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TRANSFORMING FOOD SECURITY IN THE REPUBLIC OF MOLDOVA THROUGH THE AGROVOLTAIC CONCEPT

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Abstract

In the economic conditions, in which vulnerabilities are increasingly accentuated, the issue of ensuring food security for the Republic of Moldova is becoming not so much an agricultural issue but a comprehensive one directly related to sustainable macroeconomic development, its ability to implement socially oriented policies, the constant increase in the standard of living of the population and the use of the advantages of the international division of labor in agriculture. Solving these problems cannot be achieved without implementing new technologies in agriculture. Based on these arguments, we set out to investigate the opportunities for increasing food security by applying new innovative approaches, such as Agri-PV. The research methodology includes quantitative and qualitative methods based on national and international data sources. The main results highlight that the advantages of Agri-PV in the Republic of Moldova primarily relate to the favorable climatic zone for these technologies, the average annual duration of sunshine, and the variety of crops grown in the Republic of Moldova. We want to mention that the use of Agri-PV not only increases productivity and soil quality but also makes it possible to use green energy. At the same time, we have revealed that there are several impediments that hinder the implementation of photovoltaic panels in the Republic of Moldova.

Key words: *agrovoltaics, Republic of Moldova, resilience, food security, renewable energy, sustainable agriculture, climate change*

INTRODUCTION

Food security is critical to global, national, and personal security. The evolution of society and the environment makes adjustments to the food security system. Historically, natural disasters and adverse climatic conditions have been the primary threats to food security. In modern times, however, economic and socio-cultural factors, and more recently, military-political events, have added to these challenges.

Today, a paradox exists in the global food system: while hunger remains the cause of millions of deaths each year, global food production is generally sufficient to meet the world's food needs. Achieving a stable state of food security for all people - ensuring physical, economic, and social access to food - is essential to maintaining human potential and enabling sustainable development.

In the context of destabilized global markets, maintaining the stability of national food systems and ensuring the efficient functioning of food markets, agricultural commodities and food production is a cornerstone of food security.

Effective strategies are urgently needed to promote adaptive development and mitigate vulnerabilities that affect food security.

The Republic of Moldova, being a country that, at first glance, should not present problems regarding food security due to its reasonably high level of self-sufficiency (Stratan et al., 2024) [23], nevertheless faces significant challenges regarding food security resilience. In this situation, new innovative approaches are needed to increase food security. Such an approach could be agrovoltaics. Agri-Photovoltaics (Agri-PV) is a direction in agriculture that combines solar energy production and agriculture on the same land (Widmer, 2024) [30]. Installing photovoltaic panels on agricultural land allows farmers to generate clean energy while continuing to grow crops, making the most of the land.

Through this system, it is possible to meet the growing energy demand, protect crops, and manage the risks associated with climate change. At the same time, agri-PV has double advantages: it produces green energy and improves food security. Based on these arguments, we propose investigating the opportunity to implement agri-PV in the Republic of Moldova to strengthen food security.

The research's purpose is expected to be achieved by achieving the following objectives:

(1) Identifying the capacities for implementing Agri-PV in the Republic of Moldova.

(2) Elucidating the advantages of Agri-PV for increasing food security in the Republic of Moldova.

The research methodology used to execute the proposed purpose and objectives will be qualitative and quantitative. The data will be accessed from national (NBS) [19, 20] and international databases (FAOSTAT [6, 7, 8, 9, 10], The World Bank Data) [24, 25, 26] databases.

MATERIALS AND METHODS

In order to achieve the purpose and objectives of the study, a mixed arsenal of scientific methods was applied based on the versatility of the research topic. The research began by analyzing Agri-PV literature and its impact on agricultural productivity and food security. Subsequently, statistical methods were used to track the evolution of the leading food security indicators, namely, techniques for calculating the average, dispersion, and percentages. In order to compare the food security indicators of the Republic of Moldova with those of other states and highlight the performance level and the potential for improvement, comparative analysis was applied. In order to interpret the impact of Agri-PV on the six dimensions of food security, taking into account the socio-economic conditions and climatic characteristics of the Republic of Moldova, qualitative analysis was applied.

During the research, several indicators for evaluating the dimensions of food security were examined: availability (volume of agri-food production, Self-Sufficiency Ratio – SSR, Import Dependency Ratio – IDR); access (evolution of prices for agri-food products, Gini coefficient); use of (average caloric and protein consumption per capita); stability (Value Added (Agriculture, Forestry and Fishing)Share of GDP US$; Agriculture, forestry, and fishing, value added per worker (constant 2015 US$); Gross Production Index Number (2014-2016 = 100) (Agriculture); agency (Prevalence of severe food insecurity; Prevalence of moderate or severe food insecurity); sustainability (temperature change on land, meteorological year (Standard Deviation); food waste per capita (kg); terrestrial protected areas (% of total land area)).

The analysis was based on a set of statistical and informational data sources. The information sources and statistical databases used were national and international. Among the national sources, we can mention the National Bureau of Statistics of the Republic of Moldova: data on cultivated area, agricultural production, yield per hectare, and other relevant indicators for the agri-food sector were taken; Reports and official documents of the Ministry of Environment and other national authorities, which provided information on the average duration annual sunshine, climate change and government programs to support renewable energy.

The international data sources used were the following: FAOSTAT: data were collected on international agricultural production, per capita calorie and protein consumption, and indicators for establishing benchmarks for food security; The World Bank Data: was used for information on the value added in agriculture in GDP, the share of agri-food exports, and macroeconomic developments.

By combining these information sources with research methods, the study aimed to highlight to what extent Agri-PV implementation can positively influence food security in the Republic of Moldova, especially in the context of climate vulnerabilities and the energy crisis.

RESULTS AND DISCUSSIONS

Literature review

As the world grapples with climate change, energy security, and sustainable food production, the Agri-PV market has emerged as a game-changing solution.

By integrating agriculture with solar energy, Agri-PV enables the simultaneous production of food and electricity on the same land. This dual-purpose approach not only addresses energy and food needs, but also represents a compelling investment opportunity in the burgeoning renewable energy sector.

Agri-PV installations involve placing photovoltaic panels on agricultural land, allowing farmers to generate clean energy while continuing to grow crops. This innovative system optimizes land use, helps farmers meet their energy needs, protects crops, and mitigates the risks of climate change. Studies have demonstrated its effectiveness: research by Germany's Fraunhofer Institute for Solar Energy Systems (ISE) as part of the Agrophotovoltaics – Resource Efficient Land Use (APV-RESOLA) [11] project showed increased land use efficiency and crop yields (e.g., celery, winter wheat) under solar panels, particularly in arid regions (ISE, 2019).

Additional research, including a study from Oregon State University published in *Nature* (Adeh et al., 2019) [1], highlights the potential of agri-PV. The study identifies cropland, grassland, and wetlands as optimal locations for solar panel performance and notes the positive effects of diffuse shading from photovoltaic panels on crop yields. While shading effects vary by crop (Lee et al., 2022) [14], careful planning can maximize benefits.

Agri-PV aligns seamlessly with the goals of the European Green Deal (EGD) [4], which addresses food security, sustainable agriculture, biodiversity, and innovation.

However, it is crucial to ensure that agricultural land remains productive after installation. At the EU level, legislation on agri-PV varies between member states. Germany, for example, is a leader in setting technical standards (Czyżak and Mindeková, 2024) [3].

(1)Figure 1 illustrates how Agri-PV can impact different dimensions of food security **Optimizing land use.** Combining agricultural production with power generation enables more efficient use of limited land resources, especially in land-scarce regions. This can contribute to improving the following dimensions of food security: availability and sustainability.

(2)**Build resilience to climate change.** Agri-PV mitigates the impact of climate change on agricultural production by protecting crops from extreme weather events such as droughts and heat waves. This positively contributes to the ***availability***, ***agency***, and ***sustainability*** dimensions of food security.

(3)**Crop protection.** Solar panels installed above crops provide partial shade, reducing heat stress on crops during heat waves. This creates a more favorable environment for plant growth, resulting in higher yields, especially under changing climate conditions. This benefit reinforces the dimensions of ***availability*** and ***utilization***.

(4)**Reducing Greenhouse Gas Emissions.** By promoting the use of solar energy, Agri-PV reduces CO_2 emissions and helps combat climate change. This contributes to the ***sustainability*** dimension and supports the ***agency*** aspect of food security.

(5)**Mitigating drought and soil overheating.** Solar panels provide shade, reducing water evaporation and maintaining stable soil temperatures. These effects promote plant growth and improve the ***availability***, ***accessibility***, and ***stability*** of agricultural products.

(6)**Enhancing economic resilience.** Farmers gain an additional source of income through the sale of electricity, which improves their financial stability and reduces the risk of crop failure. This positively impacts the ***availability***, ***access***, ***utilization***, and ***stability*** dimensions of food security.

(7)**Facilitating access to irrigation.** On-site power generation from Agri-PV can power pumps and drip irrigation systems, increasing the efficiency of water use. This supports the ***availability*** and ***sustainability*** of food security.

(8)**Reducing dependence on external energy sources.** A reliable supply of sustainable energy promotes rural development and increases food self-sufficiency, thereby improving the ***availability***, ***accessibility***, and ***stability*** of food security.

(9)**Promoting innovation and sustainable agriculture.** Agri-PV promotes the transition to sustainable, low-carbon agricultural practices. This strengthens all six dimensions of food security, with particular emphasis on ***availability*** and ***access***.

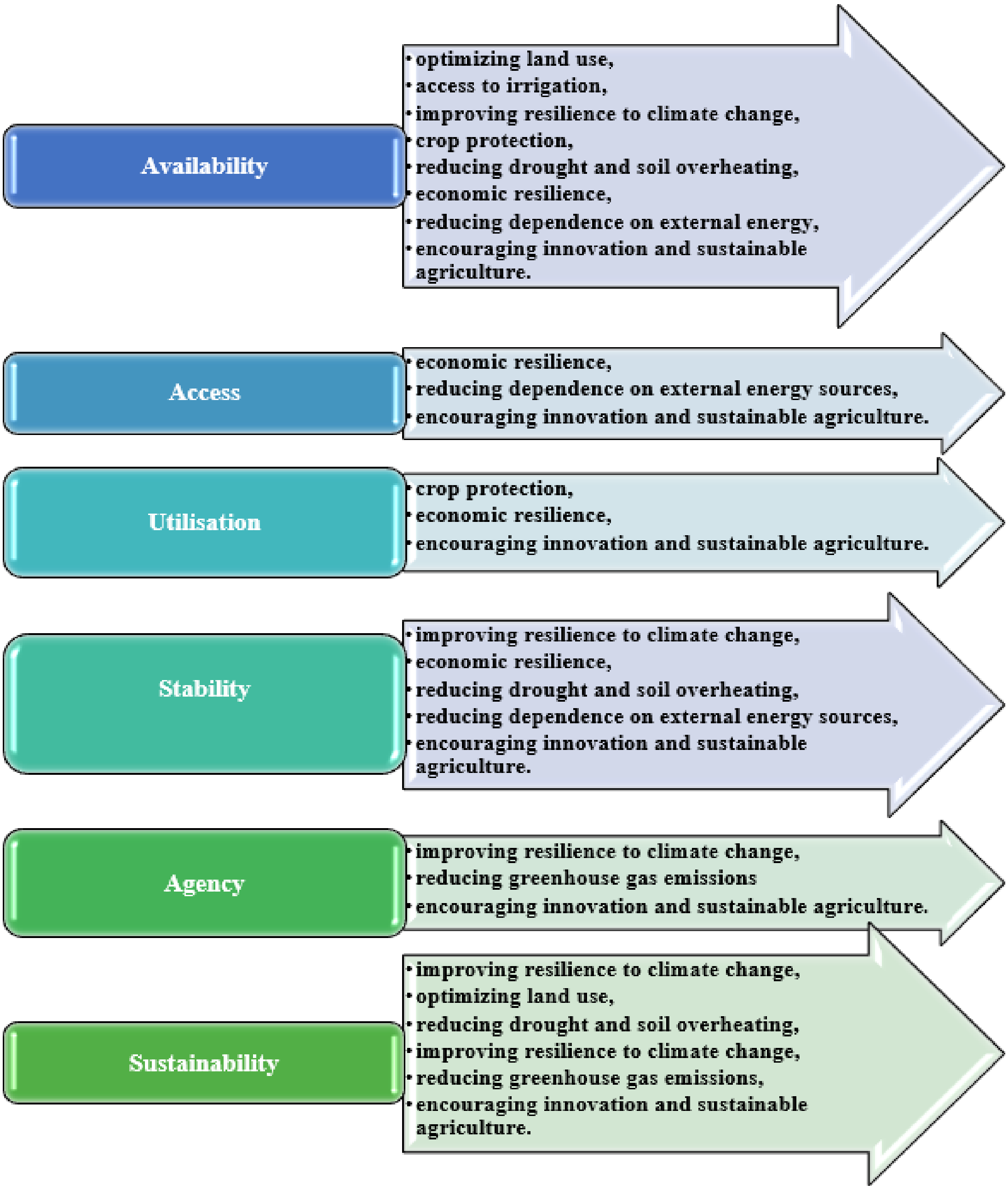

Fig. 1. Strengthening dimensions of food security security through Agri-PV
Source: developed by the authors.

Research shows that it is possible to increase land productivity by 35% to 75% (Sarr, 2023) [22], using it efficiently for agriculture and energy production. In regions with abundant sunshine, Agri-PV represents an excellent opportunity to improve the economic sustainability of farms and an innovative approach that not only meets the dual needs of energy and food but also offers an opportunity for investment in the rapidly growing renewable energy sector.

Agri-PV can improve food security by increasing yields, sustainable agricultural production, and creating additional economic opportunities for farmers.

The role of agriculture in the economy of the Republic of Moldova

Agriculture is a central pillar of the Republic of Moldova's economy, directly impacting the country's economic and social development. Although the added value of agriculture in GDP in 2023 was 7.6% and has decreased by 2 times over the last decade (The World Bank Data, 2023 a [24], agri-food exports account for 57% of total exports (The World Bank Data, 2023 b) [25]. The Republic of Moldova benefits from fertile soil and favorable climatic conditions for cultivating various crops.

The average duration of annual sunshine has increased over the last thirty years. The duration of sunshine is significantly increasing in the north of the country, where the difference between the years 1961-1990 and 1991-2020 is 196 hours. During the warm season, the increase is more pronounced, ranging from 124 additional hours in Briceni (north) to 83 hours in Cahul (south). During the cold season, the differences are smaller - 72 hours in Briceni and 68 hours in Cahul. Currently, the average annual sunshine duration is 2,107 hours in Briceni, 2,271 hours in Chisinau and 2,328 hours in Cahul (Ministry of Environment, 2022) [17].

However, Moldovan agriculture faces many challenges. These include climate change affecting production, soil degradation caused by unsustainable agricultural practices, and limited access to modern technology and investment. The recent energy crisis has exacerbated these problems, exposing the country's energy vulnerabilities and underscoring the need to diversify energy sources and reduce dependence on external suppliers. In addition, food security remains a pressing concern, with notable shortfalls in some areas.

Given these circumstances, conditions in Moldova are favorable for the adoption of agro-photovoltaics (Agri-PV), a technology that integrates solar energy generation with agricultural production. Agri-PV offers numerous benefits, particularly in terms of improving food security.

The efficiency of Agri-PV systems is achieved by balancing energy production with maintaining or increasing agricultural yields. Successful application depends on several factors, which can be divided into several categories:

(i)*technical factors* - these include the quality of the panels, the control system, adaptation to the needs of different crops grown, but also the ability to connect energy generation to the existing electricity grid.

(ii)*environmental factors* - key considerations include the average annual duration of sunshine, the ability of the soil to maintain moisture; types of crops grown, with the advantage being those sensitive to excess solar radiation

(iii)*economic factors* - these include the costs of photovoltaic panels but also the expenses related to their installation, on the one hand, and on the other hand the benefits from increasing agricultural productivity, but also from the sale of solar energy, but also the availability of government support programs for the implementation of Agri-PV;.

(iv)*social factors* - these include the openness to adopting new technologies, the impact on the creation of new jobs

(v)*legal factors* - these relate to the legal framework for regulating Agri-PV.

This holistic approach to these factors is essential, as it optimizes the benefits of Agri-PV technology.

Previous research can highlight the results of using Agri-PV for different crops, both in terms of the yield efficiency of these crops and the energy produced.

Thus, because plants react differently to shade, crops that can adapt better to partial shade tend to perform well on such soils. Leafy vegetables (lettuce, spinach, cabbage) can increase yields by protecting against the excess sun (Laub et al., 2022) [13], and fruits and berries (raspberries, strawberries) show stable or improved productivity due to microclimate regulation (Touil et al., 2021) [27].

Conversely, some crops are less suitable for agricultural PV. For example, forage crops, root crops, and cereals such as wheat and maize can experience reduced yields under shade (Lee et al., 2022) [14]. In particular, grain legumes and maize are significantly disadvantaged by shade (Laub et al., 2022) [13].

It is important to note, however, that research on the compatibility of specific crops with Agri-PV remains limited.
Table 1 provides an overview of the area and average yield of potential arable land suitable for Agri-PV in the Republic of Moldova.
The potential use of Agri-PV and a higher yield of agricultural crops and energy production could also contribute to increasing food security. To understand the deficiencies faced by the Republic of Moldova in terms of food security and how the use of Agri-PV could positively influence these dimensions, we will try to evaluate them through the indicators that characterize them.

Table 1. Total area and average yield of potential arable land for Agri-PV use in the Republic of Moldova

Crops	Indicators	2019	2020	2021	2022	2023
Wheat - total (winter and spring)	Area, ha	314,889	274,422	310,057	304,615	356,188
	Average yield, 1 ha/q	32.9	17.6	46.4	25.9	41.5
Winter wheat	Area, ha	313,970	273,426	309,148	303,788	354,946
	Average yield, 1 ha/q	32.9	17.6	46.4	25.9	41.5
Maize grains	Area, ha	200,237	250,310	230,064	233,758	204,785
	Average yield, 1 ha/q	49.4	15.7	76.6	22.5	37.1
Legumes - total	Area, ha	16,138	9,646	9,691	9,210	12,177
	Average yield, 1 ha/q	20.5	14.6	24.5	15.9	18.6
Field vegetables	Area, ha	3,739	4,163	4,095	3,269	4,138
	Average yield, 1 ha/q	151.7	158	153	198.3	211.6
Green vegetables	Area, ha	14	79	53	36	29
	Average yield, 1 ha/q	72.1	23.4	28.4	32.5	50.6
Food melon crops	Area, ha	556	632	621	501	722
	Average yield, 1 ha/q	78.3	43.8	97.4	70.6	101.3
Maize for silage, green mass and hay	Area, ha	4,225	9,574	4,922	6,751	5,803
	Average yield, 1 ha/q	206.8	102.5	271.4	106.6	176.6
Pot fruits	Area, ha	7,667	8,027	8,152	7,534	6,680
	Average yield, 1 ha/q	158.4	116.2	177.1	126	160.1
Drop fruits	Area, ha	4,836	4,923	5,146	5,303	5,695
	Average yield, 1 ha/q	68.9	45.1	59.1	52.9	76.8
Fruit shrubs	Area, ha	167	201	179	233	224
	Average yield, 1 ha/q	39.1	22.5	44.3	41.5	50.6

Source: NBS (2023 a) [19].

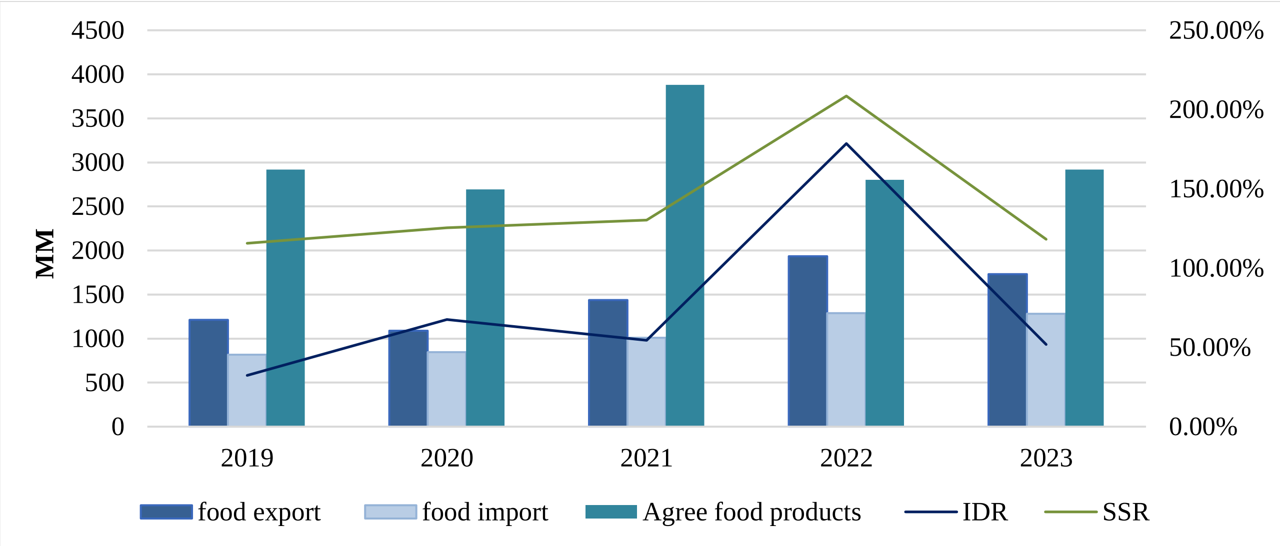

Fig. 2. Dynamics of availability dimension indicators
Source: the author's calculation based on FAOSTAT (2023 a, b) [7, 8].

Figure 2 shows that while the IDR and SSR indicators remain within acceptable limits, their trends are worrying. In addition, the dynamics of agro-food production highlight challenges in the availability of these products. The implementation of Agri-PV could help increase availability by offering several benefits (as shown in Figure 1), which in turn would have a positive impact on the volume of agri-food production.

Access is one of the most problematic dimensions of food security. Through Agri-PV, it is possible to increase economic resilience and reduce dependence on external energy sources, which could increase the purchasing power of the population and, accordingly, physical, economic, and social access.

Figure 3 presents the indicators characterizing the access dimension of food security. In this respect, it is about:

-inflation rate;
-food price inflation;
-percentage of the population unable to have a healthy diet;
-Gini coefficient by disposable income.
-Gini coefficient by consumption expenditures.

The Republic of Moldova's food security is not positioned well in terms of utilization. Agri-PV could improve this dimension, at least by increasing economic resilience, thereby contributing to better utilization outcomes.

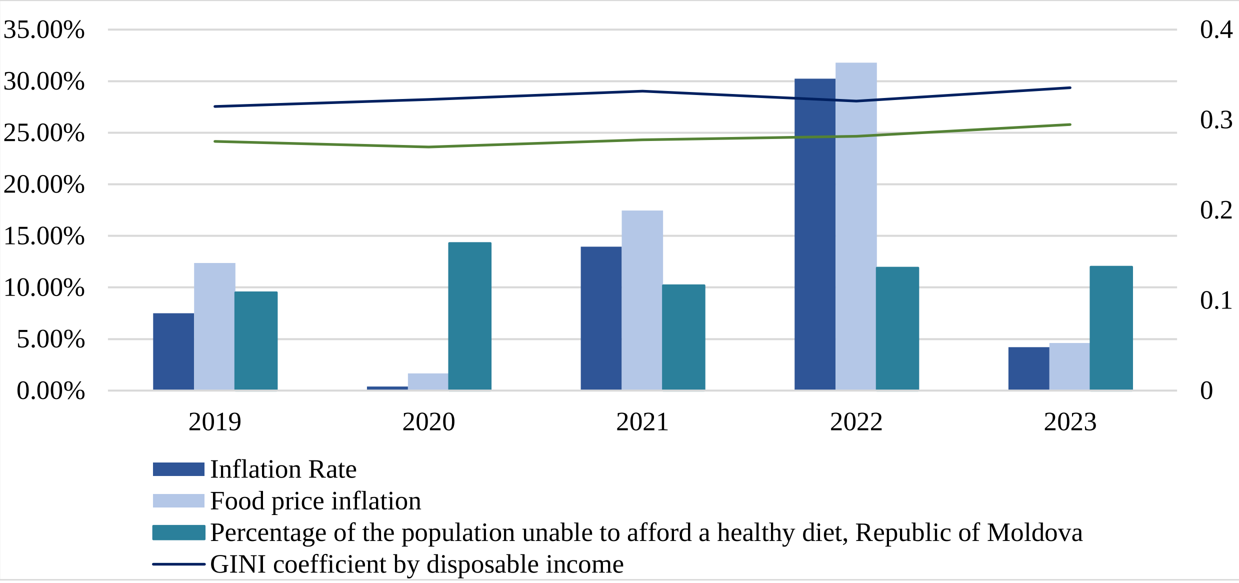

Fig. 3. Indicators characterizing the access dimension of food security
Source: Trading Economics, (2024 a, b) [28, 29]; NBS (2023 b) [20].

Stability is one of the most vulnerable dimensions of food security. Thus, through facilities such as improving resilience to climate change and economic resilience, reducing drought and soil overheating, reducing dependence on external energy sources, and encouraging innovation and sustainable agriculture.

These interventions can improve key indicators such as value added per worker in agriculture, forestry and fisheries, as well as the gross production per capita index number (agriculture). In addition, the implementation of Agri-PV systems can increase the profitability of crops and thus improve agricultural productivity.

Table 2. Utilization dimension indicators

Indicators	2019	2020	2021	2022	2023
Food supply (kcal/capita/day)	3,015	2,966	2,953	2,889	2,800
Protein supply quantity (g/capita/day)	92.97	94.1	87.6	84.5	82.3

Source: FAOSTAT (2023 c) [9].

Table 3. Stability dimension indicators

Indicators	2019	2020	2021	2022	2023
Value Added (Agriculture, Forestry and Fishing)Share of GDP US$	10.16	9.37	10.59	7.87	7.60
Agriculture, forestry, and fishing, value added per worker (constant 2015 US$)	1,393.0	996.5	1,477.7	1,230.9	1,240.0
Gross Production Index Number (2014-2016 = 100) (Agriculture)	118.5	81.41	122.9	89.53	90.8
Gross per capita Production Index Number (2014-2016 = 100) (Agriculture)	124.9	86.52	131.6	89.69	91.08

Source: The World Bank Data (2023 c) [26].

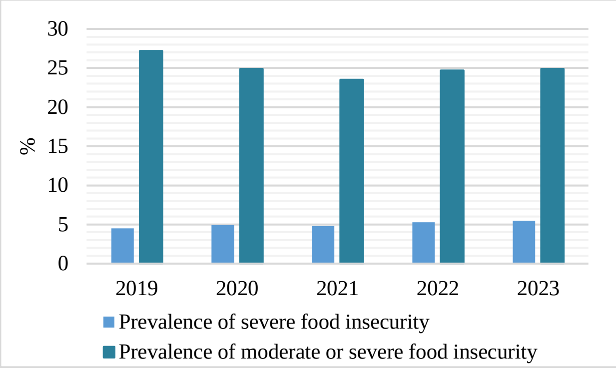

Fig. 4. Indicators characterizing the agency dimension of food security
Source: FAOSTAT (2023 d) [10].

Figure 4 highlights significant challenges related to the agency dimension of food security, which refers to the ability of individuals or groups to act independently in choosing their food, the types of food they produce, how food is produced, processed and distributed, and their participation in political processes that shape food systems (FAO, 2020) [5]. In a country where the prevalence of severe food insecurity exceeds 5%, compared to an Eastern European average of 1.9% (FAOSTAT, 2023 d) [10], food choices are extremely limited for a significant portion of the population. Therefore, the implementation of agri-PV technology is essential, not only from the perspective of increasing economic resilience, but also to reduce dependence on external energy sources.

The sustainability dimension of food security also faces significant challenges in Moldova. Sustainability indicators for 2024 include: soil temperature change of 0.731 °C (compared to the Eastern European average of 0.522 °C) (FAOSTAT, 2023 c) [9]; food waste per capita of 76.13 kg (compared to Romania's 69.63 kg and Ukraine's 72.85 kg) (World Population Review, 2024) [31]; and terrestrial protected areas accounting for 11.43% of total land area (compared to Romania's 34.52% and Ukraine's 12.96%) (The World Bank Data, 2023 c) [26].

The implementation of Agri-PV could bring more facilities to the sustainability dimension of food security. The panels protect crops from extreme weather conditions (from heat to hail) by optimizing land use, reducing drought and soil overheating, improving resilience to climate change, reducing greenhouse gas emissions, and encouraging innovation and sustainable agriculture.

The advantages of using Agri-PV to increase the food security of the Republic of Moldova are apparent, especially in the context of the energy crisis currently triggered in the Republic of Moldova. Its consequences are alarming for the agri-food sector, requiring substantial energy input in production and preservation. At the same time, the population's ability to access agri-food products is becoming increasingly small.

According to the Land Code of the Republic of Moldova (Article 36) [12], land used for solar photovoltaic systems is classified as agricultural land, provided that it is grassed or used for agricultural activities (Registru de Stat, 2025) [21]. However, the implementation of Agri-PV in Moldova faces several constraints:

-***Financial.*** Photovoltaic panels require significant investment, which is a challenge for Moldovan farmers. Nevertheless, foreign partners regularly offer financing programs to help agricultural producers purchase photovoltaic equipment (MAIA, 2022 [16]; AIPA, 2023 [2]; Livada Moldovei, 2022) [15].

-***Lack of expertise***. Moldovan farmers are often reluctant to adopt innovations. Promoting the positive impacts of Agri-PV, especially by showing successful practices in countries with longer experience, is essential.

Thus, the climatic conditions, the type of crops grown, and the average annual sunshine duration in the Republic of Moldova allow for Agri-PV use. In addition, there are programs for financing photovoltaic panels for agriculture by foreign partners.

CONCLUSIONS

Agri-PV is a technology that combines agriculture and solar panels, and it could increase the level of food security in the Republic of Moldova. Key benefits include optimizing land use, which is critical in a country with fertile but highly eroded soils. The shade provided by the photovoltaic panels reduces crop stress caused by overheating and water evaporation, resulting in higher yields. Agri-PV also mitigates the effects of extreme weather conditions, such as droughts and heavy rains, and builds climate resilience.

By increasing renewable energy production, Agri-PV reduces the country's reliance on energy imports, strengthening its economic resilience and contributing to energy independence. Energy independence is currently Moldova's most critical national security challenge.

In summary, the use of Agri-PV can increase economic resilience, increase crop yields, and reduce dependence on external factors, thereby significantly improving food security in the Republic of Moldova.

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REFERENCES

[1]Adeh, E.H., Good, S.P., Calaf, M., Higgins, C.V., 2019, Solar PV Power Potential is Greatest Over Croplands. Sci Rep, 9, 11442.

[2]AIPA, 2023, Program de granturi privind îmbunătățirea productivității terenurilor (Program of grants for improving land productivity) https://aipa.gov.md/ro/management-durabil-al-terenurilor, Accessed on 16 January 2025.

[3]Czyzak, P.,Mindeková, T., 2024, Empowering Farmers in Central Europe: The Case for Agri-PV. EMBER..https://ember-energy.org/latest-insights/empowering-farmers-in-central-europe-the-case-for-agri-pv. Accessed on January 11, 2025.

[4]European Commission, 2019, Green Deal (EGD). fromhttps://eur-lex.europa.eu/resource.html?uri=cellar:b828d165-1c22-11ea-8c1f-01aa75ed71a1.0002.02/DOC_1&format=PDF, Accessed on 14 December 2024.

[5]FAO, 2020 a, Food Security and Nutrition: Building a Global Narrative Towards 2030. A report by the High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security. https://www.fao.org/right-to-food/resources/resources-detail/en/c/1295540/. Accessed on January 11, 2025.

[6]FAOSTAT, 2023 e, Temperature change on land. https://www.fao.org/faostat/en/#data/ET, Accessed on January 12, 2025.

[7]FAOSTAT, 2023 a, Production. https://www.fao.org/faostat/en/#data/QCL. Accessed on January 11, 2025.

[8]FAOSTAT, 2023 b, Trade. https://www.fao.org/faostat/en/#data/TCL. Accessed on January 11, 2025.

[9]FAOSTAT, 2023 c, Food Balances. https://www.fao.org/faostat/en/#data/FBS. Accessed on January 12, 2025.

[10]FAOSTAT, 2023 d, SDG Indicators. https://www.fao.org/faostat/en/#data/SDGB, Accessed on January 15, 2025.

[11]Fraunhofer Institute for Solar Energy Systems ISE, 2019, Agrophotovoltaics: High Harvesting Yield in Hot Summer of 2018.Press Release, 10. https://www.ise.fraunhofer.de/en/press-media/press-releases/2019/agrophotovoltaics-hight-harvesting-yield-in-hot-summer-of-2018.html. Accessed on 14 December 2024.

[12]Land Code of the Republic of Moldova (Article 36)

[13]Laub, M., Pataczek, L., Feuerbacher, A., Zikeli, S., Högy, P., 2022, Contrasting yield responses at varying levels of shade suggest different suitability of crops for dual land-use systems: a meta-analysis. Agron. Sustain. Dev. 42, 51.

[14]Lee, H.J., Park, H.H., Kim, Y.O., Kuk, Y.I., 2022, Crop Cultivation Underneath Agro-Photovoltaic Systems and Its Effects on Crop Growth, Yield, and Photosynthetic Efficiency. Agronomy, 12, 1842.

[15]LivadaMoldovei, 2022, Panourile fotovoltaice – eligibile în cadrul Proiectului ”LivadaMoldovei”. https://livada-moldovei.md/panourile-fotovoltaice-eligibile-in-cadrul-proiectului-livada-moldovei/, Accessed on January, 12, 2025.

[16]MAIA, 2022, Producătorii agricoli pot achiziţiona panouri fotovoltaice în condiţii avantajoase. (Agricultural producers could buy photovoltaic plans in advantageous conditions). Accessed on January, 12, 2025.

[17]Ministry of Environment, 2022, Assessment of solar climate resources on the territory of the Republic of Moldova from the perspective of climate change. www.https://mediu.gov.md/ro/content/3723.Accessed on January 6, 2025.

[18]National Agency for Research and Development of the Republic of Moldova (NARD).

[19]NBS, 2023 a, Total area, yielding area, average yield and gross harvest of permanent crops in agricultural enterprises and farms. fromhttps://statbank.statistica.md/PxWeb/pxweb/en/40%20Statistica%20economica/40%20Statistica%20economica__16%20AGR__AGR020/AGR020900reg.px/?rxid=b2ff27d7-0b96-43c9-934b-42e1a2a9a774, Accessed on January 10, 2025.

[20]NBS, 2023 b, Inequality measures by areas, 2014-2023. https://statbank.statistica.md/PxWeb/pxweb/en/30%20Statistica%20sociala/30%20Statistica%20sociala__04%20NIV__NIV070/NIV071200.px/?rxid=b2ff27d7-0b96-43c9-934b-42e1a2a9a774, Accessed on January 12, 2025.

[21]Registru de Stat, 2025, Codul Funciar. https://www.legis.md/cautare/getResults?doc_id=122075&lang=ro, Accessed on January 16, 2025.
[22]Sarr, A., Soro, Y.M., Tossa, A.K., Diop, L., 2023, Agrivoltaic, a Synergistic Co-Location of Agricultural and Energy Production in Perpetual Mutation: A Comprehensive Review. Processes, 11, 948.
[23]Stratan, A., Lopotenco, V., Staver, L., 2024, Resilience of agri-food security in the Republic of Moldova. In Agricultural Value Chain - Past Trends and Emerging Issues, IntechOpen.
[24]The World Bank Data, 2023 a, Agriculture, forestry, and fishing, value added (% of GDP). https://data.worldbank.org/indicator/NV.AGR.TOTL.ZS, Accessed on January 5, 2025.
[25]The World Bank Data. (2023 b)Food exports (% of merchandise exports). https://data.worldbank.org/indicator/TX.VAL.FOOD., Accessed on January 5, 2025.
[26]The World Bank Data.(2023 c). World Development Indicators. https://databank.worldbank.org/source/world-development-indicators. Accessed on January 15, 2025.
[27]Touil, S., Richa, A., Fizir, M., Bingwa, B., 2021, Shading effect of photovoltaic panels on horticulture crops production: a mini review. Reviews in Environmental Science and Bio/Technology, 20.
[28]Trading Economics, 2024 a, Inflation Rate. https://tradingeconomics.com/country-list/inflation-rate. Accessed on January 12, 2025.
[29]Trading Economics, 2024 b, Food Inflation. 2024. https://tradingeconomics.com/country-list/food-inflation. Accessed on January 12, 2025.
[30]Widmer, J., Christ, B., Grenz, J., Norgrove, L., 2024, Agrivoltaics, a promising new tool for electricity and food production: A systematic review. Renewable and Sustainable Energy Reviews, Vol. 192, 114277.
[31]World Population Review, 2024, https://worldpopulationreview.com/country-rankings/food-waste-by-country, Accessed on January 12, 2025.