INTRODUCTION

- On farm tree planting:
  - Integral part of sustainable rural development in marginal areas
  - Providing financial and environmental benefits

- *Falcataria*-based farm forestry is an innovative practice:
  - Enhancing productivity of marginal areas
  - Contributing to carbon sequestration

- Indonesian governments at all levels are promoting tree planting on farmland
  - Soeharto’s era has spent in an average amount of US $ 100 -125 million annually for at least 250 re-greening projects (Mangundikoro, 1986)
  - In 2003-2009, the government has spent at least US $ 300 million annually to run national movement for land and forest rehabilitation
  - The establishment of farm forestry on farmland is widely varied
INTRODUCTION

- Adoption of innovation study, whether in the field of agroforestry or others, is a mature research area. See, for instance, comprehensive reviews of by Pattayanak, Mercer, Sills, and Yang (2003) and by Mercer (2004). Yet…
- Most of studies applied dichotomous choice model and thereby they cannot properly explain the individual timing of an adoption decision, meaning the time a farmer takes until he/she adopts an innovation.

- Examines the information gap between static and dynamic nature of adoption studies by providing information on duration analysis of adoption of Falcataria-based farm forestry.
- The main objective is to seek determinant factors contributing on the speed of adoption of Falcataria-based farm forestry.

METHOD

- Cross-sectional Survey Method
- Location: Tempurejo Village, Wonosobo
  - Headwater of sub-watershed Medono
  - Ring two of green-belt of Wadaslintang reservoir → irrigation, flood control
- Sample: 117 farmers selected randomly
- Face-to-face interview using structured questionnaire:
  - Age, education, off-farm employment, membership to farmers’ group, family size, farm size.
METHOD

Empirical Model Specification

- Duration analysis → survival analysis or event history analysis

First learn/hear

Survival time → Failure

Survival time ≡ non-adoption period
Failure ≡ adoption

Suppose \( t \) as “failure” time, at which farmer makes a transition from non-adoption to adoption. Probability to adopt is at time \( t \)

\[
F(t) = \Pr(T \leq t)
\]
Prob. density function → \( f(t) = \frac{dF(t)}{dt} \)

- \( T \) is non-negative cont. random variable → stay in non-adoption period. Variable \( t \) is actual time of adoption. But, not all farmers had adopted at time \( t \). Probability of not adopting at time \( t \) is defined as a survival function \( S(t) \)

\[
S(t) = 1 - F(t) = \Pr(T > t)
\]

- To explore relationship failure and survival → hazard function \( h(t) \) = instantaneous potential = conditional failure rate

\[
h(t) = \lim_{\Delta t \to 0} \frac{\Pr(t \leq T \leq t + \Delta t | T \geq t)}{\Delta t} = \lim_{\Delta t \to 0} \frac{f(t)}{1 - F(t)} = \frac{f(t)}{S(t)}
\]
To account for the influence of determinant factors, we use Cox proportional-hazard regression:

\[ h(t) = h_0(t) \exp(\beta'x) \]

- **Hazard rate**
- **Baseline hazard function**
- **Covariates and regression parameters**

**Empirical model 1**

\[
ADOPT(i,t) = \exp \left( \beta_1\text{AGET}_{i,t} + \beta_2\text{EDUC}_{i,t} + \beta_3\text{OFFE}_{i,t} + \beta_4\text{PRIC}_{i,t} \right)
\]

**Empirical model 2**

\[
ADOPT(i,t) = \exp \left( \beta_1\text{AGET}_{i,t} + \beta_2\text{EDUC}_{i,t} + \beta_3\text{OFFE}_{i,t} + \beta_4(\text{EDUC} \times \text{OFFE})_{i,t} \right)
\]

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description of the variable</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dependent variable</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ADOPT</td>
<td>Number of years from the date of first hearing to the date of adoption. (years)</td>
<td>11.026</td>
<td>5.149</td>
<td>1</td>
<td>19</td>
</tr>
<tr>
<td><strong>Explanatory variables</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age (AGET)</td>
<td>Age of farmer when he adopted farm forestry. (years)</td>
<td>31.453</td>
<td>8.107</td>
<td>15</td>
<td>53</td>
</tr>
<tr>
<td>Education (EDUC)</td>
<td>Years of formal education. (years)</td>
<td>6.231</td>
<td>2.339</td>
<td>0</td>
<td>12</td>
</tr>
<tr>
<td>Off-farm employment (OFFE)</td>
<td>Farmer has off-farm employment. 1 = Yes, 0 = No</td>
<td>0.479</td>
<td>-</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Member of farmers’ group (FORG)</td>
<td>Membership to farmers’ group. 1 = Yes, 0 = No</td>
<td>0.393</td>
<td>-</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Farm size (FARM)</td>
<td>Size of farmland owned by farm household at the time of adoption. (ha)</td>
<td>0.807</td>
<td>0.675</td>
<td>0.018</td>
<td>3.023</td>
</tr>
<tr>
<td>Price (PRIC)</td>
<td>Relative price of Falcataflogo price of coffee bean/kg at the time of adoption.</td>
<td>11.054</td>
<td>2.620</td>
<td>7.619</td>
<td>20</td>
</tr>
<tr>
<td>Number of adults (HHSZ)</td>
<td>Number of adults in household with the age more than 15 years old. (people)</td>
<td>3.504</td>
<td>1.119</td>
<td>1</td>
<td>8</td>
</tr>
</tbody>
</table>
Balitekdas

RESULTS

• History: Turi (Sesbania grandiflora) and Lamtoro (Leucena sp)
• Kutuloncat (Heteropsylacubana) outbreaks in the late of 1980s
• Sengonisasi
• Karat puru (Gall rust) outbreaks
• Jabon (Anthocephalus cambada) emergence and popularity
• Yet, the winner is Sengon (Falcataria)
RESULTS

<table>
<thead>
<tr>
<th>Variables</th>
<th>Model 1</th>
<th>Model 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hazard Ratio</td>
<td>Standard Errors (Robust)</td>
</tr>
<tr>
<td>1. AGET</td>
<td>1.044 ***</td>
<td>0.013</td>
</tr>
<tr>
<td>2. EDUC</td>
<td>1.325 ***</td>
<td>0.092</td>
</tr>
<tr>
<td>3. OFFE</td>
<td>2.920 ***</td>
<td>0.634</td>
</tr>
<tr>
<td>4. EDUC x OFFE</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>5. FORG</td>
<td>3.570 ***</td>
<td>0.871</td>
</tr>
<tr>
<td>6. HHSZ</td>
<td>0.952</td>
<td>0.089</td>
</tr>
<tr>
<td>7. FARM</td>
<td>1.297 **</td>
<td>0.146</td>
</tr>
<tr>
<td>8. PRIC</td>
<td>1.272 ***</td>
<td>0.069</td>
</tr>
</tbody>
</table>

Log-likelihood: -398.183 - 393.601

Wald chi²: 192.84 *** 225.83 ***

Notes: *, **, *** significant at the 10%, 5%, and 1% level, respectively

CONCLUSIONS

- Determinant factors influencing the speed of adoption were age of farmer, education, off-farm employment, farm size, membership to farmers’ group and price.
- The influence of off-farm employment and membership to farmers’ group to the speed of adoption are much higher than any other factors. F
- Farmers who are well educated and have off-farm employment are among the earlier adopters.
- Policy insights derived in the context of this study suggest that speeding up Falcataria-based farm forestry requires policies that promote farmers’ participation in off-farm income activities and timber markets in addition to access to

