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How AI Will Speed Up the Improvement Process of Transformation 4 Food, Biosphere & Water in the Valencian Community of Spain.

Introduction

The Valencian Federation of Municipalities and Provinces (FVMP), formed by local entities of the Valencian Community (VC), it is a non-profit association strongly committed to promoting local autonomy, defending local interest, and encouraging European spirit within local contexts, guided by the Spanish Constitution, the Statute of Autonomy of the VC, and local regulations, the FVMP advocates for local autonomy and interest.

Currently, the FVMP is recollecting data regarding the initial alignment of the 542 municipalities of the VC concerning with the SDGs. Preliminary survey results discovered a standard need for more technical, financial, and informational resources to implement the SDGs and 2030 agenda in their local daily activities.

Responding to the municipality's necessities, the FVMP organized two webinars in the first semester of 2023. The main purpose was to promote knowledge exchange about SDG-related projects and funding strategies. Creating benchmarking initiatives, in the second webinar eight municipalities shared their funded initiatives, giving the opportunity to other municipalities to take ideas in the process of driving sustainable progress. The post webinars surveys have proven that facilitating the process of knowledge sharing, creation, and production steadfast everyone to understand how to land the SDGs in the local agenda. Recordings and more information are available in our website¹.

Nevertheless, sustainability efforts face alarming challenges; severe droughts, 60% of the European soils is in poor health, unhealthy food options, production waste, depopulation of rural areas. There are several actions that can improve sustainability in the agriculture sector². In connection with the lack of in-depth studies in the municipal field, this document introduces a fresh perspective highlighting how artificial intelligence (AI) can turn these obstacles into opportunities. Earmarking at least 35% of funds for climate, biodiversity, and environmental initiatives, shows the financial commitment to our research's focal points³.

¹ Roig Albelda, Alex. "ODS Agenda 2030". FVMP. 2023: <https://www.fvmp.es/redes/ods-agenda-2030/>

² Timmermans, Frans. "EU farmers do not need more money to smooth green transition". EURACTIV. Last modified July 12, 2023: <https://www.euractiv.com/section/agriculture-food/news/timmermans-eu-farmers-do-not-need-more-money-to-smooth-green-transition/>

³The common agricultural policy: 2023-27 "Agriculture and rural development". European Commission: https://agriculture.ec.europa.eu/common-agricultural-policy/cap-overview/cap-2023-27_en





Collaborative pathways to SDG achievement

The World in 2050 (TWI2050) is a global initiative promoting best practices knowledge to support the policy making process and implementation of the SDGs and the UN 2030 Agenda. Addressing Sustainable Food, Water, and Biosphere will provide vital information on how AI will speed up the process of achieving the SDGs in resource-limited municipalities of VC.

Goals, targets, and indicators will show improvements and how these new advanced technologies are pushing up the achievement of the SDGs.

Shown below we have the SDGs with direct impact:



Optimizing food production and reduce emissions offers transformative opportunities for all municipalities



Lighting the path to a clean progress by utilizing renewable energy for a sustainable world.



Empowering cleaner waters by halving waste and doubling reuse



Driving growth and productivity for a prosperous future in agriculture.



Shaping the future by catalyzing climate action through education and resilience



Empowering progress by fomenting technological initiatives for sustainable development and inclusive growth

The use of AI will notably contribute to social, environmental, and economic impacts by enhancing food security, supporting inclusive economic growth, optimizing water management, promoting sustainable energy, reducing greenhouse gas emissions, and stimulating global economic partnerships.



Exploring the agricultural sector

The Observatory for the Digitalization of the Agri-food Sector⁴ launched 3.600 surveys to analyze the agricultural sector in Spain. Only 39% of 3.600 respondents knew of the Next Generation financial help options. Spain has an important digitalization⁵. By 2024, 90% of the rural Spanish population will have Wi-Fi access for 35 euros a month. This is an unprecedented technological transformation in Spain. As a result of this investigation, the observatory is launching an app called Digimapa. It will help farmers search for digitalizing companies that support them with the Next Generation projects in their territory.

In June of 2023 the Annual General Assembly of the Agro-alimentary Cooperatives of the VC⁶ presented a socioeconomic report of the Valencian agriculture corporativism. It shows a 7% increase in production value reaching an all-time high of 2.228 billion euros. There are 333 cooperatives in the VC, employing 173,915 individuals (28% women, 17% under 40). Along with organic farming, the VC experienced a significant +129% growth over the past decade, surpassing the national average. Organic farming is undoubtedly a great alternative to generational challenges, as the average age of agriculture operators is 48 versus the 64 standards in the traditional agriculture sector in the VC. Women are climbing up to 30% of the ecologic agriculture sector. With 501 municipalities engaged in organic cultivation out of 542, this is a valuable opportunity to combat rural depopulation in resource-limited municipalities.

Pedro José Bañon Belda, an olive farmer from Anna (2638 inhabitants), provides us an insightful perspective on the integration of AI within the agricultural field. He perceives AI as a potentially transformative tool that can significantly magnify resource optimization and time management, fortifying both ecological and economical agriculture. However, he articulates a valid concern regarding the potential monopolization of these technological advancements by large corporations, thereby marginalizing small-scale farmers. Bañon Belda reinforces the indispensable role of women in the sector and views agriculture as an inclusive profession. For him, and likely for many of his peers, agriculture transcends mere occupation, and it embodies a lifestyle.

A case study of a cooperative experience

Alt Palancia is one of the counties with the highest ecological farming activity in the VC. It is also a rural area with a risk of depopulation. Viver (1690 inhabitants), is where the Viver cooperative⁷ operates. This cooperative is well known for its commitment to innovative projects in the search for sustainable agriculture development that can guarantee its territory's prosperity. Proof of their commitment is their contribution to the HANDYWATER project⁸. Throughout this automated, remotely controlled drip irrigation system, farmers are incorporating water-saving strategies into their irrigation management. The project is pioneering in Europe and is scheduled for completion in 2026. This initiative is coordinated by the Irrigation Group of the Valencian Institute of

⁴ "Observatorio para la digitalización del sector agroalimentario". *Gobierno de España*. 2023:

https://www.mapa.gob.es/es/desarrollo-rural/temas/innovacion-medio-rural/estudio_3def_tcm30-655779.pdf

⁵ "España digital 2026". *Gobierno de España*. 2023:: https://espanadigital.gob.es/sites/espanadigital/files/2022-07/Espa%C3%B1aDigital_2026.pdf

⁶ "Cooperatives agro-alimentàries". 2023: <http://www.cooperativesagroalimentariescv.com/las-cooperativas-agroalimentarias-valencianas-facturaron-de-forma-agregada-en-2021-mas-de-2-228-me/>

⁷ Cooperativa de Viver. "Homepage": <https://www.cooperativaviver.es/>

⁸ "Handywater". Instituto Valenciano de Investigaciones Agrarias. *Generalitat Valenciana*. 2023: <https://ivia.gva.es/es/handywater>





Agricultural Research (IVIA), which is responsible for looking to incorporate advanced, technologically innovative irrigation solutions into the Mediterranean agriculture sector.

Viver Cooperative is facing essential challenges regarding water efficiency resource management. Some initiatives to mitigate these challenges are participating in the LIFE Food & Biodiversity project⁹ to promote the inclusion of biodiversity criteria in the agri-food industry and the Agrilclimate Change project¹⁰ to reduce CO₂ (carbon dioxide) emissions.

Implementing AI systems with efficient data management in the agri-food production chain will be beneficial in producing top-quality products and minimizing environmental impact and optimal profitability for farmers. Viver Cooperative is willing to participate in knowledge exchanges and collaborations in line with its project of dignified agriculture for people and territory.

Most of the identified barriers facing AI are the lack of knowledge of the advantages of implementing AI systems, in addition to the resistance of older farmers to change from the old system and adapting themselves to technological advances. To address these barriers, it is suggested to demonstrate the efficiency of these advanced technologies in optimizing farm labor and final crop profitability.

Building momentum through AI's research and benchmarking:

At the end of 2022 Cátedra FACSA from the Universitat Jaime I de Castelló organized a technical and benchmarking congress about water digitalization and AI. During the event, Nuria Oliver, one of the top world AI influencers, highlighted not only AI's strategic role today, and the potential to optimize agriculture and reduce food waste, but also the ethical changes it faces¹¹. Oliver is also a co-founder of the ELLIS Foundation¹² in Alicante. Oliver and the ELLIS Foundation play a significant role in Naixus¹³, a global network linking AI with sustainable development. Naixus promotes collaboration, research, and offers opportunities that aim to solve global challenges and shape a sustainable future.

Additional insight was provided by Hèctor Monclús¹⁴, a post-doctoral researcher from LEQUIA at the University of Girona, who explained how microbiological risk can be turned into digital data and what valuable this could have for drinking water.

Elías Ferreres, the president of the Royal Academy of Engineering of Spain and a member of the European Academy, has a long-standing agricultural engineering background and a research career. With a Ph.D. in ecology from University Davis of California and was recently awarded Doctor Honoris Causa during the 50th anniversary of Universitat de Lleida, Ferreres implied that the expansion of Spanish irrigation is unsustainable. The biggest challenges facing present generations of farmers are improving surface and groundwater, aquifer profitability strategies in rainy years,

⁹ "Food & Biodiversity" *Fundación global nature*: <https://fundacionglobalnature.org/portfolio/food-biodiversity/>

¹⁰ Fuentes, María. "Climate friendly agriculture" *Agriadapt 2023*: https://agriadapt.eu/wp-content/uploads/download-manager-files/Manual_English.pdf

¹¹ Oliver, Núria. "Research and innovation" *European Commission*. Last modified July 4th, 2022: https://research-and-innovation.ec.europa.eu/knowledge-publications-tools-and-data/publications/all-publications/srip-report-chapter-2022_en

¹² "Fundación ELLIS Alicante" *Ellis Alicante*: <https://ellisalicante.org/es/>

¹³ "Network for Artificial Intelligence, Knowledge, and Sustainable development" *Naixus*: <https://naixus.net/>

¹⁴ Monclús Sales, Hèctor. "POST-DOCTORAL RESEARCHERS". *Lequia*: <http://www.lequia.udg.edu/presentation/members/postdoctoral-researchers/item/1145-dr-hector-monclus-sales.html>





Meanwhile, thanks to José Correa and his collaborations with the Spanish Federation of Municipalities and Provinces (FEMP), we were able to connect with a very technologically advanced company in vertical farming, Ekonoke¹⁸. Inés Sagrario, co-founder and head of research and development of Ekonoke, presents that they can reduce their emissions by 20%, saving 16 times more water than regular farming and producing 40 times more efficiently their hop vertical farming production. However, with vertical farming production, Ekonoke's hop plants face an extremely high renewal energy cost. According to Ekonoke, renewable energy producers sell energy at around five times higher than a reasonable and profitable price, making to Ekonoke's process of obtaining renewable energy a very challenging chapter. To ensure the correct regulation of green energy prices, Ekonoke suggested establishing public renewable energy manufactories that can sell green energy at a regular price. Without price regulation, it will be very difficult for indoor agriculture to survive.

Turning our attention to Valencian cooperative associations aiming to digitalize the agriculture industry, farming, fishing, and rural areas of Spain, one such association is AGROTECH ESPAÑA¹⁹. Ivan Lütolf, president of AGROTECH ESPAÑA is also Agro Business Developer of ELLIOT CLOUD²⁰. ELLIOT CLOUD is a platform that interconnects, controls, and optimizes different smart technologies in one data-driven software. AGROTECH ESPAÑA and ELLIOT CLOUD's collaborative innovations include integrated avocado fertilization management²¹, citrus harvest estimation²², prevention of HLB plague in citrus²³, pest detection and prevention²⁴, and water and agriculture sustainability in the 21st century²⁵. These AI applications, already adopted by some cooperatives and citrus warehouses in our region, enable farmers to maximize their resources in constrained environments. AGROTECH is showing a solid commitment to digitizing agriculture through implementing emerging technologies which is vital in advancing sustainable farming in the VC.

Ferran Fernández is a Valencian talent in the agriculture investigation for sustainable purposes. Pursuing a doctoral degree in geometric engineering at Universitat Politècnica de Valencia, Ferran focuses on remote sensing and machine learning to optimize crop care and prevent plant stress. Ferran uses data from the Copernicus Sentinel²⁶ space mission to examine plant health, from the level of individual leaves to the complete canopy. Despite certain limitations in the quality and detail of data, advanced techniques in geographic information processing and machine learning allow him to overcome these obstacles. His research is generating new strategies for the efficient use of resources in the VC, promoting better care of our crops, reducing environmental impact, and strengthening the resilience of our agriculture in the long run.

In addition to this, Ferran offers five courses about this framework:

- ✓ Agrotech. Technological tools in agriculture.
- ✓ GIS Agro. Geographic Information System for agriculture.
- ✓ Satellite and drone remote sensing.
- ✓ Google Earth Engine. Satellite image processing.

¹⁸ "Ekonoke. "Homepage": <https://www.ekonoke.com/es/>

¹⁹ "Agrotech España. "Homepage": <https://www.agro-tech.es/>

²⁰ Elliot Cloud. "Homepage": <https://elliottcloud.com/>

²¹ "Manejo integrado de fertilización del aguacate" Agufert": <https://agufert.es/>

²² "Go Citriaforo. Estimación de la cosecha en cítricos" Citriaforo Go: <https://citriaforo.com/>

²³ PreHBL: <https://www.prehbl.eu>

²⁴ "Desarrollo de herramientas digitales para la detección temprana de plagas clave en citricultura" Sensoplag: <https://sensoplag.es/proyecto/>

²⁵ "Aprobado el proyecto de investigación SOS AGUA XXI de la Convocatoria MISIONES CIENCIA E INNOVACIÓN CDTI 2022". SACYR. Last modified January 26 of 2022: <https://www.sacyr.com/-/sos-agua-xxi>

²⁶ Copernicus European Union. "Sentinel Copernicus European Union Homepage". Accessed July 5, 2023: <https://sentinels.copernicus.eu/web/sentinel/home>





- ✓ Near sensors. Soil – Plant – Atmosphere monitoring.

The Radio Forum, Foro de Nuevo regadío²⁷ (New irrigation forum) is a virtual event celebrated annually and at the end of last June 2023. At the forum, Ferran Fernández presented how VisualNAcert²⁸ (VISUAL), is helping the agricultural sector's digitalization by using AI systems²⁹. VISUAL is responsible for digitalizing 20% of the Spanish surface in its first five years (2014-2019). VISUAL, a company with a presence in every continent, offers smart AgTech technological tools to optimize agriculture practices, minimize unused resources and improve efficient, sustainable production. VISUAL is also promoting the entrepreneurship culture throughout endeavor³⁰, a worldwide entrepreneur community aiming to promote economic development by helping new emerging talent.

Rafelbunyol (8.941 inhabitants) is the city where VISUAL was born and where its headquarters are located. The Rafelbunyol government team is working nonstop in the transformation to a smart city. In recent years they have been creating an integrated database saving data from all their five municipal areas. Nowadays, Rafelbunyol, is the most transparent city of the VC under 10.000 inhabitants and has over 400 city progress indicators and a clear ICT strategy.

Onda (25.099 inhabitants) is the most transparent city in the VC. Onda Smart City is in the next level of sustainability. Onda³¹ has won multiple awards and is currently presenting a project for the Scalable Cities Action Grant³².

Having smart cities like Onda and Rafelbunyol could be a great environment for ICT implementation systems promoting benchmarking scenarios that introduce the benefits of AI into municipalities with limited resources.

According to IBM, there are five pillars to address AI responsibly: Explainability, fairness, robustness, transparency, and privacy. This is something we must address throughout the entire lifecycle of AI. We all need to be aware of both the potential good and the potential harm that comes from AI. Therefore, we should encourage everybody to ask questions, and make room for people to be curious about how AI works and what it's really doing. This way, we can use it to address good problems, have great results, and mitigate any potential harm. The fact is that AI emerges as an essential driver to speed up the six transformations³³ needed to achieve the SDGs.

²⁷ Redacción iAqua, "Nuevo Regadio Forum analizará durante 5 días el presente y futuro del regadío en España". 23 of June of 2023: <https://www.iagua.es/noticias/redaccion-iaqua/nuevo-regadio-forum-analizara-durante-5-dias-presente-y-futuro-regadio>

²⁸ VisualNAcert. "Homepage.": <https://visualnacet.com/language/esp/>

²⁹ Fernández, Ferran. "Nuevo Regadio Forum 2023: Modelos de riego y predicción del riego mediante inteligencia artificial". YouTube video, 29:08, June 29, 2023: <https://www.youtube.com/watch?v=ah--2cy3DtQ>

³⁰ Endeavor. "Homepage": <https://www.endeavor.org.ar/>

³¹ "La Actualidad de Onda". *Ajuntament Onda*. Last modified 27 of August 2022: <https://www.onda.es/ond/news/new.php?id=1562>

³² European Commission. "Smart Cities Marketplace". 2022 to 2024: <https://smart-cities-marketplace.ec.europa.eu/action-grant>

³³ Mascaspac Hernandez, Ariel. "TWI2050" *ResearchGate*. July of 2020: https://www.researchgate.net/figure/TWI2050-focuses-on-Six-Transformations-that-capture-much-of-the-global-regional-and_fig1_344452375





AI as a powerful tool for inclusion and gender equality

Spain has tremendous potential in AI and emerging technologies. BigData Magazine, a Spanish media company specializing in information about new technologies, is part of the Ecommerce News Group, a global reference informing about the digital economy. In May of 2023, Big Data Magazine awarded Carmen Reina, the head of data culture at Orange, as the most valuable person in AI in 2023³⁴. With over two decades of interest in AI and experience fostering its development, Reina is a unique and valuable voice in the effective use of data generated by us and IoT devices as a competitive edge for businesses. She was a great motivational person, while we were developing this document, especially in the beginning. Coordinated by Jose Correa (FEMP), we had several meetings with her, and she gave valuable insights into our AI and Agriculture studies through her commitment and expertise, enhancing its impact and reach.

Regina Monsalve is a Spanish agricultural engineer and President of the Official College of Agricultural Technical Engineers of Valencia and Castellón (COITAVC). As a great example of woman entrepreneurship, Regina is the founder of NATUVERA³⁵, a company looking to implement circular economy systems in agricultural companies as well as implement the most advanced technologies to improve efficiency in the primary sector. Monsalve is also founder of IDESCUM SCV, a cooperative investigating Stevia in the Mediterranean, and its acclimatization, varieties, mechanization, transformation, and marketing of products in an ecological regime. Regina's list of awards is inspirational, and she is a motivational example of a rural entrepreneurial woman with over 30 years of researching and delivering improvements to food, water, and the biosphere in the VC.

Nuria Oliver, Inés Sagrario, Carmen Reina, and Regina Monsalve, are four of very significant examples of woman talent in the AI and agriculture sector in Spain. Bridging the rural, gender, equality and digital gaps are at the center of this document.



Conclusions

Over the past few years, considerable resources have been allocated to exploring the use of AI for agriculture. This study underlines the urgency of connecting humans with technology in the intersection of AI, digitalization, agriculture for sustainability, and reduction of inequalities.

Nowadays influencers, MVPs, celebrities, and society as a whole need to take a new role empowering everybody via media with AI literacy perspective. People needs to understand what is behind the scenes. They need to understand not only the benefits of AI and how it works, but also the risk and potential harm of improper use as the technological advances.

We have uncovered how organic agricultural practices, aided by AI and digital tools, are not only proven strategies to combat depopulation or economic inequalities, but also are contributing to a succesful new generational shift in the farming sector. Younger

³⁴ Gómez Becerra, Mari. "Carmen Reina, MVP del sector IA en 2023 para Big Data Magazine". *Big Data Magazine*. Last modified 11 of May of 2023: <https://bigdatamagazine.es/carmen-reina-mvp-del-sector-ia-en-2023-para-big-data-magazine>

³⁵ Natuvera. "Homepage": <https://natuvera.es/>





generations are passionate about new technological tools and applications. This is inspiring young people to see digital farming as an attractive career. ICT and AI specifically could be the bridge that reconnects the big aging gap existing in the agriculture sector of the VC.

The pathway towards this transformation is dependent on agricultural cooperatives. Regional cooperatives play a key role digitalizing farmers and sharing knowledge and good practices.

Next Generation funds, AI advancements, and collective action, are the three main elements needed to be able to develop an ambitious plan in the process of helping digitalize every single farmer in the rural areas of the VC.

In this beginning of a new era of sustainable agriculture driven by technology and shared responsibility, we have to call for action to all the stakeholders. Sustainable solutions require everyone involved. Governments, businesses, universities, civil society, researchers, cooperatives, farmers, we all have a crucial role in achieving the sustainable development goals.

FVMP is deeply committed to coordinating and to helping create benchmarking spaces that inspire innovation and push the boundaries of limited resources municipalities. Events, like FERIA Eco³⁶ are participatory meetings that create synergies between stakeholders. The goal of this study is to unify forces in the Valencian territory and to organize an event that starts unifying AI experts and farmers on a special day for the AI in the transformation of Food, Water, Land and Biosphere in the Valencian Community, specially in limited resource scenarios, ensuring we are not leaving anyone behind.

Author contributions statement

All collaborators contributed significantly to this paper, with research design and data analysis performed collectively. At the same time, each provided unique insights and expertise in their respective fields, leading to the generation of a cohesive, comprehensive, and multidimensional investigation into the role of AI in agriculture.

Declaration of competing interest

The author declares that we have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The data supporting this study's findings are available from the corresponding author upon reasonable request. Any proprietary or sensitive information is withheld due to confidentiality agreements.

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³⁶ "Terra Eco, la nueva feria de la producción ecológica". Terra Eco, last modified April 14, 2023, <https://terraeco.feriavalencia.com/>

