Assessing the socio-economic determinants for adoption of conservation agriculture practices among smallholder farmers: A case study in the mid-hills of Nepal

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Agricultural Adoption Issues

- Introduced agricultural practices often abandoned for traditional methods
- Factors influencing adoption can be personal, social, economic, and cultural, including:
  - Age
  - Gender
  - Education
  - Economic status
  - Social responsibility
  - Knowledge of natural resources
- No universal determining factors identified
- Highly contextual due to varying local and ecological conditions and individual goals/motivations

(Bunch 1999; Knowler & Bradshaw 2007; Pannell et al. 2006)
Study Area: Central Mid-hills, Nepal

- Mid-hill agriculture supports half of Nepal’s population
  - Important for food security
- Selected villages characterized by:
  - Size (26-42 HH), food insecurity, subsistence farming, marginal, small landholdings (<1 ha)
- Cultivate highly sloping, degradation-prone land
- Practice continuous cultivation, terracing, and mono-cropping
Research Questions

- What are the significant socio-economic factors contributing to individual farmers’ likelihood of adoption of CA?
- What are the major constraints leading to non-adoption of CA?
Farmer Characteristics: Methods

① Conduct individual surveys to measure:
   • Farmer characteristics
   • Resource/economic characteristics

② Use self-reported history of CA implementation (dependent variable) to identify adopter and non-adopter groups

③ Conduct Cronbach’s alpha to test internal consistency of latent variables (indices)

④ Use a Logit regression model to determine contributing factors that characterize adopters and non-adopters
   ○ 56 surveys representing 82% of households
Binomial logistic regression model

- Incorporates multiple independent variables
- Determines the degree and direction of influence each variable has on a dependent variable
- Dichotomous dependent variable
  - ADOPTER or NON-ADOPTER
  - Hedgerow technology used as proxy
    - Introduced 10 years ago
    - Analogous to CA due to similar soil conservation benefits and minimal inputs
- 12 explanatory (independent) variables
# Theoretical Logit model

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
<th>Predicted direction of influence</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dependent variable</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$Y_i$</td>
<td>$1 = ADOPTER$, has implemented hedgerow technology on farm</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$0 = NON-ADOPTER$, has never implemented hedgerow technology on farm</td>
<td></td>
</tr>
<tr>
<td><strong>Explanatory variables</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Farmer characteristics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AGE</td>
<td>Age of farmer in years</td>
<td>-</td>
</tr>
<tr>
<td>GENDER</td>
<td>$1 = Female$, $0 = Male$</td>
<td>-</td>
</tr>
<tr>
<td>EDUCATION</td>
<td>Years of formal education completed</td>
<td>+</td>
</tr>
<tr>
<td>TRUST</td>
<td>Index of trust in NGO staff, projects, and expertise</td>
<td>+</td>
</tr>
<tr>
<td>Resource/economic characteristics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>INCOME</td>
<td>Total on- and off-farm annual household income</td>
<td>+</td>
</tr>
<tr>
<td>FARMSIZE</td>
<td>Total hectares of farm</td>
<td>+</td>
</tr>
<tr>
<td>LABOR</td>
<td>Number of adult household members contributing to agricultural labor</td>
<td>+</td>
</tr>
<tr>
<td>FOODSECURITY</td>
<td>Household Food Insecurity Access Scale</td>
<td>-</td>
</tr>
<tr>
<td>INFORMATION</td>
<td>Level of interaction with agriculture extension or NGOs in past 2 years:</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>$0 = none/low$, $1 = moderate$, $2 = high$</td>
<td></td>
</tr>
<tr>
<td>EXPERIENCE</td>
<td>Number of years involved in farm decision-making (shared or total control)</td>
<td>+</td>
</tr>
<tr>
<td>ENVIROCONCERN</td>
<td>Index of farmer perception of environmental degradation and need for conservation</td>
<td>+</td>
</tr>
<tr>
<td>LANDTENURE</td>
<td>$1 = owns land title$, $0 = does not own land title$</td>
<td>+</td>
</tr>
</tbody>
</table>
Index of TRUST in NGOs

• 12 questions related to goals, values, accountability, expertise of NGO projects and staff

Sample questions:
• *Do you think that the goals of NGO projects are the same as your own goals for your farm?*
• *When someone from an NGO makes a promise, does it usually happen?*
• *In general, do NGO projects meet their stated goals?*
• *Do NGO workers provide technical knowledge or expertise?*
Household Food Insecurity Access Scale

- 9 questions related to household food availability, quantity, and diversity over the past month
- Uses a Likert scale: 0-no, 1-rarely, 2-sometimes, 3-often
- Higher scores indicate greater food insecurity (MAX=27)

Sample questions:
- In the past 4 weeks (due to lack of food) did you or any household member:
  - Eat a smaller meal than you felt you needed?
  - Eat fewer meals in a day?
  - Eat a limited variety of foods?
  - Go to sleep hungry?

(Coates et al. 2007)
ENVIROCONCERN Index

- 12 questions regarding concerns over crop yield, soil quality and erosion, and water availability

Sample questions:
- How has the amount of your crop yields changed in the past 5 years? (increasing/decreasing)
- What is the condition of soil erosion on your farm in the past 5 years? (increasing/decreasing)
- Do you think there is a need to improve water availability on your farm? (yes/no)
- Do you think the actions you take can affect soil quality? (yes/no)
Adjusted Logit model equation

- ENVIROCONCERN index was removed due to inconsistency found in Cronbach’s Alpha (0.454)
- LANDTENURE & EXPERIENCE removed due to lack of significance in stepwise regression analysis
- 9 explanatory variables in the adjusted Logit model

\[ Y_i = \beta_0 + \beta_1 \text{AGE}_i + \beta_2 \text{GENDER}_i + \beta_3 \text{EDUCATION}_i + \beta_4 \text{TRUST}_i + \beta_5 \text{INCOME}_i + \beta_6 \text{FARMSIZE}_i + \beta_7 \text{LABOR}_i + \beta_8 \text{FOODSECURITY}_i + \beta_9 \text{INFORMATION}_i + \varepsilon_i \]
Results: What are the significant Farmer Characteristic factors contributing to individual farmers’ likelihood of adoption of CA?

- Overall model was significant
  - 29.9-43.4% of the variance (Cox & Snell R²; Nagelkerke R²)
  - 81.8% of cases correctly classified
- All farmer characteristic variables significant

<table>
<thead>
<tr>
<th>Variable</th>
<th>$\beta$</th>
<th>S.E.</th>
<th>Sig.</th>
<th>$e^B$</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGE</td>
<td>-0.096</td>
<td>0.055</td>
<td>0.082</td>
<td>0.908</td>
</tr>
<tr>
<td>GENDER</td>
<td>-1.906</td>
<td>1.076</td>
<td>0.076</td>
<td>0.149</td>
</tr>
<tr>
<td><strong>EDUCATION</strong></td>
<td>-0.559</td>
<td>0.260</td>
<td>0.031</td>
<td>0.572</td>
</tr>
<tr>
<td>TRUST</td>
<td>0.383</td>
<td>0.226</td>
<td>0.090</td>
<td>1.466</td>
</tr>
</tbody>
</table>

a Significant at 5%
b Significant at 10%
Results: EDUCATION

- >53% of respondents no formal education
- 1 respondent had >6 years education
- Skewed distribution of data may affect directionality
- Existing literature generally considers higher levels of education than represented in this study
- The model showed that with every additional year of education, farmers were 0.57 times less likely to become CA adopters
- This could be a function of less education leading to greater reliance on external information, such as NGOs, and a greater willingness to adopt

(D’ Souza et al. 1993; Knowler and Bradshaw 2007)
Results: What are the significant Resource/Economic factors contributing to individual farmers’ likelihood of adoption of CA?

- FOODSECURITY highly significant
- FARMSIZE, LABOR, INFORMATION not significant
- INCOME significant, opposite direction of influence

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<th>Sig.</th>
<th>e^β</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resource/economic characteristics</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>INCOME</td>
<td>-0.017</td>
<td>0.009</td>
<td>0.048^a</td>
<td>0.983</td>
</tr>
<tr>
<td>FARMSIZE</td>
<td>2.459</td>
<td>2.200</td>
<td>0.264</td>
<td>11.689</td>
</tr>
<tr>
<td>LABOR</td>
<td>0.399</td>
<td>0.295</td>
<td>0.176</td>
<td>1.490</td>
</tr>
<tr>
<td>FOODSECURITY</td>
<td>-0.193</td>
<td>0.083</td>
<td>0.020^b</td>
<td>0.825</td>
</tr>
<tr>
<td>INFORMATION</td>
<td>0.574</td>
<td>0.556</td>
<td>0.302</td>
<td>1.775</td>
</tr>
</tbody>
</table>

^a Significant at 5%
^b Significant at 10%
Results: INCOME

• Wide range of values, from <500 NPR (5.09 USD) to almost 300,000 (3,043 USD)
  – Average income: 87,150 NPR (887 USD).

• Higher incomes from livestock and off-farm wage earning
  – Some remittance from family members (16% households)

• This indicates that, as households earn more income through livestock or off-farm activities, they may become less invested in improving cultivation
Farmer Characteristics: Conclusions

• Improving food security in the short-term can allow for longer-term conservation efforts
• Identification of demographic factors (age, gender) inhibiting adoption can contribute to understanding farmer perspectives and priorities
• Trust is critical to co-management of resources, though transfer of information may require improved implementation strategies
• The dynamics between education, off-farm wage-earning, and investments in conservation on smallholder farms are areas for further research
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