Factors of Residents’ Attitude to Solar-PV Project

Shigeo NISHIKIZAWA*, Yohei MAEKAWA*, Atsushi Nagaoka*, Takehiko MURAYAMA*, Kiyoshi TAKEJIMA** and Shinya YASUMOTO**

* Tokyo Institute of Technology  ** Chubu University

JAPAN

nishikizawa.s.ab@m.titech.ac.jp

http://www.nishikiz.depe.titech.ac.jp/
Background

• The introduction of renewable energy has been steadily increased under FIT since 2012 in Japan

• In 2020, Japanese Government declared “Zero Carbon Society” toward 2050

• Energy Policy 2021: Introducing renewables as much as possible with the highest priority

• Many conflicts due to renewable energy projects

Aim to introduce the overview of conflicts and to clarify factors influencing the attitude to solar-PV facility
Installed Capacity of Renewables in Japan

<table>
<thead>
<tr>
<th></th>
<th>GW as of SEP 2021</th>
<th>FIT approved</th>
<th>Installation Capacity</th>
<th>To be installed</th>
<th>Operation Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar PV</td>
<td></td>
<td>80.9</td>
<td>63.1</td>
<td>17.8</td>
<td>78%</td>
</tr>
<tr>
<td>(MAR 2020)</td>
<td></td>
<td>(79.3)</td>
<td>(55.2)</td>
<td>(24.1)</td>
<td>(70%)</td>
</tr>
<tr>
<td>Wind</td>
<td></td>
<td>15.9</td>
<td>4.6</td>
<td>11.3</td>
<td>29%</td>
</tr>
<tr>
<td>(MAR 2020)</td>
<td></td>
<td>(11.6)</td>
<td>(4.1)</td>
<td>(7.5)</td>
<td>(36%)</td>
</tr>
<tr>
<td>Biomass</td>
<td></td>
<td>9.5</td>
<td>4.5</td>
<td>5.0</td>
<td>47%</td>
</tr>
<tr>
<td>(MAR 2020)</td>
<td></td>
<td>(9.8)</td>
<td>(3.5)</td>
<td>(6.3)</td>
<td>(36%)</td>
</tr>
</tbody>
</table>

Source: Agency for Natural Resource and Energy, 2021

Solar PV
- more than 80GW was approved under FIT: 3rd place in the world
- high ratio of installation and operation
- relatively low installation in case of commercial-based-project
Conflicts due to Renewable Energy Projects

Newspaper Articles Survey:
- by a search keyword “Solar PV + Opposition” within ELNET database
- “conflict” is defined as opposition movements by a specific group

<table>
<thead>
<tr>
<th>Energy</th>
<th>Installation [GW] JUN2012→SEP2021 + to be installed</th>
<th>Survey Period</th>
<th>Number of Conflict Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar PV</td>
<td>5.6→63.1 +11.3</td>
<td>until JUN 2021</td>
<td>74</td>
</tr>
<tr>
<td>Wind $\geq 7.5$MW</td>
<td>2.6→4.6 +11.3</td>
<td>until JUL 2017</td>
<td>76</td>
</tr>
<tr>
<td>Biomass</td>
<td>2.3→3.5 +6.3</td>
<td>until APR 2017</td>
<td>8</td>
</tr>
</tbody>
</table>

Solar PV: many conflicts have occurred in recent years
Overview of Environmental Conflicts in Solar-PV

**Installed site**

- Mountain forest: 51%
- Building site: 9%
- Tourist/villa area: 7%
- Tableland: 8%
- Agricultural land: 11%
- Along river/ocean: 4%
- Others: 5%
- Unknown: 7%

N=74

**Project status (as of June 2021)**

- Operation: 22%
- Under construction: 22%
- Under planning or pending: 26%
- Cancellation: 9%
- Unknown: 9%

N=74

Only 22% start operation after conflicts

740kW, 9,973 m², Yamanashi Pref.

**Location of conflicts**

N=74
Major Issues of Conflicts in Solar PV

People tends to be concerned of **land slide disaster** due to forest developments

(N=74, some cases have multiple issues per case)
Conflict Case: Solar PV in Mt. Tsukuba

Installation Capacity: 1,122kW
2015: Opposition from community
   Landscape, landslide disaster
2016.3: Started operation
### Overview of the Questionnaire Survey

<table>
<thead>
<tr>
<th>Duration</th>
<th>NOV 15, 2021 ~ DEC 22, 2021</th>
</tr>
</thead>
<tbody>
<tr>
<td>Survey Scope</td>
<td>851 houses (All houses located within a 3km radius)</td>
</tr>
<tr>
<td>Survey Method</td>
<td>On-site posting, Collection by postal</td>
</tr>
<tr>
<td>Collected Number</td>
<td>238 sheets (Recovery rate: 28%)</td>
</tr>
</tbody>
</table>

The questionnaires were numbered by 500m mesh to identify the distance.

### Major Question Items

- **Attitude of approval or disapproval**
  - The target facility, installation in Mr. Tsukuba, in Tsukuba City ...

- **Landscape change due to the facility**
  - Landscape change perception
  - Annoyance level

- **Visibility status**
  - **The target facility**
    - Visibility from home
  - **Other facilities in surrounding area**
    - Frequency to see other solar-PV facilities

- **Operator and government response**
  - Satisfaction with the operator’s response
  - Satisfaction with the government’s response
Attitudes of approval / disapproval to the solar PV

The target Solar PV facility
- 11% Agree
- 12% Somewhat Agree
- 21% Neutral
- 55% Somewhat Disagree

Installing Solar PV Facilities in Mt. Tsukuba
- 4% Agree
- 25% Somewhat Agree
- 11% Neutral
- 21% Somewhat Disagree
- 39% Disagree

Installing Solar PV Facilities in Tsukuba City
- 10% Agree
- 45% Somewhat Agree
- 20% Neutral
- 12% Somewhat Disagree
- 13% Disagree

Installing renewable energy Facilities in Tsukuba City
- 16% Agree
- 67% Somewhat Agree
- 6% Neutral
- 6% Somewhat Disagree
- 6% Disagree

“NIMBY” phenomena (Not-In-My-Backyard)
Local egoism?
Multiple Regression Analysis

To clarify factors influencing residents’ attitudes

(1) Factors of **Opposition to the Target Facility**

- Objective variable
- Explanatory variables:
  - $x_1$
  - $x_2$
  - $x_n$

(2) Factors of **Annoyance due to Landscape Change**

- Objective variable
- Explanatory variables:
  - $x_1$
  - $x_2$
  - $x_n$
Factors of Opposition to the Target Facility

<table>
<thead>
<tr>
<th>Explanatory variables</th>
<th>Opposition to the target facility</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>β</td>
</tr>
<tr>
<td>Landscape change perception</td>
<td>-0.16</td>
</tr>
<tr>
<td><strong>Annoyance due to landscape change</strong></td>
<td><strong>0.49</strong></td>
</tr>
<tr>
<td><strong>Concern about landslide damage</strong></td>
<td>-0.03</td>
</tr>
<tr>
<td>Visibility from home</td>
<td>0.04</td>
</tr>
<tr>
<td>Frequency to see the facility outside of home</td>
<td>0.08</td>
</tr>
<tr>
<td>Frequency to see other (solar-PV) facilities</td>
<td>0.07</td>
</tr>
<tr>
<td>Annoyance due to seeing other facilities</td>
<td>-0.09</td>
</tr>
<tr>
<td><strong>Satisfaction with the operator’s response</strong></td>
<td><strong>-0.30</strong></td>
</tr>
<tr>
<td>Satisfaction with the government’s response</td>
<td>0.11</td>
</tr>
<tr>
<td><strong>Opposition to solar-PV in Mt. Tsukuba</strong></td>
<td><strong>0.21</strong></td>
</tr>
<tr>
<td>Opposition to solar-PV in Tsukuba City</td>
<td>0.04</td>
</tr>
<tr>
<td>Distance from the facility</td>
<td>0.04</td>
</tr>
<tr>
<td>Sex</td>
<td>0.02</td>
</tr>
<tr>
<td>Age</td>
<td>0.06</td>
</tr>
<tr>
<td>Years of residence</td>
<td>0.07</td>
</tr>
</tbody>
</table>

- Significant correlation with three variables: particularly strong with “Annoyance due to landscape change”
- No significant relationships with “Concern about landslide damage”

| R-square (R²)                                           | 0.44  |
| Adjusted R-square (R²_adj)                              | 0.37  |
| F value                                                  | 6.53*** |
| N                                                        | 141   |

r: Spearman’s rank correlation coefficient
β: Standardized partial regression
* : p<0.05  ** : p<0.01  *** : p<0.001
### Factors of Annoyance due to Landscape Change

<table>
<thead>
<tr>
<th>Explanatory variables</th>
<th>Annoyance due to landscape change</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>β</strong></td>
</tr>
<tr>
<td><strong>Size of the panel</strong></td>
<td>0.22**</td>
</tr>
<tr>
<td>Color of the panel</td>
<td>-0.06</td>
</tr>
<tr>
<td><strong>Installation in mountain forest (Mt. Tsukuba)</strong></td>
<td>0.50**</td>
</tr>
<tr>
<td><strong>Visibility from home</strong></td>
<td>0.07</td>
</tr>
<tr>
<td><strong>Frequency to see the facility outside of home</strong></td>
<td>0.23**</td>
</tr>
<tr>
<td>Frequency to see other (solar-PV) facilities</td>
<td>0.03</td>
</tr>
<tr>
<td>Annoyance due to seeing other facilities</td>
<td>0.07</td>
</tr>
<tr>
<td>Proud of the Mt. Tsukuba landscape</td>
<td>0.07</td>
</tr>
<tr>
<td><strong>Distance from the facility</strong></td>
<td>0.07</td>
</tr>
<tr>
<td><strong>Sex</strong></td>
<td>-0.08</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td>0.10</td>
</tr>
<tr>
<td><strong>Years of residence</strong></td>
<td>-0.01</td>
</tr>
<tr>
<td><strong>R-square (R²)</strong></td>
<td>0.59</td>
</tr>
<tr>
<td><strong>Adjusted R-square (R²ᶠ)</strong></td>
<td>0.55</td>
</tr>
<tr>
<td><strong>F value</strong></td>
<td>16.37***</td>
</tr>
<tr>
<td><strong>N</strong></td>
<td>151</td>
</tr>
</tbody>
</table>

- **Significant relation with three variables:** particularly strong with “Installation in mountain forest (Mt. Tsukuba)”
- **No significant relation with “Visibility home”** or “Distance from the facility”
The Model of Opposition Attitude Formation

Factors of annoyance due to landscape change

- Size of the panel: \[0.19^{**}\]
- Installation in mountain forest (Mt. Tsukuba): \[0.53^{**}\]
- Frequency to see the facility outside of home: \[0.19^{**}\]

\(R^2 \approx 0.58\)

Factors of opposition to the target facility

- Satisfaction with the operator’s response: \[-0.24^{**}\]
- Opposition of solar-PV in Mt. Tsukuba: \[0.27^{**}\]

\(R^2 \approx 0.43\)

Factors of opposition to the target facility may be having an effect.

Carefully considered site selection in mountain forest regardless of setback distance or visibility from their houses.
Let’s continue the conversation!
Post questions and comments via chat in the IAIA22 platform.

Shigeo Nishikizawa
Associate Professor, Tokyo Institute of Technology, Dr. Eng
JAPAN
nishikizawa.s.ab@m.titech.ac.jp
http://www.nishikiz.depe.titech.ac.jp/

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