AgriVoltaics World Conference 2024

Social Sciences

https://doi.org/10.52825/agripv.v3i.1404

Published: 02 Apr. 2025

A Social Media Analysis of the Agrivoltaics Discourse in Japan

Christian Doedt[1,2,*], Makoto Tajima[1,2], and Tetsunari Iida[1,2]

[1]Institute for Sustainable Energy Policies, Japan

[2]Japan Community Power Association, Japan

*Correspondence: Christian Doedt, christian_doedt@isep.or.jp

Abstract. Japan's first agrivoltaics project was built already 20 years ago and since then more than 4,300 projects have been implemented in all parts of the country. Nevertheless, it is still a niche technology and social acceptance is necessary to further advance agrivoltaics. Nowadays, information gathering and public opinion-making often take place on social media. Attitudes and social norms towards projects are formed online but social media is still often ignored by academia. To fill this gap, this study analyzed 21 months of Twitter data related to agrivoltaics in Japan. The results show an active discourse about agrivoltaics with an average of more than 1,000 tweets per month. The discourse is in majority supportive of agrivoltaics highlighting the potential to solve big societal problems in Japan, such as decarbonization and rural revitalization. Concerns are voiced regarding the potential negative impact on the already weak agricultural sector in Japan. Overall, a lack of reliable and evidence-based information in the discourse was noticeable. This should be addressed to avoid a shift to negative narratives based on misinformation which has already been the case in the solar photovoltaics discourse.

Keywords: Agrivoltaics, Japan, Social Media, Discourse, Social Acceptance

1. Introduction

The idea of agrivoltaics was introduced in Japan already twenty years ago under the name "solar sharing" by Akira Nagashima. The first pilot project was installed in 2004 in Chiba, close to Tokyo. Japan was also the first country to establish a legal framework that allows agrivoltaics on all types of farmlands since 2013 if certain requirements are met [1]. In combination with other policy measures, above all the generous Feed-in Tariff, agrivoltaics were able to quickly spread to 46 out of 47 prefectures in Japan. As of March 2022, 4,349 agrivoltaics permits were granted. The number of new permits per year is rising steadily reaching 851 in FY2021 [2].

Agrivoltaics bring many advantages to the challenging conditions in Japan. The dual land use is important since only 34% of land in Japan is flat. Most of the suitable land for ground-mounted solar photovoltaic (PV) is already in use and developers are in search of new areas for their projects. Agrivoltaics increases the available space for new projects, which is also important for reaching the government's goal of becoming carbon neutral by 2050. Currently, the renewable energy share is only 25.7% of which 11.2% is from solar energy [3]. Most of Japan's energy needs must be imported. The energy self-sufficiency rate is only 12% [4].

Similarly, the agricultural sector in Japan faces difficulties. Food self-sufficiency is already relatively low with just 38% [5] and the agricultural sector is in further decline in recent years. The number of farmers has fallen by a third in the last decade. Only 19% of the farmers in

Japan are under 60 years old with an average age of 68 years [6]. Many retiring farmers struggle to find successors and the area of abandoned farmland increases steadily [7]. Consequently, depopulation in rural areas advanced especially fast.

Agrivoltaics can help to solve these big societal problems in Japan. However, social acceptance is necessary for a rapid expansion of agrivoltaics from a niche to a mainstream technology since it will directly affect many people due to its decentralized nature. Nowadays, social media has become an important place for information sharing and public opinion making. Discussions online have the potential to influence attitudes and social norms. The perceived opinion can then potentially influence the decision to support or oppose renewable energy projects [8].

Social media has advantages such as allowing active participation in discourses due to its low cost and high accessibility. However, there are also many drawbacks such as the fast spread of misinformation [9], the existence of echo chambers with influential opinion leaders who can control the flow of information [10, 11], or the fact that the number of shares is seen as social proof for the quality and legitimacy of a story [12]. In Japan, there is an overrepresentation of far-right content on Twitter which resulted in increased mistrust in politicians, traditional media, and academia [13]. Still, Twitter cannot be ignored since it is also very popular among the general Japanese public. It provides more anonymity than other social media platforms and therefore, users are more likely to express their opinions without yielding to the strong social pressure in Japan [14]. This allows researchers to analyze unfiltered views on diverse topics. In recent years several studies have analyzed the online discourse of wind energy and large-scale photovoltaics in several countries [15-17]. The results show a one-sided negative discourse highlighting the drawbacks of renewable energy in an often exaggerated and misleading way. So far, there is no study on the online discourse of agrivoltaics.

2. Research Questions and Methods

This study was conducted to fill the gap in the literature and advance the still insufficient research on social acceptance of agrivoltaics. A social media content analysis was conducted to identify 1) the general attitude towards agrivoltaics on Japanese Twitter, 2) the locality of the discourse, 3) the key topics that are discussed online, and 4) the types of users who take part in the agrivoltaics discourse.

Therefore, tweets containing the Japanese words for agrivoltaics were collected via the Twitter Search Network from June 2021 to February 2023. The 50 most retweeted tweets per month in this period of 21 months, 1,050 tweets in total, were analyzed. These so-called primetime tweets are posts with the most engagement. People looking for information online about agrivoltaics, therefore, are most likely to be confronted and influenced by these tweets.

As a first step, each tweet was manually coded and categorized based on their attitude towards agrivoltaics. Additionally, it was analyzed if tweets named specific projects or if general aspects of agrivoltaics were discussed. In the next step, tweets were analyzed in a directed content analysis to identify key topics [18]. Initial coding was based on the research on mega solar opposition on social media in Japan [17]. During the data analysis, new themes emerged and the code set was adapted to fit the agrivoltaics context. For example, codes such as “Agricultural land loss” or “Rural revitalization” were added. Finally, the Twitter profile descriptions of each user with primetime tweets were analyzed to detect the self-identified user role. Users without sufficient information (e.g., political or academic affiliation) were classified as “Individuals”.

The analysis focuses specifically on the Japanese discourse about agrivoltaics on Twitter. Hence, the generalizability of the results in other contexts is limited. Further research on different social media sites and cultural backgrounds is necessary.

3. Results and Discussion

3.1 Data

Between June 2021 and February 2023, a total of 21,653 tweets related to agrivoltaics have been collected. This is an average of 1,031 tweets per month and indicates an active and continuous discourse about agrivoltaics on Twitter in Japan. However, the agrivoltaics discourse is still small compared to other similar discourses on Japanese Twitter. In the same period, there were 1.3 million tweets about mega solar (solar PV projects over 1 MW) and 240,000 tweets about solar PV.

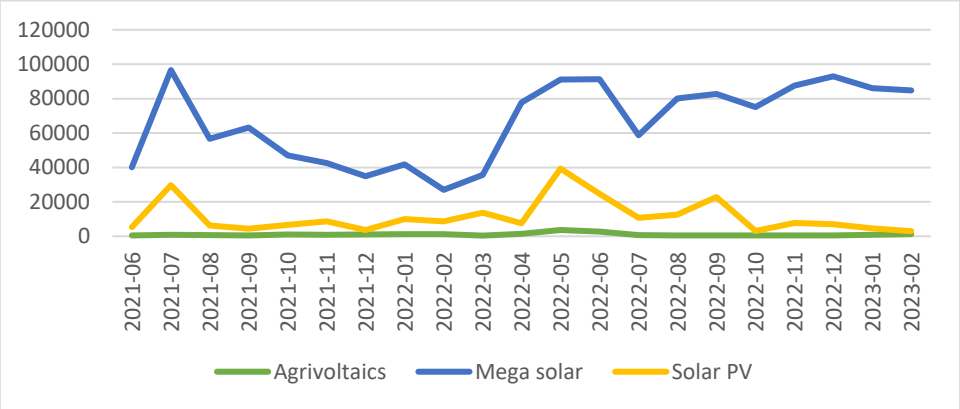

Figure 1. *Number of tweets about mega solar, solar PV, and agrivoltaics per month between June 2021 and February 2023.*

3.2 Attitude

In the first step, the tweets were coded based on their attitude towards agrivoltaics. A distinction was made between positive, neutral, and negative tweets.

The analysis showed that the discourse is generally in favor of agrivoltaics with almost three-quarters of the tweets being positive. A representative positive tweet is as follows: *"I visited a person who is regenerating degraded farmland and cultivating it without pesticides through agrivoltaics. This was the first time I had seen agrivoltaics on such a large scale, but it didn't feel overwhelming. In this case, the yield and quality have increased, which is very good."*

Only 11.9% of the tweets were negative. An exemplary negative tweet of the sample is: *"There is nothing good about agrivoltaics, as the yield, quality, and workability will all suffer, and the panels will also be more easily blown away by the wind..."* The remaining 15% of the tweets were labeled neutral with no clear indication of positive or negative attitude towards agrivoltaics.

Even though most tweets are positive, negative tweets receive noticeably more engagement. They are retweeted four times as often and therefore, reaching on average a larger audience per post. Nevertheless, the agrivoltaics discourse is still very positive compared to other similar discourses about renewable energy in Japan. For example, the mega solar and solar PV discourses are dominated by opponents with a share of 80-90% negative tweets.

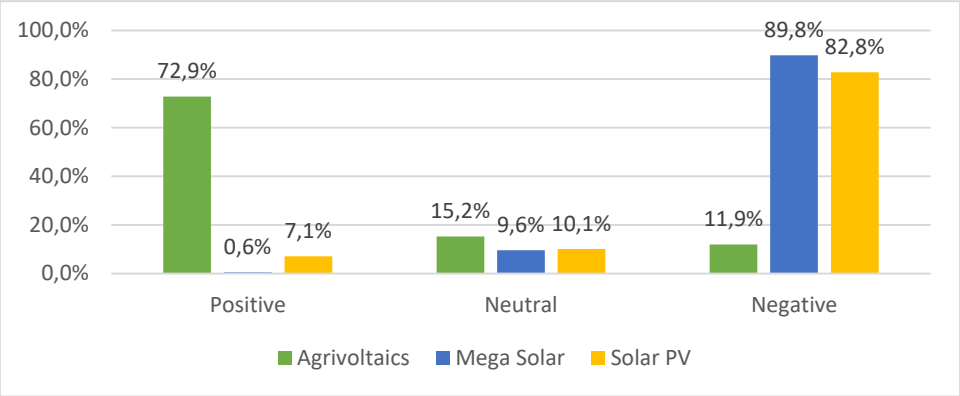

Figure 2. *Attitude towards agrivoltaics (n=1,050), mega solar(n=1,050), and solar PV (n=1,050) on Japanese Twitter.*

3.3 Locality

Tweets were categorized as “project specific” if the content was directed towards a specific agrivoltaics project in a community and “general” if the content was about agrivoltaics in general without mentioning a specific project. 76% of the negative tweets were general indicating that users have overall concerns about agrivoltaics and not just against specific problematic projects in their neighborhood. Only projects in 5 out of the 46 prefectures with agrivoltaics were mentioned directly.

Positive tweets on the other hand highlighted the benefits of agrivoltaics in general (54.5%) as well as promoting specific good-practice examples (45.5%). Forty-three different projects in 25 prefectures were mentioned. The most mentioned prefecture is Chiba, where the first agrivoltaics project was built and the technology is already very well established with over 600 projects. Awareness-raising activities, such as field trips, are also offered widely in Chiba contributing to the positive image of agrivoltaics by offering direct experiences. Many people take the opportunity to take pictures of the projects and share them on social media.

3.4 Concerns about Agrivoltaics

To understand the specific concerns of Japanese Twitter users, the topics of the negative tweets were analyzed. The ability to trust foreign developers and politicians who support agrivoltaics is the biggest concern of Japanese Twitter users. The mistrust against the former prime minister Naoto Kan who calls for a rapid expansion of agrivoltaics both in offline and online statements is particularly widespread. Moreover, users with right-wing tendencies joined the discourse and expressed their fear of a “Chinese invasion” of Japan through large-scale agrivoltaics projects that would destabilize the energy sector. This narrative fits seamlessly in the overall anti-Chinese narrative of the wide-spread Japanese right-wing activists on Twitter [19] and therefore was shared widely.

People are also concerned about the impact of agrivoltaics on the agricultural sector. Forty percent of the negative tweets are focused especially on this topic. The main concern is the loss of agricultural land due to agrivoltaics projects that would neglect agricultural production completely. Moreover, a high yield reduction due to the shading of the solar panels is feared even if agricultural production is continued. Users are afraid that the already declining agricultural sector will be even further weakened if agrivoltaics projects will increase.

To a lesser extent, there are also concerns related to the electricity production of agrivoltaics. However, these are mainly related to the general skepticism about renewable energy in Japan, such as the perceived instability of solar PV and the believe that nuclear power is

needed as base load. Specifically related to agrivoltaics, elevated systems are seen as unsuitable for Japan's geographic conditions with high wind loads due to typhoons and heavy snow events in the north of the country.

In summary, concerned Twitter users are afraid that both food and energy security would be decreased by an expansion of agrivoltaics. Many also believe that politicians and developers with vested interests want to advance agrivoltaics for their own gain and at the cost of citizens. These arguments are not backed by references to research articles or other reliable information sources.

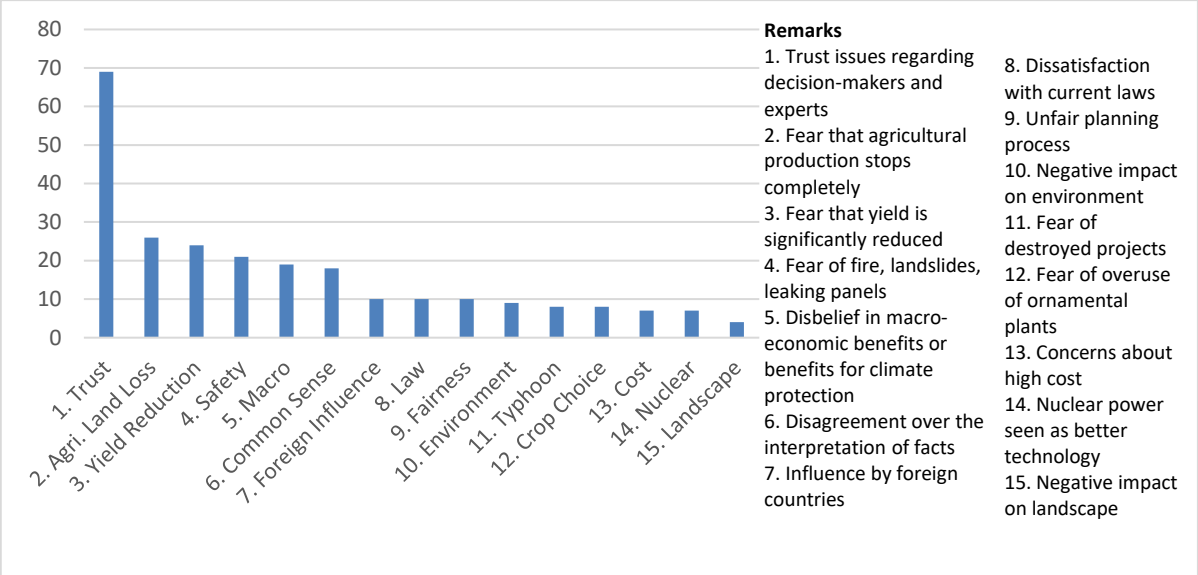

Figure 3. *Main concerns about agrivoltaics on Twitter in Japan (n=250).*

3.5 Support for Agrivoltaics

Even though there are concerns about agrivoltaics, the majority of Japanese Twitter users are supportive of agrivoltaics. Positive tweets were analyzed in this section to understand the key reasons by supporters. They highlight both the benefits for agricultural and electricity production and are optimistic about synergies between the two. Many tweets also show photos of good-practice examples taken during awareness-raising activities, such as field trips to agrivoltaics projects.

Above all, agrivoltaics is seen as an important tool for solving the big societal problems of Japan. Users understand the land scarcity of Japan and the need for dual use wherever possible. Agrivoltaics is therefore seen as crucial for a successful energy transition and reaching the goal of decarbonization by 2050. The close connection between the anti-nuclear movement and agrivoltaics is also evident. Supporters see a chance in agrivoltaics to secure energy security without the need for nuclear power.

Hope is also placed in agrivoltaics role in revitalizing the rural areas in Japan. So far, agriculture is often not profitable, especially for small-scale farmers, and therefore unattractive for the younger generation. Agrivoltaics is seen as a way to provide extra income for farmers and support young families in rural areas. Therefore, according to the supporters, the trend of increasing abandonment of farmland and the depopulation of rural areas can be mitigated to a certain extent with the help of agrivoltaics, which will also help to increase food self-sufficiency.

The synergy between agricultural and electricity production is also mentioned. Especially, the improved working conditions for farmers and the protection of crops due to the shading of

the solar panels are highlighted. However, these observations are mostly based on anecdotal evidence rather than on systematic research. Non-Japanese information sources to support arguments were only used five times.

Some users also emphasize the advantages of agrivoltaics over the very negative perceived mega solar projects. In Japan, large-scale ground-mounted solar PV projects are often built on forested mountain slopes. The impact on the local environment due to deforestation, the increased risk of landslides, and the negative visual impact on the landscape are heavily criticized by anti-mega solar movements. It is noticed that agrivoltaics' dual use of flat land mitigates these concerns and therefore should be prioritized.

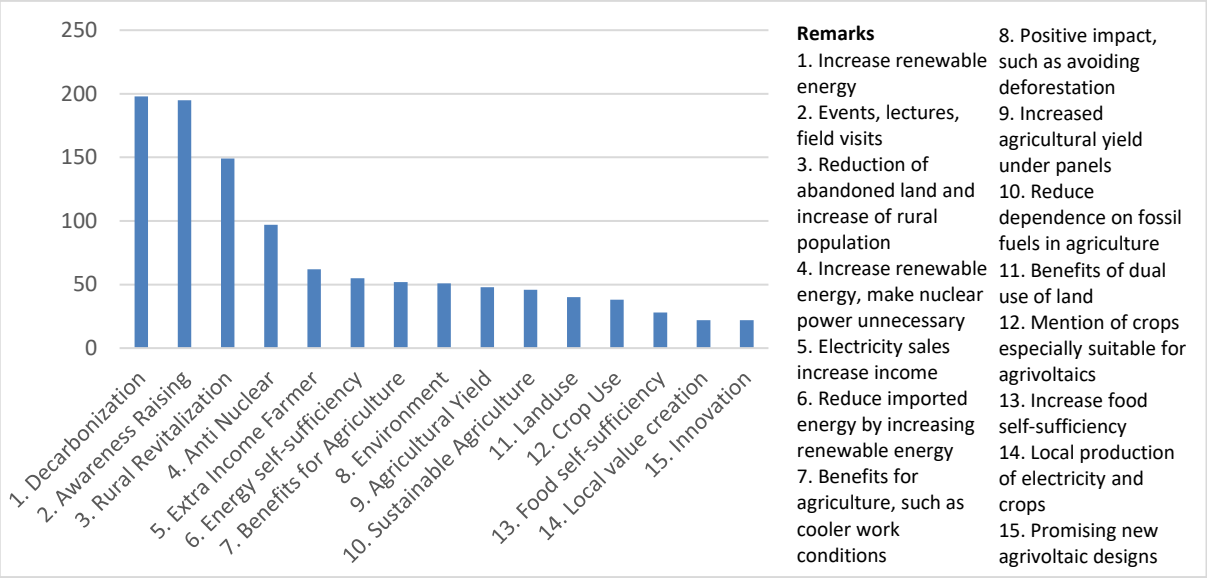

Figure 4. *Benefits of agrivoltaics mentioned in Japanese tweets (n=1,103).*

3.6 User Type

To understand who is tweeting about agrivoltaics, all profiles of the users with primetime tweets were analyzed and a user type based on the profile description was assigned.

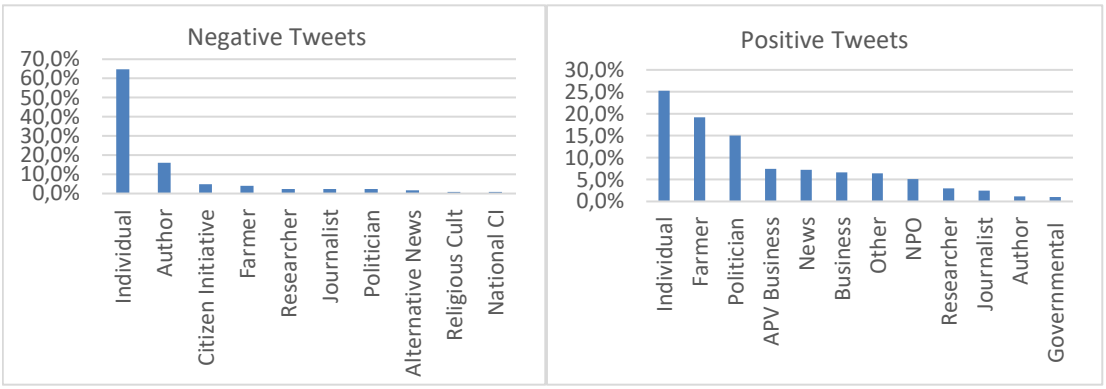

Figure 5. *Share of user types of negative (n=125) and positive (n=765) tweets.*

Users who tweet negatively about agrivoltaics are mainly "individuals", which means that they do not provide any identifying information about themselves on their profile. In other words, these users do not have any apparent professional knowledge or direct experience with agrivoltaics.

On the other hand, supporters are often practitioners with direct experience and knowledge of agrivoltaics. Farmers with (planned) agrivoltaics projects and agrivoltaics businesses combined have a share of 26.7% of all primetime tweets. Left-leaning opposition party members are also showing their support for agrivoltaics on Twitter. The number of tweets increases during election campaigns. On the other hand, supporting tweets by politicians of the ruling party are rare. Only 8% of the tweets by politicians are from the governing Liberal Democratic Party.

4. Conclusion

Agrivoltaics are actively discussed on Twitter in Japan. Thousands of users continuously voiced their concerns and hopes of agrivoltaics during the analyzed 21 months. Currently, the discourse is still very positive with almost three-quarters of tweets being supportive of agrivoltaics. However, the few tweets that are negative receive more attention and therefore, reach a larger audience per tweet. It is important to avoid a shift towards negative narratives fueled by misinformation as it already happened to the mega solar and solar PV online discourse in Japan.

Supporters especially emphasize the role of agrivoltaics in solving big societal problems, such as decarbonization and rural revitalization. Synergies between agricultural and electricity production are mentioned to a lesser extent and are often based only on anecdotes rather than research results. Concerns are mainly about the feared negative agricultural impact of agrivoltaics and the lack of trust in decision-makers. The concerns are not supported by reliable information but are rather grounded on emotional and subjective arguments of opinion leaders with no apparent professional knowledge of agrivoltaics.

It is important to provide reliable and evidence-based information about agrivoltaics both for supporters and opponents, as well as for undecided users who otherwise may be persuaded by misinformation. This information must be in Japanese. Otherwise, the information will not reach the Japanese audience due to the language barrier. Only a handful of references in the thousands of tweets were directed to English information sources. Input from other languages is even rarer. Other non-English speaking countries likely face similar obstacles in accessing the ever-growing English literature on agrivoltaics. A global Frequently Asked Questions (FAQ) homepage for agrivoltaics that is translated into many different languages could help to remove the barrier efficiently. Moreover, best-practice examples from around the world could also be shared, since good projects, as shown in the Japanese Twitter discourse, increase interest and engagement in agrivoltaics.

Author contributions

Christian Doedt: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Validation, Writing – original draft, Writing – review & editing Makoto Tajima: Guidance, Writing – review & editing Tetsunari Iida: Supervision, Funding acquisition

Competing interests

The authors declare that they have no competing interests.

Funding

This work was supported by the Japan Fund for Global Environment.

References

[1] C. Doedt, M. Tajima, and T. Iida, "Agrivoltaics in Japan: A Legal Framework Analysis," *AgriVoltaics Conference Proceedings,* vol. 1, 02/06 2024, doi: 10.52825/agripv.v1i.533.

[2] Ministry of Agriculture Forestry and Fisheries, "営農型太陽光発電設備設置状況等について [Status of Installation of Agrivoltaics Systems]," 2022. [Online]. Available: https://www.maff.go.jp/j/nousin/noukei/totiriyo/attach/pdf/einogata-9.pdf.

[3] Institute for Sustainable Energy Policies, "2023 年(暦年)の自然エネルギー電力の割合 [Share of Electricity from Renewable Energy Sources in FY 2023]," 2024. [Online]. Available: https://www.isep.or.jp/archives/library/14750.

[4] Ministry of Economy, Trade and Industry, "Understanding the current energy situation in Japan," 2021. [Online]. Available: https://www.enecho.meti.go.jp/en/category/special/article/detail_171.html.

[5] Ministry of Agriculture, Forestry and Fisheries, "Summary of the Basic Plan for Food, Agriculture and Rural Areas," 2020. [Online]. Available: https://www.maff.go.jp/e/policies/law_plan/attach/pdf/index-13.pdf.

[6] Ministry of Agriculture, Forestry and Fisheries, "Census of Agriculture and Forestry 2020," 2020.

[7] C. Doedt, M. Tajima, and T. Iida, "The Socio-Technical Dynamics of Agrivoltaics in Japan," *AgriVoltaics Conference Proceedings,* vol. 2, 05/23 2024, doi: 10.52825/agripv.v2i.990.

[8] G. Hübner, V. Leschinger, F. J. Y. Müller, and J. Pohl, "Broadening the social acceptance of wind energy – An Integrated Acceptance Model," *Energy Policy,* vol. 173, 2023, doi: 10.1016/j.enpol.2022.113360.

[9] S. Vosoughi, D. Roy, and S. Aral, "The spread of true and false news online," *Science,* vol. 359, no. 6380, pp. 1146-1151, 2018, doi: 10.1126/science.aap9559.

[10] C. R. Sunstein, "The Law of Group Polarization," *John M. Olin Program in Law and Economics Working Paper No. 91,* 1999. doi: http://dx.doi.org/10.2139/ssrn.199668.

[11] E. Milani, E. Weitkamp, and P. Webb, "The Visual Vaccine Debate on Twitter: A Social Network Analysis," *Media and Communication,* vol. 8, no. 2, pp. 364-375, 2020, doi: 10.17645/mac.v8i2.2847.

[12] V. F. Hendricks and M. Vestergaard, *Reality lost: Markets of attention, misinformation and manipulation*. Springer Nature, 2019 doi: 10.1007/978-3-030-00813-0.

[13] M. Yoshida, T. Sakaki, T. Kobayashi, and F. Toriumi, "Japanese conservative messages propagate to moderate users better than their liberal counterparts on Twitter," *Scientific Reports,* vol. 11, no. 1, 2021, doi: 10.1038/s41598-021-98349-2.

[14] T. Fuchs and F. Schäfer, "Normalizing misogyny: hate speech and verbal abuse of female politicians on Japanese Twitter," in Japan forum, 2021, vol. 33, no. 4: Taylor & Francis, pp. 553-579, doi: 10.1080/09555803.2019.1687564.

[15] K. Borch, A. K. Munk, and V. Dahlgaard, "Mapping wind-power controversies on social media: Facebook as a powerful mobilizer of local resistance," *Energy Policy,* vol. 138, p. 111223, 2020, doi: 10.1016/j.enpol.2019.111223.

[16] J. T. Fergen, J. B. Jacquet, and R. Shukla, "'Doomscrolling' in my backyard: Corrosive online communities and contested wind development in rural Ohio," *Energy Research & Social Science,* vol. 80, p. 102224, 2021, doi: 10.1016/j.erss.2021.102224.

[17] C. Doedt and Y. Maruyama, "The mega solar Twitter discourse in Japan: Engaged opponents and silent proponents," *Energy Policy,* vol. 175, p. 113495, 2023/04/01/ 2023, doi: 10.1016/j.enpol.2023.113495.

[18] Y. Zhang and B. M. Wildemuth, "Qualitative Analysis of Content," *Human Brain Mapping,* vol. 30, no. 7, pp. 2197-2206, 2005.

[19] F. Schäfer, "Japan's Shift to the Right: Computational Propaganda, Abe Shinzō's LDP, and Internet Right-Wingers (Netto Uyo)," *The Asia-Pacific Journal | Japan Focus,* vol. 20, no. 2, 2022, doi: 10.1017/S1557466022018733.