Adoption and Abandonment of Conservation Agriculture (CA) in Developing Economies: The Case of South Asia
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Background

- Agriculture in developing economies is becoming unprofitable due to falling yields, loss in soil productivity, increasing energy prices, and fertilizer input costs. Adversely impacting income and livelihood of majority of small holder households.
- Most farmers in developing economies are marginal and small land holders. Loss in production and income poses serious threat to food security.
- Urgent need to adopt sustainable agricultural systems (i.e., CA), along with conserving resources is expected to increase food production.

Indo-Gangetic Plain and “Partial” adoption/abandonment of CA

- “Full” package adoption of CA technologies/practices includes all three core components and other complimentary practices (see below);
- “Partial” adoption of CA technologies/practices includes only few components and practices.

Defining “partial” adoption/abandonment of CA

- “Full” package adoption of CA technologies/practices includes all three core components and other complimentary practices.
- “Partial” adoption and “partial” abandonment includes only few components and practices.

Objectives:

- Assessing the factors affecting the “partial” adoption and abandonment of CA technologies/practices.
- Assessing the role of social networks in “partial” adoption and abandonment of CA technologies/practices.
- Assessing the role of spouses in “partial” adoption and abandonment of CA technologies/practices.

Indo-Gangetic Plain and “Partial” adoption/abandonment of CA technologies/practices:

- The Indo-Gangetic Plain (IGP) constitutes 76% of the rice-wheat cropping system of South Asia.
- IGP is characterized by fertile soil, good irrigation infrastructure – huge potential for its improvement.
- IGP is home to large number of small, marginal farmers and impoverished population.

Method

- To identify factors which explain the decision of farming households regarding “partial” adoption and “partial” abandonment of CA technologies/practices.
- The decision to adopt/abandon depends on net benefits to the households. Let Y be the difference between net benefits from adoption and non-adoption. Adoption takes place, if Y > 0.
- However, Y is not observable, but actions (Y) of adoption is. Therefore

\[ Y = \mu Z_i + \epsilon_i \]

Where, \( Y = 1 \) if \( Y > 0 \). Similar exercise can be performed for abandonment.

“Partial” adoption and “partial” abandonment can be formalized as:

\[ YCA = 1, \text{ if one or more technologies or practices under CA has been adopted, 0 otherwise} \]

\[ YCA = 1, \text{ if all adopted CA technologies/practices were abandoned} \]

\( \beta \) is a vector of parameters to be estimated, while \( Z_i \) is a vector of household and plot level attributes and \( \epsilon_i \) is normally distributed error term.

We use the Heckman (1979) two-stage Probit model. The first stage is adoption of “partial” CA technologies/practices while the second stage is the abandonment of “partial” CA technologies/practices given that it has already been adopted.

Factors affecting adoption and abandonment of CA in Nepal, India and Bangladesh:

<table>
<thead>
<tr>
<th>Variable</th>
<th>Marginal effects</th>
<th>Marginal effects</th>
<th>Marginal effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logged square cultivated area</td>
<td>0.035</td>
<td>-0.034</td>
<td>-0.026</td>
</tr>
<tr>
<td>Age</td>
<td>0.032</td>
<td>-0.008</td>
<td>0.008</td>
</tr>
<tr>
<td>Age squared</td>
<td>-0.00004</td>
<td>-0.001</td>
<td>-0.001</td>
</tr>
<tr>
<td>Secondary education</td>
<td>0.396***</td>
<td>-0.391***</td>
<td>-0.016</td>
</tr>
<tr>
<td>Tertiary education</td>
<td>0.236***</td>
<td>-0.271***</td>
<td>-0.055***</td>
</tr>
<tr>
<td>Quality of information</td>
<td>0.082**</td>
<td>-0.089**</td>
<td>-0.013</td>
</tr>
<tr>
<td>Diversification</td>
<td>0.022*</td>
<td>-0.014</td>
<td>0.002</td>
</tr>
<tr>
<td>Social network</td>
<td>0.152***</td>
<td>-0.152***</td>
<td>-0.004*</td>
</tr>
<tr>
<td>Logged cost of irrigation</td>
<td>0.004</td>
<td>-0.005</td>
<td>-0.004*</td>
</tr>
<tr>
<td>Delayed labor</td>
<td>0.146***</td>
<td>-0.108***</td>
<td>-0.118***</td>
</tr>
<tr>
<td>Logged credit</td>
<td>0.0005</td>
<td>-0.003**</td>
<td>-0.002***</td>
</tr>
<tr>
<td>Involvement of spouse</td>
<td>0.024***</td>
<td>-0.081</td>
<td>0.011</td>
</tr>
<tr>
<td>Residue as mulch</td>
<td>-</td>
<td>-0.255***</td>
<td>-0.072***</td>
</tr>
<tr>
<td>Average tech usage</td>
<td>-0.016</td>
<td>0.051***</td>
<td></td>
</tr>
<tr>
<td>Ownership</td>
<td>-0.003</td>
<td>-0.021</td>
<td></td>
</tr>
</tbody>
</table>

VIF - 8.73 and 7.81 for both stages respectively – no multicollinearity.

- Heckman two-stage probit model performs better compared to simple probit as the existence of sample selection bias is confirmed.
- Robustness of the model proves that the marginal effects are stable.

Results

Discussion

- Social networks, as defined, has a positive effect on “partial” adoption and a negative impact on “partial” abandonment of CA.

- Quality of information (QI) is integral to the household’s perception of new technologies. QI positively influences “partial” adoption and negatively in “partial” abandonment of CA.
- Educated farmers are likely to adopt and less likely to abandon CA technologies/practices.
- Higher labor constraint and diversification in multiple crops increases adoption of CA technologies/practices.
- Large farms are less likely to abandon CA. Whereas, farms with large loans are more likely to abandon CA because these technologies tend to be more expensive.
- Residue mulching reduces the likelihood of abandonment of CA. Recall, that mulching increases soil fertility, promotes soil biological activity and reduces weed infestation. It also reduces the requirement of water.

Conclusion and policy recommendations

- Almost 46% of the households in IGP have “partially” adopted CA technologies/practices and 27% of these have abandoned it.
- Target educated households with large farmland and those having strong social networks for faster “partial” adoption of CA.
- Policies favoring equal access to land along with open access to credit and markets should be encouraged.
- Awareness campaigns and demonstration trials in villages may be organized to boost adoption of CA.
- The study underscores the importance of mulching in the adoption of CA.