Tree on farm economic

How and how much agroforestry benefit to smallholder coffee farmers in the Aberdare (Kenya)?

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Materiel and method

• Study area
  => Kenya - Murang’a district

• Tree inventory and data collection
  => (Farmer’s interview) : 62 coffee farms randomly chosen

• Determination of agroforestry product’s price
  => survey market in the area : 7 markets

• Coffee prices and production per farms
  => factories

• Cost benefit analysis
Materiel and method: Study area
Economical context

- Exportation
- Value-added captured by industries
- Crisis (2000) and post crisis

→ Economic situation of smallholder coffee farmer weak

Diversification as an option to increase economical input

Agroforestry

= > is it profitable?

✓ Low economical risk
✓ Low input
✓ Level of vegetation

Karanja & Nyoro, 2002
Surface of the coffee plot, coffee yield and production are low for most of the farms.

Moreover, 50% of the farmers don’t use chemicals fertilisers and 80% no pesticides.

Coffee plantation: neglected state.
Agroforestry profitability

**Agroforestry Products**
- Firewood
- Timber
- Fruits
- Charcoal
- Fodder

**Profitability?**
- Home consumption (SAVING)
- Sell local market (EARNING)
Benefit cost analysis:
Calculation method for one farm of the profitability (Saving+earning) for one year

Quantities
- Farmer’s interview: determination of the agroforestry products (quantities)
  - For each species
  - For each products (Firewood, Timber, Fruits, Charcoal, Fodder)

Destination
- Farmer’s interview: destination of the production
  - Home consumption
  - Sell

Input?
- Farmer’s interview: determination of the cost of the production (per species) (INPUT)
  - Most of the time = 0 KsH

Price
- Survey market: determination of the price of the products
  - Saving (Home consumption): Market Selling price
  - Earning (Sell): Market Buying price

Benefit cost analysis
- Saving: Sum (per species and product)[(Sell price*quantity)-input]
- Earning: Sum(per species and product)[(Buy price*quantity)-input]
- Agroforestry Profitability = Saving + Earning
**Agroforestry profitability**

Mean profitability per farm of the agroforestry products

- **Total Saving** (900 809 KSH) > **Total Earning** (459 823 KSH)
- Agroforestry is mainly used to produce Firewood, Fruits and Timber
- Firewood saving > Firewood Earnings (p_value < 0.5)
Comparison between agroforestry and coffee profitability

- **Agroforestry profitability**: Benefit-cost analysis with MIN and MAX prices found on the market
- **Coffee NM (NET MARGIN)** = Production(Kg) * Price (KSH/Kg) – Q input (Kg) * P input (KsH/Kg) – number of working day * price of a working day

- Coffee profit are very low
- Profit from agroforestry are, for most of the farm, higher than coffee profit
Agroforestry:

- System profitable for most of the farm:
  => Do farmers use different strategies?

- Previous analysis of the tree diversity in the farm:
  - 2 groups of farms in regard of their tree population
    → Cluster

- Characterisation of the strategies used by farmers in term of agroforestry products and species
Cluster analysis

Study based on the 18 main species and tree with DBH > 2cm (which are represented 96% of the landscape)
The 2 axis represent nearly 40% of the total diversity

2 groups of trees, maybe representing different farmers’ strategies?
Distribution of agroforestry profitability per cluster

No significant difference (KRUSKALL WALLIS test) between the 2 clusters

CL2: Smaller farms with more trees

<table>
<thead>
<tr>
<th></th>
<th>CL1</th>
<th>CL2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of farm</td>
<td>21</td>
<td>40</td>
</tr>
<tr>
<td>Mean size (Ha)</td>
<td>1.01</td>
<td>0.433</td>
</tr>
<tr>
<td>Mean density (Tree/Ha)</td>
<td>121</td>
<td>306</td>
</tr>
</tbody>
</table>
Profitability of agroforestry products per cluster
Agroforestry products strategy?

There is a significant difference (Kruskal Wallis test) between the 2 clusters ONLY for timber saving which are more important in the CL2.
Profitability of agroforestry products per cluster
Agroforestry firewood species strategy?

Firewood species: mean density of mature (DBH>10 cm) per farm

Mean density (Tree/Ha)

CL2 : Tree density more importante but no differences in term of species

- Grevillea robusta
- Acacia mearnsii
- Eucalyptus spp.
- Bridelia micrantha
- Croton megalocarpus
- Erythrina abyssinica
Profitability of agroforestry products per cluster
Agroforestry timber species strategy?

Timber species: mean density of mature (DBH>10 cm) per farm

CL2: Tree density more important but no differences in term of species

CL2 : Tree density more importante but no differences in term of species
Profitability of agroforestry products per cluster
Agroforestry fruits species strategy?

Fruits species: mean density of mature (DBH>10 cm)
per farm

Cluster

CL2: Macadamia and Avocado in a higher density

CL1

Mean density (Tree/Ha)

Macadamia tetraphylla
Persea americana
Mangifera indica
Carica papaya

CL2 : Macadamia and Avocado in a higher density
### Agroforestry strategy : Profitability per specie

<table>
<thead>
<tr>
<th>Abundance of mature tree</th>
<th>Species</th>
<th>Main use</th>
<th>Origin</th>
<th>Saving (KsH per tree)</th>
<th>Earning (KsH per tree)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1635</td>
<td><em>Grevillea robusta</em></td>
<td>Firewood</td>
<td>e</td>
<td>304</td>
<td>101</td>
</tr>
<tr>
<td>281</td>
<td><em>Macadamia tetraphylla</em></td>
<td>Fruits (Nuts)</td>
<td>e</td>
<td>6</td>
<td>721</td>
</tr>
<tr>
<td>277</td>
<td><em>Commiphora zimmermannii</em></td>
<td>Fodder</td>
<td>i</td>
<td>8</td>
<td>0</td>
</tr>
<tr>
<td>163</td>
<td><em>Persea americana</em></td>
<td>Fruits</td>
<td>e</td>
<td>239</td>
<td>246</td>
</tr>
<tr>
<td>107</td>
<td><em>Mangifera indica</em></td>
<td>Fruits</td>
<td>e</td>
<td>632</td>
<td>73</td>
</tr>
<tr>
<td>103</td>
<td><em>Bridelia micrantha</em></td>
<td>Firewood</td>
<td>i</td>
<td>203</td>
<td>0</td>
</tr>
<tr>
<td>99</td>
<td><em>Acacia mearnsii</em></td>
<td>Firewood</td>
<td>e</td>
<td>241</td>
<td>208</td>
</tr>
<tr>
<td>79</td>
<td><em>Eucalyptus spp.</em></td>
<td>Firewood</td>
<td>e</td>
<td>687</td>
<td>97</td>
</tr>
<tr>
<td>63</td>
<td><em>Cordia africana</em></td>
<td>Timber</td>
<td>i</td>
<td>996</td>
<td>0</td>
</tr>
<tr>
<td>63</td>
<td><em>Neoboutonia macrocalyx</em></td>
<td>Firewood</td>
<td>i</td>
<td>156</td>
<td>0</td>
</tr>
<tr>
<td>57</td>
<td><em>Croton megalocarpus</em></td>
<td>Firewood</td>
<td>i</td>
<td>366</td>
<td>97</td>
</tr>
<tr>
<td>52</td>
<td><em>Eriobotrya japonica</em></td>
<td>Firewood</td>
<td>e</td>
<td>216</td>
<td>19</td>
</tr>
<tr>
<td>50</td>
<td><em>Carica papaya</em></td>
<td>Fruits</td>
<td>e</td>
<td>544</td>
<td>197</td>
</tr>
<tr>
<td>50</td>
<td><em>Erythrina abyssinica</em></td>
<td>Firewood</td>
<td>i</td>
<td>18</td>
<td>0</td>
</tr>
</tbody>
</table>

**Determination of the main usage per specie (farmer’s interview):**

number of individuals of one species used for one usage / numbers of individuals of this species used for all the usages

**Indigenous trees:**
- Profitable
- Only for home consumption

**Exotic trees:**
- Selling fruit
Agroforestry strategy: size of the farm and tree abundance?

- **CL1**: Strong positive correlation between size of the farm, profitability, and tree abundance
- **CL2**: Smaller farms, more trees => Intensification

![Graph showing the relationship between farm size and agroforestry profitability](image)

- \( R^2 = 0.7909 \)
- \( R^2 = 0.0956 \)

- **CL1 Abundance**: Linear (CL1 Abundance)
- **CL2 Abundance**: Linear (CL2 Abundance)

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- **CL1**: Strong positive correlation between size of the farm, profitability, and tree abundance
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Profitability of agroforestry and strategy

**Profitability of agroforestry**

- Agroforestry > Coffee
- Saving > Earning
- Main profitable products: Firewood, Timber, and Fruits

**Strategy**

- No differences in term of species or activity between the 2 clusters
- Farms belonging to the cluster 2: Agroforestry more intense

Hypothesis: as Farm belonging to CL1 are larger => crops (other source of income)
Agroforestry: a profitable and although sustainable practise?