Conservation agriculture to mitigate climatic variations in medium altitude areas according to farmers’ perception: the case of Madagascar (Lake Alaotra).

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[CIRAD/UMR Innovation]
Introduction

Conservation agriculture (CA) has been promoted to reduce labor requirements, to improve soil structure, water conservation, yields and eventually smallholder’s income through a sustainable rainfed agriculture.

Is CA an option for a more climate smart agriculture for farmers?

What are farmers’ perceptions on a long run CA adoption?
Outline

• Study area: Lake Alaotra, Madagascar
• Situation with a high rainfall variation (600/1600 mm/an)
• Events: erratic rainfall and typhoons
• Does CA techniques can mitigate climatic hazards?
• Mulching is the key point of CA for being climate smart
Rainfall trend analysis

- Annual and monthly rainfall pattern displays a high risk of erratic rainfall, in particular during the first 3 months.

- Mulching can significantly improve water balance and buffer hydric stress.

- What are farmer’s perception? What expected output is prioritary?
Conservation Agriculture (CA)

• To promote a sustainable rainfed agriculture (less erosion, soil fertility, better hydric pattern...)
• To mitigate some climatic events: erratic rainfall and erosion from heavy rains during typhoons
• The mulching of crop residue has a key role into the achievement of climate-smart agriculture (Bruelle et al., 2015).
• Implement a permanent mulch in a CA cropping system is a real challenge for smallholder:
  – To implement a real efficient mulch
  – To manage CA systems on a mid-term basis (5 years)
CA adoption level

In 2010, after a cohort analysis:

After the analysis on 3000 plots monitored by the Bv-lac projects (plots with technical advices/extension):

- 420 hectares under CA stricto sensu (for 600 farmers)

- In 2013/2014: new study after project shutdown: 40% of the oldest CA farmers have abandoned (post projet trauma).
# Main reasons of abandon of CA

<table>
<thead>
<tr>
<th>Social reasons</th>
<th>Economic reasons</th>
<th>Technical reasons</th>
<th>Environmental reasons</th>
<th>Other reasons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technician’s absence</td>
<td>Superposition of labor requirement</td>
<td>Increase of required labor</td>
<td>Drought</td>
<td>Simply the benefits of CA</td>
</tr>
<tr>
<td>Uncontrolled free zebu grazing</td>
<td>Increase of expenses</td>
<td>Lack of experience</td>
<td>Insects</td>
<td>Retirement</td>
</tr>
<tr>
<td>Bushfire (linked also with drought)</td>
<td>Crops incompatible with CA</td>
<td>Difficulties to get seeds for associated plants</td>
<td>Soil compaction</td>
<td>Health (refusal of phytosanitary products considered indispensable with CA)</td>
</tr>
<tr>
<td>Conflict with the project</td>
<td>Absence of assistance and bank credits after project shutdown</td>
<td>Difficulties to get phytosanitary products</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Difficulties to find labor force</td>
<td>Disappointing economic performances</td>
<td>Difficulties to control the cover</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Absence of assistance and bank credits with the project ending</td>
<td>Other reasons</td>
<td>Excess of weed</td>
<td></td>
<td></td>
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</tbody>
</table>

*In italic, points linked with climatic events*
CA cropping system evolution on *tanety*

*Abandon*
## CA Crop rotation

<table>
<thead>
<tr>
<th>Cropping systems</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>Maize + Voluble legume//Upland rice</td>
</tr>
<tr>
<td>T3</td>
<td>Introduction of groundnut in the basic rotation de T1</td>
</tr>
<tr>
<td>T4</td>
<td>Introduction of upland rice in the continuous system “Maize + Voluble legume”</td>
</tr>
<tr>
<td>T5</td>
<td>Maize based continuous system</td>
</tr>
<tr>
<td>T6</td>
<td>Introduction of “cassava + stylosanthes” in the basic rotation de T1</td>
</tr>
<tr>
<td>T7</td>
<td>Unsettled crop rotation</td>
</tr>
<tr>
<td>T8</td>
<td>Maize + Voluble legume//Maize + Voluble legume//Upland rice</td>
</tr>
<tr>
<td>T9</td>
<td>Cassava based continuous system</td>
</tr>
<tr>
<td>T9-b</td>
<td>Bean based continuous system</td>
</tr>
<tr>
<td>T10</td>
<td>Rice + stylosanthes/maize + stylosanthes</td>
</tr>
<tr>
<td>T11</td>
<td>Bean + stylosanthes //Cassava + stylosanthes</td>
</tr>
</tbody>
</table>

### Diagrams

- **Figure 7**: Cropping system in % of surface on *tanet* in the Northern zone
- **Figure 8**: Cropping system in % of surface on *tanet* in the Southern zone

**Legend**

- Maize/Dolic //rice //groundnut
- Maize or Cassava Based systems
Innovation adoption scheme

- **3-4 years**
  - Adoption of the techniques: literally application of the advice

- **2-3 years**
  - Experiments
  - Personal choices

- **2 years**
  - Sustainable choice of a cropping system

**CA stricto sensu**

**Absence of technicien**

**Systems’ diversity**
## SWOT analysis

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Weaknesses</th>
<th>Opportunities</th>
<th>Threatens</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yields’ increase or production stabilization</td>
<td>Increase of expenses (inputs, cover transportation, labour)</td>
<td>Partnership dissemination project (e.g. the ABACO project)</td>
<td>Farmers individualism</td>
</tr>
<tr>
<td>Improvement of soil structure, fertility and soil moisture</td>
<td>Pests increase</td>
<td>Spontaneous spread between CA and non CA farmers</td>
<td>Lack of organisation between the producers and supply problems in seeds, inputs</td>
</tr>
<tr>
<td>Reduction of labor requirements related to weeding and no-tillage</td>
<td>Increase of labor for planting associated crops and cover transport</td>
<td></td>
<td>Non-transmission of CA during intergenerational handover</td>
</tr>
</tbody>
</table>

**Economic related expected output! Yield, Labor, Expenses**
Farmers’ behavior typology

<table>
<thead>
<tr>
<th>1st criteria</th>
<th>2nd criteria</th>
<th>Type de comportement</th>
<th>Effectif</th>
</tr>
</thead>
<tbody>
<tr>
<td>CA Mastery/know-how</td>
<td>no consequence with the project end</td>
<td>Self-sufficient/Autonomous</td>
<td>29 (40%)</td>
</tr>
<tr>
<td>CA Mastery/know-how</td>
<td>Regrets of technical exchanges and counselling without direct impact on CA surfaces</td>
<td>Enquirer</td>
<td>22 (30%)</td>
</tr>
<tr>
<td>CA Non-mastery/know-how</td>
<td>Regrets of supervision with direct impact on CA surfaces</td>
<td>Not autonomous</td>
<td>16 (22%)</td>
</tr>
<tr>
<td>CA Non-mastery/know-how</td>
<td>Need a permanent advice</td>
<td>Never autonomous</td>
<td>6 (8%)</td>
</tr>
</tbody>
</table>

70 % of farmers having adopted CA in the long run (7-10 years) are autonomous
Expected outputs from CA adoption

**Expected benefits**

- Soil humidity
- Cultural calendar
- Securing sowing
- Drought

**Climate related criterias**

**Second after economic criteria**
Conclusion

• A continuum between conventional and CA systems
• 5 to 7 years to adopt CA and 10 years to adapt it to local constraints (CA and/or ICS)
• Take time to effectively see both economic output and risk reduction (7 to 10 years)
• Economic output is the priority (introduction of groundnut but no mulch, replacement of associatec crops ...)
• Advantages of mulching = securing sowing and yield, better soil moisture, less weeding come second priority
• Mulching to limit erosion and mitigate climatic effect in early stage of the crop is highly recognized
• A good and effective mulch is not so easy to implement
  • More scope for ICS, more flexible
CA to mitigate climatic effects

- Mulching is the key point but economic priority lead to a replacement of covercops to crop with an economic output (but far less mulch)
- CA can potentially mitigate climatic effects but farmers perception put priority on rapide economic output.
- « Being climate smart » is behind « economically friendly » (and regular yield)
- CA requires time to convince farmers in the long run
Thanks for your attention