch
- Insects and diseases favoured by mulch
- Free grazing animals during dry season
- Changes in the whole farm management
Objectives of our study

• Identify constraints to adoption of DMC
  – At farm level
  – Linked to technical and economical features
  – On a short term perspective

• What changes would favour adoption of DMC:
  – Adjustments of the technique
  – Economic Environment and subsidies
Case studies and experiments
Farm Household Model

Crops

Valley Floor
- rice/rice
- maize/rice

Slopes
- upland rice
- Maize/maize
- cassave
- Etc...

-CSMCs

Livestock
Pigs, cattle, etc

Off Farm labour opportunities

Data on Crop Production
- Yield
- inputs
- labour
- rotations
- market price

Data on Livestock Production

Farm
- Land
- Labour
- Rice needs for food
- cash balance
- objective: food needs to be matched, income to be maximized

- Set of production activities: area (crops), number (animals), off-farm activities

- Income

Optimizing algorithm
Model building

- Typology of farms (constraints to adoption may vary among farms).
- Sampling: 15 farms / Site
- Detailed surveys in sampled farms
  - Identifying and characterizing cropping systems practiced
  - Characterizing farming system
  - Labour force allocation schedule
  - Cash flow
- Modelling representative & contrasted farm types
- Ensure simulated decision matches current set of activities of real corresponding cases
- Simulations: Testing hypothesis in terms of technical management and economic environment
Introduction of DMCs in simulated farms

• Market oriented farms: no adoption of any of the DMC in any of the simulated farms
• Subsistence farms: adoption on small areas of the farms (10-20%):
  – Farm with labor and cash availability adopt maize + mulch
  – Farm constrained in land and with high labour availability adopt maize + mulch and also upland rice + mulch
• Two factors limit adoption by farms in both sites
  – Extra labour needed at peak period
  – Extra need of inputs (fertilizer, mucuna seeds, seed pesticides)
• Additional factor limiting adoption in market oriented farms of Cho Don: Labour productivity is not increased by DMC
Testing technical adjustments

• Assuming labour requirements reduced by half:
  – Mulch collected earlier in the year, when not busy with other farm activity?
  – Less mulch?

• Assuming low cost DMC (cover crop seeds at no cost, P and K fertilizer levels at farmer’s system level)

Combined reductions of labour and input requirements are needed to provoke a change in the results of simulations in favour of mulch techniques (CD + KL)
Conclusions

• Method:
  – better understand low adoption of DMC
  – helped identify what improvements have to be made to the technique
  – suggested that diversity of farms may result in variations in “adoptability” of the proposed innovations

• Need to refine the analysis:
  – Accounting for long term evolution of agronomic performances with/without DMC
  – Comparing DMC with other conservation systems
  – Accounting for variations of agronomic performances of DMC across environments

Modelling CS x environment interactions for upland rice and maize
Gathering straw residues (ex-situ produced mulch)

Creating mulch from previous crop's residues (in-situ produced mulch)

Maize + mulch
2 crops./year

Maize + mulch + Mucuna
2 crops./year

Upland rice + mulch

Maize + mulch
1 crop./year

Cropping systems introduced in the simulations
Results from farm modelling

• Farm resources in land, labour and cash vary greatly between farms
• Opportunity cost high in Chodon for any farm, lower in Dien Bien, in relation with
  – Off farm activities
  – Livestock production
• Choosing to buy rice with money from pigs fed with maize is a “stable” option for market oriented farms (model solution not changed when rainfed rice yields increased by 30%)
Testing changes in economic environment

Changes in the opportunity cost of labour:

- Wages $\rightarrow$ maize but no CSMC due to lack of cash (more pressure on slopes)
- Wages $\rightarrow$ maize replaces rice in lowland (CD); KL: maize with CSMC replaces upland rice (better labour productivity)

• Subsidies to promote the CSMC:
Discussions with farmers

Ranking of constraints to adoption of DMC

1. Cost of seeds / cuttings for cover crops
2. Labour for collecting mulch
3. Pests infestation in mulch systems
4. Cover crop becoming weeds
5. Herbicides costly and dangerous