פרטים כלליים על המחקר

1. כותרת המחקר: אגריוולטאי בישראל – ניתוח כלכלי וחקלאי
2. מספר המחקר (בקק"ל) -- 1928
3. סוג הדו"ח: דו"ח מדעי מסכם
4. שם המוסד המוביל את המחקר: אוניברסיטת תל אביב
5. רפרנט קק"ל
6. שם החוקר הראשי ודוא"ל: רם פישמן **ramf@tauex.tau.ac.il**
7. שמות חוקרים נוספים ודוא"ל
8. מילות מפתח: אנרגיה מתחדשת, חקלאות, אגריוולטאי.

תקציר מנהלים

מחקר זה עוסק בניתוח הפוטנציאל בישראל ליישום של ייצור אנרגיה במודל אגריוולטאי – דו-שימוש בקרקע לחקלאות וייצור אנרגיה בטכנולוגיה סולארית PV. גישה זו מבטיחה אפשרות לייצר אנרגיה סולארית בכמויות משמעותיות מאוד מבחינת משק האנרגיה הישראלי מבלי לוותר על שטחים חקלאיים לטובת הקמת תשתית פאנלים. היא מבטיחה גם הגדלה משמעותית של ההכנסה ממשקים חקלאיים מבלי לפגוע בצורה קשה ביבולים. משני טעמים אלה, רבים מאמינים שהיא צריכה להוות מרכיב משמעותי מתכניות האנרגיה של מדינת ישראל.

אך בחינה מדוקדקת יותר של פוטנציאל היישום בישראל צריכה לכלול מימדים כלכליים החורגים ממדידת ביצועיה הטכניים של מערכת אגריוולטאית ברמת החווה הבודדת. ראשית, יש לכמת את פוטנציאל ייצור האנרגיה וההשפעה על תפוקת המזון בתרחישי פרישה שונים כדי להבין את הטרייד-אוף הכרוכים. שנית, יש להבין באיזה מידה קיים ביקוש בקרב חקלאים בישראל לטכנולוגיה וכיצד היא עשויה להשפיע על אופי החקלאות באופן כללי.

כדי למלא פערי ידע אלו, מחקר זה כלל שני מרכיבים.

ראשית, נבנה כלי תכנון מרחבי מבוסס GIS שיתאפשר לכמת את ייצור האנרגיה שמאפשר מסד נתונים בתרחישים שונים של פרישת טכנולוגיית אגרי וולטאי בישראל וכן את ההשלכות על ייצור מזון, אי שוויון חלוקתי וכו.

שנית, נערכו סקרים מקיפים בקרב מאות חקלאים ישראליים על מנת להבין את הביקוש שלהם לטכנולוגיה כתלות בפרמטרים שונים של מדיניות ממשלתית ובפרט תעריף האנרגיה, ובאיזה מידה אימוץ הטכנולוגיה ישפיע על החקלאות שלהם.

תוצאות ניתוחים אלה יכולים לשמש את קובעי המדיניות לעצב את מדיניות האגריוולטאי באופן מיטבי מבחינה ציבורית. אנחנו ממליצים להנגיש את הכלי שפותח לשימושו של הציבור הרחב דרך אתר ייעודי. בנוסף, אנחנו ממליצים להמשיך ולפתח את הכלי יחד עם גורמים מקצועיים במשרדי האנרגיה והחקלאות, כולל על ידי גישה למסדי נתונים ממשלתיים שטרם הונגשו לנו.

Executive Summary

This study analyzes the potential for the deployment of agri-voltaic technology - the dual use of land for agriculture and energy production with solar PV technology - in Israel. This approach offers scope for producing significant amounts of solar energy in the context of the Israeli energy economy without losing agricultural land in order to establish PV infrastructure. It also promises a significant increase in income from agricultural activities without severely damaging crop yields. For these two reasons, it is widely believed that it should be a significant component of the energy plans of the State of Israel.

But a more careful examination of the application potential in Israel should include economic dimensions that go beyond measuring the technical performance of an agrivoltaic system at the individual farm level.

First, the energy production potential and the impact on food production under different deployment scenarios must be quantified in order to understand the trade-offs involved. Second, it is necessary to understand farmer demand for the technology and how adoption may affect the nature of agriculture in general.

To fill these two knowledge gaps, this study consisted of two components.

First, a spatial planning tool based on a GIS database was constructed that helps to quantify the energy production that will be possible in various scenarios of the deployment of the AgriVoltaic technology, as well as the consequences for food production, distributional inequality, and other social and environmental dimensions.

Second, comprehensive surveys were conducted among hundreds of Israeli farmers in order to understand their demand for technology as a function of various government policy parameters, and in particular the feed-in-tariff, and to what extent the adoption of technology might alter their cultivation practices.

The results of these analyzes can be used by the policy makers to design Agrivoltaic policy in Israel in a socially optimal manner. We recommend making the planning tool publicly available through a dedicated website, as well as continuing to develop the tool with officials in the ministries of energy and agriculture, including by gaining access to government data that is needed but has still not been available to us.

בנית כלי תכנון מרחבי לפרישת אגריוולטאי :I חלק

1. פירוט משימות בתקופת המחקר

פירוט השלב	סטטוס	מועד סיום השלב
איסוף נתוני קרינה מ-GIS ברחבי הארץ ברזולוציה מרחבית גבוהה, בתדירות של 30 דק' על פני שנה שלמה.	הושלם	2022
ניתוח משטר הקרקעות בישראל וחידוד סוגיות בין סוגי ישובים	הושלם	2022
בניית מודל לפוטנציאל ייצור האנרגיה אשר מבוסס על נתוני הקרינה, טמפרטורה, הספק מותקן, ומודל PV עבור טראקרים חד-ציריים	הושלם	2022
התחשבות בפריסה הקיימת של קווי הרשת החשמלית בניתוח.	לא הושלם. לא הצלחנו לקבל נתונים למרות נסיונות חוזרים ונשנים מול גורמים שונים בממשלה.	
מיפוי גידולים לפי מיקום ב-5 השנים האחרונות על בסיס מסד נתונים של משרד החקלאות.	הושלם	2022
יצירת בסיס נתונים לשינוי בביומסה ותוצר חקלאי כתוצאה מהשפעת שיטת האגריוולטאי, על סוגי הגידולים השונים, על בסיס הספרות הקיימת המחקרית שיתעדכן באופן דינמי ליצור תמונת מצב עדכנית.	הושלם.	2022
שילוב שני מסדי הנתונים שלעיל.	הושלם.	2022
תכנות המערכת ובנית ממשק משתמש ליצירת תרחישים	הושלם.	2023

2. כנסים בהם הוצג המחקר
   a. כנס קק״ל במוזיאון המדע באוניברסיטת תל אביב
3. תקציר המחקר להלן.

Summary of Scientific Progress: A Tool for the Spatial Analysis of Agrovoltaic Deployment (SAAD)

The integration of solar panels with agricultural crops entails a shared use of land and light, combining solar photovoltaic power generation with farming activities. Consequently, designing agrivoltaic facilities requires careful consideration and trade-offs to optimise objectives such as crop yields and energy production efficiency, without compromising core environmental constraints.

In order to facilitate these analytical and visualisation capabilities, we have developed an Agrivoltaic GIS tool called SAAD. This tool provides policymakers with a comprehensive set of tools for assessing, analysing, and directing agrivoltaic public policy initiatives. By utilising geospatial data and analysis, SAAD enables policymakers to simulate various agrivoltaic project deployment scenarios. This serves as a basis for making informed decisions aimed at maximising the economic, social, and environmental benefits of agrivoltaic systems.

SAAD's uses:

1. **GIS-Based System for Energy Generation Potential and Agricultural Output Impact Assessment**: An advanced GIS-based system designed to assess the energy generation potential and agricultural output impacts at the plot level.
2. **Integrated Planning Tool**: A comprehensive planning tool that calculates energy generation potential, costs, and the impacts on agricultural output, as well as additional ecological and social impacts. Users can specify various planning scenarios and constraints, including grid capacity, administrative limitations, and more.
3. **[Future Development]: Spatial Optimization Tool for Agri-voltaic Prpjects Deployment**: A powerful tool for spatial optimization, facilitating the deployment of agri-voltaic PV systems across the country. Users can set constraints such as administrative factors and limitations on agricultural output changes. The tool helps optimise energy generation while minimising various impacts, ensuring sustainable deployment.

To achieve these objectives, the GIS tool utilizes multiple data layers and employs an advanced model to calculate the two primary outputs essential for informed decision-making: energy generation potential and the impact of photovoltaic (PV) systems on crops.

The following are the data layers were included in the tool:

1. **Solar radiation potential** (annual average) - this layer illustrates the level of solar radiation in each polygon, which can be utilized to generate solar power.
2. **Electric grid capacity availability** per area - this layer provides information on the local grid's capacity to accommodate new renewable energy sources.
3. **Agricultural plots** (location, size, crop type) - This layer displays agricultural plots, their sizes, and the types of crops grown in each area.
4. **Administrative borders** - This layer delineates the borders of local authorities and assigns each agricultural crop to its corresponding area.
5. **Environmental constraints** - primarily ecological corridors and other sensitive land. This layer provide insights on the relevant polygons, which AV projects could be planned. The layer should take into account land zoning and additional planning restrictions in order to evaluate land availability.

Key components of the calculative model

1. **Energy-related calculation**

The purpose of the energy calculation section is to calculate the energy production potential from the PV deployments in each defined scenario, and, the potential revenue from solar energy generation in this scenario.

Energy generation potential: The energy generation potential is determined by multiplying the area of the photovoltaic (PV) installation by the type of PV factor and by the solar radiation potential at each location across the country, assuming that the electricity grid capacity is sufficient to transmit the energy:

1. **Solar Radiation** - Solargis provides an estimate of the solar photovoltaic (PV) power generation potential. The estimates are based on fixed tilt panels, while for bifacial

panels, the potential is typically higher by approximately 5%. The calculation of solar electricity is based on high-resolution solar resource data and PV modelling software provided by Solargis. This calculation incorporates various factors including solar radiation, air temperature, and terrain. It simulates the energy conversion and losses in the PV modules and other components of a PV power plant to provide accurate estimates of energy generation potential.

2. **Type of PV factor** - Different types of PV technologies exhibit varying energy generation potentials. Therefore, in order to change the Solargis PVOUT from fix-tilt to one or two axis tracker, we will multiply the sun hours by a factor of the specific installation type and geographical location according to relations that were extracted from NREL official figures.
3. **Ground Cover Ratio** - GCR describes the percentage of ground covered by photovoltaic (PV) panels. The GCR typically ranges from 0 to 1. In reality, ground-mounted solar plants usually have a GCR between 0.5 and 0.6, while agrivoltaic (APV) systems typically range from 0.3 to 0.5. In some APV systems, trackers adjust based on crop needs, which may require reducing sun exposure by a specific factor, typically between 0 and 0.15.
4. **Grid Capacity** - Data from Israel’s Electric Company (IEC) provides information on the grid's capacity to accommodate new renewable energy sources. This data determines the Agrivoltaic system's ability to connect to the national grid, taking into account factors such as proximity to transmission stations, transmission station capacity, connectivity priority, and electrical planning restrictions. If the grid is at full capacity in a particular area, the entire calculation would be multiplied by 0 to indicate the inability to use the generated energy. Conversely, if the grid has sufficient capacity in a certain area, the entire calculation would be multiplied by 1 to demonstrate the ability to use the generated energy.

Revenue potential: The revenue from solar energy generation potential is determined by multiplying the energy generation potential by the feed-in tariff.

1. **Energy generation potential** - as described above, multiplying the solar radiation by the type of PV factor and by the ground cover ratio.

2. **Feed-in tariff** - As electricity feed-in tariffs are subject to change, we have assumed a rate of 0.5 NIS per kW produced. However, users have the flexibility to update this figure according to their defined scenarios.

2. Crops-related calculation

The agricultural yield calculation section is designed to determine the total crop yield potential and assess the potential impact of installed PV systems on this potential. The impact varies for each crop type, as different crops require different levels of sunlight exposure. Therefore, the extent to which PV systems shade them affects each crop differently.

Crop yields potential - The crops yields potential is determined by multiplying the average crop yields (per crop type) by the potential impact of PV on this type of crop factor and by the area of the photovoltaic (PV) installation:

1. **Average crop yields** - Average crop yields are predefined figures provided by the Ministry of Agriculture. These figures represent multi-year measurements of average yields (in kilograms) per type of crop per square kilometre.
2. **Potential impact of PV on crops** -The exact potential impact of PV systems on crops is currently unknown, as pilot studies conducted by the Ministry of Agriculture are not yet complete. However, we have utilised figures from global research in the field to estimate the potential impact of PV systems on each type of crop. These estimates are provided as default values, which can be adjusted by users once real data from the pilot studies is measured and validated. The full list of research papers can be found in Appendix A.
3. **Ground Cover Ratio** - GCR describes the percentage of ground covered by photovoltaic (PV) panels. The GCR typically ranges from 0 to 1. In reality, ground-mounted solar plants usually have a GCR between 0.5 and 0.6, while agrivoltaic (APV) systems typically range from 0.3 to 0.5. In some APV systems, trackers adjust based on crop needs, which may require reducing sun exposure by a specific factor, typically between 0 and 0.15.

Revenue potential: The revenue from the potential impact of PV systems on crops is calculated by multiplying the potential impact on crop factor by the average crop yields and by the average price per kilogram of the crop in the market over the last few years:

1. **Average crop yields** - Average crop yields are predefined figures provided by the Ministry of Agriculture. These figures represent multi-year measurements of average yields (in kilograms) per type of crop per square kilometre.
2. **Potential impact of PV on crops** -The exact potential impact of PV systems on crops is currently unknown, as pilot studies conducted by the Ministry of Agriculture are not yet complete. However, we have utilised figures from global research in the field to estimate the potential impact of PV systems on each type of crop. These estimates are provided as default values, which can be adjusted by users once real data from the pilot studies is measured and validated. The full list of research papers can be found in Appendix A.
3. **Average price per Kg** - the average price per kilogram of each of the crops are predefined figures provided by the Ministry of Agriculture. These figures represent multi-year measurements of average price per kilogram of each of the main types of crops sold in Israel in the past decade.

3. Socio-economic calculation

The socio-economic calculation section is designed to evaluate how economic benefits are distributed among different socio-economic layers of society. Given the significant potential economic impact of agrivoltaic projects, this analysis can provide insights into the availability of opportunities across various social layers in Israel. It helps determine whether a particular scenario narrows or widens socio-economic gaps in the country.

Revenue distribution: The expected distribution of potential revenue from energy production among different socio-economic deciles of the Israeli population is calculated by determining the socio-economic decile of the groups likely to benefit from this revenue in various agrivoltaic deployment scenarios simulated by the tool.

1. **Socio economic decile**: A socio-economic decile is a statistical measure used to categorise a population into ten groups based on their socio-economic status. Each decile represents 10% of the population, ranging from the lowest socio-economic status (1st decile) to the highest (10th decile). This categorization helps in understanding the distribution of socio-economic conditions within a population. We have utilised data from the Israel Central Bureau of Statistics detailing the socio-economic decile of each city or settlement in Israel.
2. **Potential revenue from energy production**: as described above.

We presented the revenue distribution per socio-economic decile to illustrate the distributional implications of each PV deployment scenario. This analysis shows how potential revenue from photovoltaic energy generation is expected to be distributed across different socio-economic groups, highlighting the impact of each deployment scenario on various segments of the population.

Database structure

The GIS tool database is designed to accurately reflect the implications of various agrivoltaic deployment scenarios. It comprises four main data layers:

1. **Agricultural Plots data layer**: Provided by the Ministry of Agriculture, this layer includes detailed information on the location and crop type of agricultural plots. Each plot is attributed with additional data such as geolocation, size in dunams, crop sector (e.g., citrus), crop sub-sector (e.g., peelables), specific crop type (e.g., mandarin), and crop cover type (covered or uncovered). Since the types of crops grown in each agricultural plot change annually, we designed the tool and its database to allow users to easily update this data layer with new information each year. Currently, the tool includes baseline data provided by the Ministry of Agriculture for 2023.
2. **Administrative classification data layer**: This layer, sourced from the Ministry of Interior Affairs, includes the administrative classification of every location in Israel, encompassing each agricultural plot. It features region classification (north, south, centre, etc.), administrative classification by municipality and the name of the municipality. This layer is enhanced with data from the Israel Central Bureau of

Statistics, which provides the socio-economic decile classification of each municipality in Israel.

3. **Solar Radiation Data Layer**: This layer is sourced from the SolarGIS platform (https://solargis.com) providing global Solar irradiance data, and details the potential solar radiation for every location in Israel, including each agricultural plot.
4. **Environmental Sensitivity Data Layer**: This layer is sourced from the Ministry of Environmental Protection and identifies environmentally sensitive areas where photovoltaic technology should not be deployed.

Agrivoltaic deployment scenarios

The GIS tool was developed to simulate various agrivoltaic technology deployment scenarios and evaluate their implications comprehensively. This includes assessing energy generation, impact on crop yield and health, and the economic value of each scenario. Users have the flexibility to define scenarios by setting specific threshold conditions, which filter the deployment possibilities according to desired criteria. This allows for the creation of tailored potential scenarios that align with specific goals and constraints - enabling users to explore a wide range of "what-if" scenarios, helping them understand the trade-offs and synergies between different public policies alternatives.

Example: “Max out” scenario - PV deployment in every agricultural plot in the country

This scenario envisions the maximum potential for agrivoltaic technology deployment across Israel, assuming no limitations or setbacks. It involves installing photovoltaic (PV) systems in every agricultural plot in the country. While this scenario is not realistic, of course, by considering the full extent of available agricultural land, this scenario aims to demonstrate the upper limit of energy generation and the possible economic and environmental impacts of widespread agrivoltaic implementation. It is only meant here as an illustration.

This scenario is based on several key assumptions:

1. **PV Technology**: The installed PV systems are equipped with trackers, representing the most efficient technology available for maximizing energy capture.
2. **Coverage Limitation**: PV systems would cover 100% of each agricultural plot. Although current regulatory limits dictate a maximum of 30% coverage rate, this

scenario assumes the removal of these constraints to reflect the maximum potential for energy production.

3. **Energy Pricing**: The generated power would be sold at a rate of 0.5 NIS per kWh. Although this rate is slightly higher than the average price of 0.3 NIS per kWh, it is intended to reflect the maximum potential for optimistic yet realistic revenue from energy production.
4. **Environmental Considerations**: This scenario does not take into account any environmental limitations. While issues such as ecological corridors, land sensitivity, rivers, and other environmental restrictions are likely to significantly impact the potential for PV deployment, this assumption allows for the assessment of maximum energy production potential without considering these factors.
5. **Statutory Considerations**: No statutory limitations are considered in this scenario. Although factors such as land designation, ownership, taxes, and other similar issues are expected to significantly affect the potential for PV deployment, this scenario assumes the removal of these constraints to reflect the maximum potential for energy production.

By utilising these assumptions, the "Max Out" scenario provides a theoretical upper limit for agrivoltaic deployment. This helps policymakers understand the full extent of what could be achieved under ideal conditions and serves as a foundation for discussions and planning around more realistic and sustainable agrivoltaic deployment strategies in Israel.

Energy production potential

This scenario results in a total energy generation potential of 631,319 million kWh per year, equivalent to an annual energy generation capacity of 72 kW. Out of this total, the vast majority of energy production (over 77%) is generated from PVs installed on either field crops, plantations, or vegetable crops. Specifically, 227,226 million kWh per year (36%) are attributed to potential PVs deployed on field crop plots, 161,073 million kWh per year (25.5%) are attributed to potential PVs deployed on plantation plots, and 98,514 million kWh per year (15.6%) are attributed to potential PVs deployed on vegetable crop plots.

Figure 1: Nominal energy generation potential of “Max Out” scenario, by crop sector

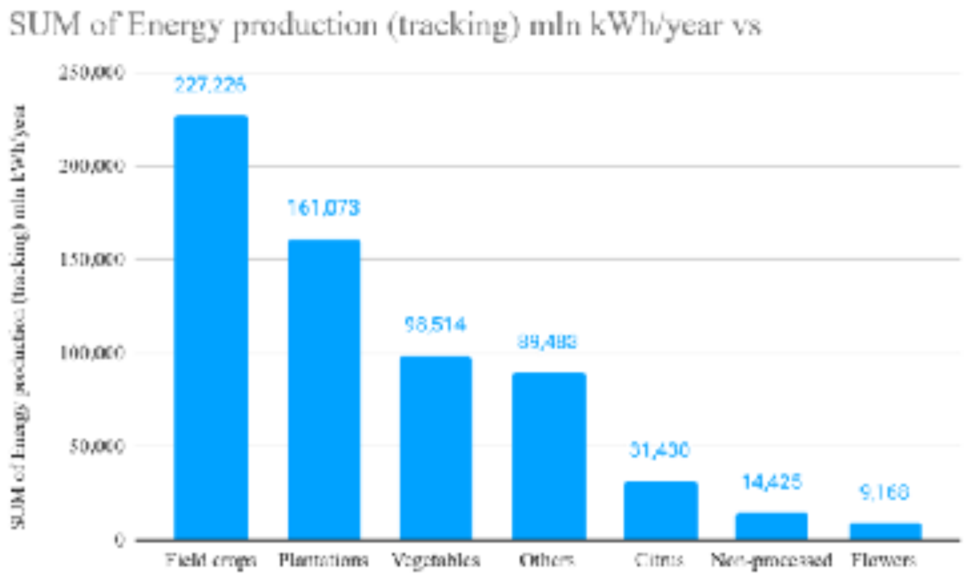
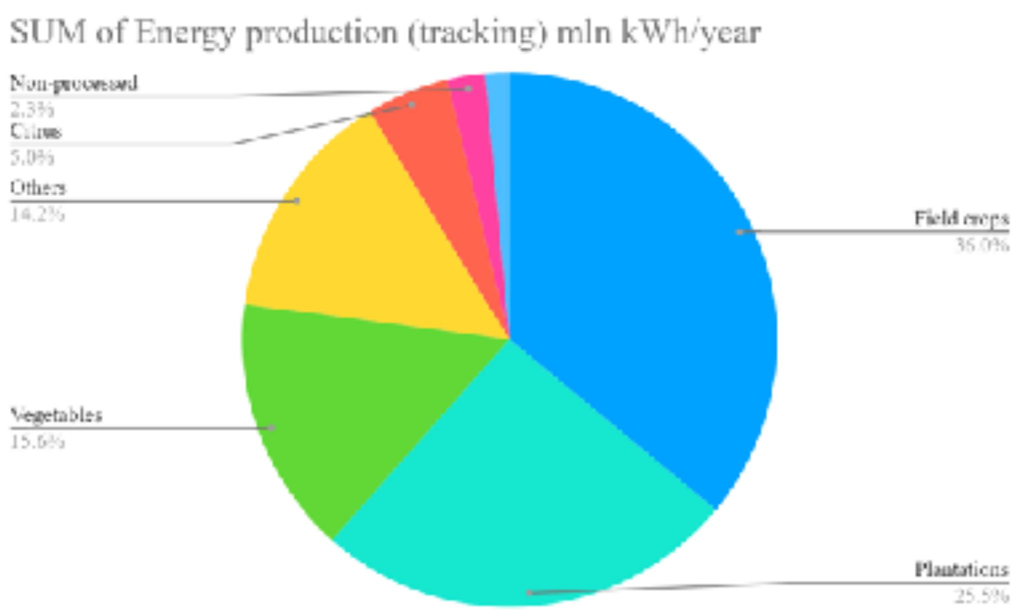


Figure 2: Percentage energy generation potential of "Max Out" scenario, by crop sector



חלק 2: סקר של חקלאים ישראליים

1. פירוט משימות בתקופת המחקר

פירוט השלב	סטטוס	מועד סיום השלב
יצירת מסד נתונים לישובים ובחירת קריטריונים לישובים רלוונטיים	הושלם	ינואר 2021
ניתוח משטר הקרקעות בישראל וחידוד סוגיות בין סוגי ישובים	הושלם	אפריל 2021
בניית סקר ראשוני	הושלם	יוני 2021
ביצוע פיילוט לסקר	הושלם	דצמבר 2021
תיקון סקר סופי	הושלם	פברואר 2022
ביצוע סקר פנים אל פנים בישובים: 172 נסקרים ב57 ישובים.	הושלם	אוקטובר 2022
ניתוח תוצאות הסקר	הושלם	ינואר 2023
כתיבת פרק מבוא	הושלם	מרץ 2023
כתיבת פרק שיטות	טיוטה להערות	אפריל 2023
ניתוח התוצאות וכתיבת פרק תוצאות ודיון	טיוטה להערות	יוני 2023
כתיבת פרק המסקנות	טיוטה להערות	אוגוסט 2023

2. כנסים בהם הוצג המחקר
   a. The World Conference - Agrivoltaics 2023 (South-Korea)
   b. The Israeli Agrivoltaics conference – Sunnyside 2023
   c. הועידה השנתית ה-51 למדע ולסביבה סיכום מחקר והמלצות
3. סיכום המחקר ומסקנותיו מוצגים מטה. בכדי לראות את הגרפים הנלווים, אנא פתחו את עבודת התיזה המלאה ובסופה כל הגרפים.

Summary of Scientific Progress: Survey of Israeli Farmers

We conducted a survey of almost 200 Israeli farmers in order to better understand perceptions of and demand for Agri-Voltaic PV (APV) and the factors that shape it. In this summary, we will focus on informing policy and regulation formulation on the basis of the survey results. Detailed results can be found in the enclosed final paper.

The main focus of the survey was to understand under which financial conditions farmers of different types will be interested in adopting APV. Overall, we found a substantial level of demand for APV in most reasonable levels of annual rent. There were some groups, however, in which demand was lower.
Like any new product, challenges perceived by users are typically more significant during the pioneering phase when the technology is unfamiliar to farmers. Addressing these challenges with practical solutions is crucial during the adoption phase. Many of these challenges and solutions will remain relevant in a mature market, albeit to a lesser extent.

Through APV rent and partnership offerings, we identified a significant challenge in reducing financial and agricultural risks perceived by farmers when adopting APV technology. Small farms, moshavim, and older individuals are particularly less interested in APV. These groups also face challenges adapting to new crops or agricultural methods, possibly due to limited crop diversity, agricultural machinery, and knowledge among smaller farms and moshavim. Another reason for perceived high risk is the absence of future generations interested in farming, especially within family-owned farms. Older farmers may also lack motivation to learn, adapt, and invest in new agricultural methods.

We also observed a high reluctance among field crop growers to adopt APV under almost any level of rent offering, possibly due to operational uncertainties associated with integrating APV with large machinery and cultivating diverse crops with different needs on the same land using crop cycle methods. Interestingly, 37% of farmers indicated willingness to accept some agricultural yield loss due to APV, provided the overall energy and agriculture project is more profitable. This sentiment was particularly strong among Kibbutzim and field crop growers.

While 48% of farmers believe that integrating APV into their farms will increase agricultural motivation, 23% express concerns about decreased motivation. Notably, a higher percentage of farmers believe that the impact on agricultural motivation among younger generations will be larger as compared to existing farmers. This suggests that increased profitability and advanced technology may not necessarily attract non-farmers to join the agriculture industry. However, if they do choose farming, it could significantly boost their motivation.

When asked about the main efforts needed from the government to foster a flourishing APV market, farmers identified bureaucracy as their primary concern. The challenges posed by bureaucracy include the permit process for installing APV on farms and the operational tasks required to comply with future APV regulatory standards. Additionally, farmers emphasized the need for governmental financial assistance, such as subsidies, grants, and favorable feed-in tariffs for electricity sales.

Sharing updated knowledge with farmers is essential. This includes information on suitable crops and APV structures, agronomic results, best agricultural practices, financial outcomes, and bureaucratic processes. Emphasizing the positive aspects of being an APV farmer—such as sustainability, technology integration, and reduced financial risk—can further encourage adoption among existing and potential farmers. This information should be disseminated through agricultural ministries, associations, schools, and academic faculties.

Regarding APV rent levels, while nearly 70% of farmers willing to integrate APV in their farms accept rent levels of 12,000 NIS/ha/year or less, current market reality sees offers as high as 30,000 NIS/ha/year, with some companies offering up to 50,000 NIS. The competition among IPPs for land, combined with uncertainty about APV feed-in tariffs, has driven rent levels upward. It remains to be seen how demand will shape once uncertainty is reduced. But our results suggest that the government may be able to meet substantial portions of its energy needs without raising tariffs to very high levels.

It seems that streamlining regulatory processes to reduce complexity and cost for APV development is vital. Learning from the challenges of ground-mounted PV projects, governments should simplify APV development permitting to expedite deployment. Clear land designations specifying where APV is allowed, disallowed, or conditionally permitted could streamline approvals, reducing bureaucracy and time required for local planning.

Addressing grid availability challenges is essential for successful APV deployment. Enhancing grid infrastructure and transparency on grid availability, including geographical dimensions and improvement timelines, would facilitate increased PV deployment.

In conclusion, Agrivoltaics presents a potential solution for enhancing renewable energy demand and mitigating agriculture-related climate risks. This study offers pioneering research on farmer perceptions regarding APV integration, identifying challenges and potential accelerators for the market. Predicting technology adoption can guide regulatory frameworks and avoid critical errors. It is imperative for the Israeli government to review these findings and collaborate with stakeholders across agriculture and energy sectors to shape future regulations. Establishing a dedicated APV forum involving government, academia, businesses, and NGOs would facilitate ongoing analysis, implementation of solutions, and result evaluation.

Future economic research should focus on farmers currently working under APV panels as part of Israel's 2023-2026 pilot initiative to examine actual behaviors rather than hypothetical predictions.

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