Broad Adoption of AI by SMEs in the Agriculture and Farming Sector: Overview of 2023 Activities and 2024 Outlook

GPAI Innovation & Commercialization Working Group

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GPAI | THE GLOBAL PARTNERSHIP ON ARTIFICIAL INTELLIGENCE

This report was developed by Experts involved in the Global Partnership on Artificial Intelligence's project on 'Broad Adoption of AI by SMEs in the Agriculture and Farming Sector'. The report reflects the personal opinions of the GPAI Experts and External Experts involved and does not necessarily reflect the views of the Experts' organizations, GPAI, or GPAI Members. GPAI is a separate entity from the OECD and accordingly, the opinions expressed and arguments employed therein do not reflect the views of the OECD or its Members.

This report is not an academic report. Rather, it is an overview on the 2023 activity of GPAI's Broad Adoption of AI by SMEs in the Agriculture and Farming Sector Project Advisory Group.

This project has been working towards building a web portal for public use, following the objectives of this working group in building assets for industry in the open market and in line with the SME Web portal. Agriculture and Livestock farming have their own dynamics and data governance environments that merited in 2021 to be approved by the Executive Council for the construction of its own web portal.

Acknowledgements

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Introduction

Experts in the agriculture and farming (A&F) sector hold considerable relevance for the GPAI Members in economic terms. Although A&F represents a low GDP percentage for some of the Members, the majority of the GPAI Members rank within the top 20 global list of exporters of food and agricultural products. What this means is that it is of utmost importance that we optimize the yields of this sector as demand for A&F products is likely to increase because of population growth and the reduction of arable land in the next 20 years.

Furthermore, the A&F sector deals with issues that directly affect humankind's survival. A top priority is the optimization of natural resources such as water, which is an area that needs to be addressed from an AI perspective. There is growing consensus within the scientific community regarding the growing need to build and maintain a drinkable water grid worldwide and the optimization of water resources deployed in A&F, especially in countries suffering from climate over-heating.

There is also undeniable evidence of the direct connection between the destiny of nature, the animal kingdom, and our own survival. The A&F sector today is not just about "feeding" the human race, but about managing Earth's resources for an economic prosperity based on sustainability practices that AI will help us achieve and deliver to the world. Past and current A&F AI projects have helped improve the sector with digital technologies and AI tools that have transformed rural communities to gain better quality of life and become more prosperous. At government level, A&F AI is seen as the path to enable science-based policies and the gentrification of rural areas suffering from negative net migration.

The objective of this project is in line with the objectives of the GPAI Member countries regarding modernizing the A&F sector in order to develop decarbonization strategies and fulfil the UN Sustainability Objectives as well as the creation of an international platform for cooperation across all AI institutes developing projects addressing the challenges of the A&F sectors. AI is demonstrating that it can contribute to:

1. The preservation of arable land due to the degenerative effects of climate change and outdated agriculture methods;
2. Ensure that CO2 emissions and water waste in livestock farming are reduced as well as the healthcare of farm animals is improved;
3. Provide GPAI Members with have access to international agricultural data sets across the wide spectrum of its provenance and variety in order to establish the pillars of its governance and future downstream applications.

The use of AI in agriculture presents immense potential for transforming global food systems. This project, focusing on global partnerships in AI-driven agricultural practices, comes at a critical juncture. The world is grappling with pressing challenges like climate change, food security, and sustainable farming practices. AI technologies, such as machine learning, predictive analytics, and robotics, offer revolutionary approaches to addressing these challenges. By leveraging AI, farmers can optimize crop yields, expand their distribution, reduce environmental impacts, and enhance the overall efficiency of agricultural processes.

Collaborations between tech companies, agricultural experts, governments, and international organizations can lead to the exchange of valuable knowledge, resources, and technologies across borders. Such partnerships are essential in tailoring AI solutions to diverse agricultural contexts,

ensuring they are accessible and beneficial to farmers worldwide, including those in developing countries.

This project involves stakeholders from various businesses and agriculture sectors to assess and document the best practices, as well as the economic and social implications of AI in agriculture. These studies aim to ensure that AI technologies are developed and implemented in a manner that is equitable, sustainable, and respects local and global ecological boundaries. This project aims to educate and promote the forefront of technological innovation at the intersection of global cooperation for a more sustainable and food-secure future. Furthermore, this project aims to foster a unified approach across countries and businesses towards data sharing and standardization, which is crucial for the advancement of AI in agriculture.

The GPAI “Agro Portal” (whose creation is in progress) is a visible asset of the GPAI open to online consultation and aims to create a dynamic and easy to consult website of sharable resources in support of local country initiatives looking out to learn from international best practices and collaborative approaches to solving common challenges.

GPAI’s I&C WG Agro Project was able to successfully setting the foundations of data-gathering and methodologies in 2022 and effectively worked towards constructing a platform in 2023.

Contributors

In its second year, the Agro Project maintained a set of high-caliber sector specialists from France, Japan, and the United States, with the objective of delivering the sector expertise that this project requires. Such External Experts include:

- **Vikram Adve** (United States), Donald B. Gillies Professor of Computer Science at University of Illinois at Urbana-Champaign, Director of the AIFARMS National AI Institute and Co-Director of the Center for Digital Agriculture;
- **Cyrus Hodes** (France/United States) is a co-founder of the World Climate Tech Summit (Q1 2023, Miami), a cofounder of Duckweed Bio, an Agtech/climate tech startup based in south Florida and is a contributor to Blockchain Web Services (BWS) a Web3 P2P cloud computing platform for Machine Learning which enables resilient computation on a distributed network. Cyrus is a Partner at FoundersX Ventures, a cross-stage Silicon Valley VC firm focusing on AI, biotech, digital healthcare, enterprise SaaS, quantum computing, Fintech and Foodtech;
- **Noriyuki Murakami** (Japan), Deputy Director-General of Research Center for Agricultural Information Technology (RCAIT) and Deputy head of Research Center for Agricultural Robotics (RCAR) at National Agricultural Research Organization (NARO), Japan's national laboratory for agriculture.

Additionally, the Agro Project has engaged, for the second year in a row, with the innovation labs of the University of Loyola Andalusia (Spain), a research University with deep experience in Agro AI. The Loyola Innovation Hub, under the Direction of Enrique Moreno Benítez, has been tasked with the delivery of the technical milestones of the Agro Project: digitization of all case studies into data sets. In 2023, the technical team included José-María Manzano-Crespo and Luis Rafael Ramírez Camacho. The data sets are to be fed into the same OS database that the I&C WG SMEs Project uses for their web portal and support for the administrative parts of the Experts' reviews of all case studies to create an initial approach to standardization practices, methodologies and protocols that could be turned into white papers or informational content of the future Agro AI web portal.

Work progression in 2023

In 2023, this project made significant strides toward its original goals set at the outset of the year. The overarching objectives were aimed at transforming the role of AI solutions within the Agriculture and Livestock farming sectors, with a strong emphasis on benefiting small and medium-sized farmers and fostering innovation within the industry.

One of the primary goals for the year was to engage with AI solution providers in the agriculture and livestock sectors. This engagement involved the issuance of Requests for Information (RFI) to qualify potential AI vendors, paving the way for collaboration and innovation in the field. All case studies provided were rendered into an Agro Data Base that can be queried in a variety of ways: searching for AI solutions available for a specific crop or use in livestock farming, or directly searching for solutions, such as “pest control”, “detection of plagues”, “irrigation optimization”, and other uses. This free-text search allows farmers and agricultural technicians to search in free-text style according to their needs. This search capability is already built and in beta in the first backend/front end architecture of the portal.

In addition, the project placed a substantial focus on assessing the readiness of small and medium-sized farmers for the adoption of AI technology. This assessment drew insights from successful AI deployments in similar-sized farms across different geographical regions, with the ultimate aim of sharing knowledge and empowering more farmers with AI solutions. The database of AI solutions provided by the startup community offers around 100 solutions across the Americas, Europe, Africa and Asia-Pacific. The conclusions derived from this study point out to a local approach from the AI solution providers: the solutions documented show that AI Agro Startups deliver local solutions around robotics, detection, prediction, quality control of produce, and monitoring of ripening processes whilst in transport, an important advance for local farmers who export globally. There is no evidence that any of these startups will aim to sell abroad because similar solutions at local level already exist in every market, which will help governments to safeguard agricultural data within their national borders.

Furthermore, the project took on constructing hypotheses regarding how the data collected from case studies and AI vendors could be effectively queried by future users of the web portal. This strategic thinking was critical to ensure that the data would be accessible and valuable for informed decision-making.

Finally, as a key milestone, the project was advanced in the development of the user-friendly, natural-text-based information retrieval query facility within the web portal. This effort was directed at creating a seamless and intuitive user experience. Notably, the project plans to unveil a Minimum Viable Product (MVP) version of the web portal in H1 2024, providing users with a glimpse of the platform's capabilities and the innovative possibilities it held for the agriculture and livestock sectors.

Web Portal Development

The Loyola Innovation Hub plays a pivotal role in shaping the content architecture and providing valuable insights into the content strategy for the portal. Their contributions are crucial for ensuring that the informational content aligns with the portal's objectives and serves its users effectively.

In addition, the taxonomies employed for the portal searches are based on the FAO's established taxonomies. These taxonomies categorize solutions based on the type of solutions offered rather than focusing solely on the specific AI technologies utilized. This approach enhances the search experience for users by making it more solution-oriented and user-friendly.

As part of their ongoing efforts, the team is currently dedicated to constructing the "Managing Earth's Resources" section (see below). This section features a compelling case study from NARO in Japan, showcasing real-world applications and success stories in the field of resource management.

Furthermore, the team is actively engaged in building the "AI in Agro Ecosystem" section (see below), which spotlights around 30 representative startups per continent dedicated to developing innovative AI solutions in the agricultural sector. These startups are at the forefront of leveraging artificial intelligence to address various challenges and opportunities within the A&F ecosystem, contributing to the portal's rich and diverse content landscape.

Portal Content Sections – Delivering the Strategic Mission

A New Data Class

Biological data whether animal or plant, represents a challenging layer of Real Word Data (RWD) and Real-World Evidence (RWE) that governments must capture, analyze, and leverage from.

Beyond The Need to Feed Humans

Optimization of crops and water resources and the need to increase the welfare of animals and limit their overproduction for their effect on CO_2 and draining of resources.

Safety Of Human Food Chain

The management of Earth's natural resources and the implementation of sustainability principles are crucial in achieving the United Nations' 17 development goals. In the A&F sector, the necessity for food certification, encompassing certified provenance and compliance with diverse food labeling laws across regions, is transforming into a data-driven imperative. Presently, Blockchain is emerging as a distributed architecture for AI, effectively showcasing provenance to guarantee food safety by tracking the entire food production, processing, transportation, storage, and retailing processes.

Managing Earth’s Resources

The New Agro is mandated to fulfil Sustainable Practices that attract and nurture bio-ecosystems in Forestry and the management of erosion, water, wetlands, and wild life around it.

Fighting Rural Negative Net Migration

Fostering the involvement of younger generations in agriculture is being pursued through the establishment of an AI-driven Agro Startup Ecosystem. This involves the formation of startup ecosystems focusing on AI Agro in regions like the Americas, Europe, and Asia-Pacific. Emerging innovators and entrepreneurs are actively addressing market gaps and verticals within this ecosystem, with micro-trends such as Agro B2C acting as drivers for sector adoption. An illustrative example is Farmbot, a CNC Open-Source Farming Bot, showcasing the potential for transformative developments in the field.

Next steps in 2024

The Agro Project Advisory Group envisions that the project will be in an excellent position to achieve the 2024 milestones:

1. Strengthen the portal with the addition of further case studies, AI solutions providers and the mapping of AI-in-Agro activities on a world-wide basis, continuing to account for innovation emergence coming from startups and disruptive business models;
2. Map out regulatory environments for agricultural data, taking into consideration that governments need to verify that their agricultural data is governed and handled appropriately:
    a. Sponsored by India;
    b. Sponsored by the European Union;
    c. Sponsored by FAO;
    d. Sponsored by individual GPAI Members with leading activity in AI-driven Agriculture
3. Further integrate institutions that work on agricultural data and already have their knowledge built:
    a. Identify the national agencies in the GPAI Member countries that are developing AI-driven Agriculture platforms:
        i. ILVO in Flanders (Belgium);
        ii. NARO (Japan);
        iii. Center for Digital Agriculture/AIFARMS a 20M USD National Artificial Intelligence Research Institute funded by NIFA and NSF at University of Illinois at Urbana-Champaign (United States);
        iv. German Research Center for Artificial Intelligence (DFKI) and the Agrotech Valley Forum to collaborate in Germany's *AgrifoodTEF Project* at Ösnabruck University of Applied Sciences (Germany);
        v. INRAE (France);
        vi. NL AIC (The Netherlands);
        vii. DATAGRI (Spain);
        viii. Comissão de Agricultura e Meio Ambiente (Brazil);
        ix. Various institutions within Israel;
        x. Various institutions within India,
        xi. And other GPAI Member's institutions.
4. Continue the ongoing recruitment process of external experts in agriculture and/or in relevant institutions.

This mandate and the objectives can be achievable as a short-term project because it can be built on skills existing within the Working Group experts and with the support of member countries who have AI in Agriculture projects as a government objective.

Milestone	**Time frame**
• Portal Launch (Go-to-Market Activities, User Engagement monitoring)	January 2024
• Engage at least 2 GPAI countries AI-in Agro institutes and establish collaborative scopes, mutually beneficial goals, incorporation into GPAI Agro Portal of national AI-AGro case studies, Agro data governance, Agro-data sets for global analysis; others;	June 2024

• Present results of activities, portal outreach activities, results from various projects in Agro Robotics, Agro Data, Agro Business Models, Agro Innovation at Summit	November 2024

Future collaborators

- Recruitment of India's AI in Agro case studies and collaborators to join group as additional specialists;
- Seeking contacts at FAO to obtain further collaboration on other portal sections (Fighting Rural Negative Net Migration / Safety of Human Food Chain).

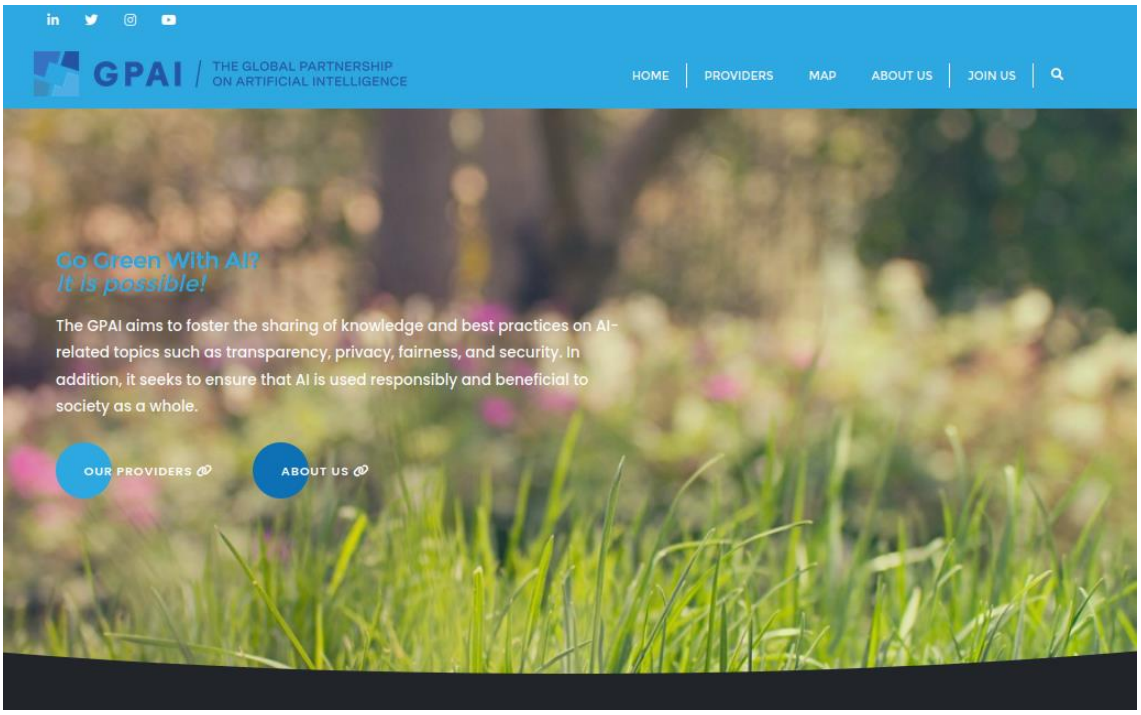
Annex

The following screenshots are a visual map of the web portal (for demonstration purposes only).

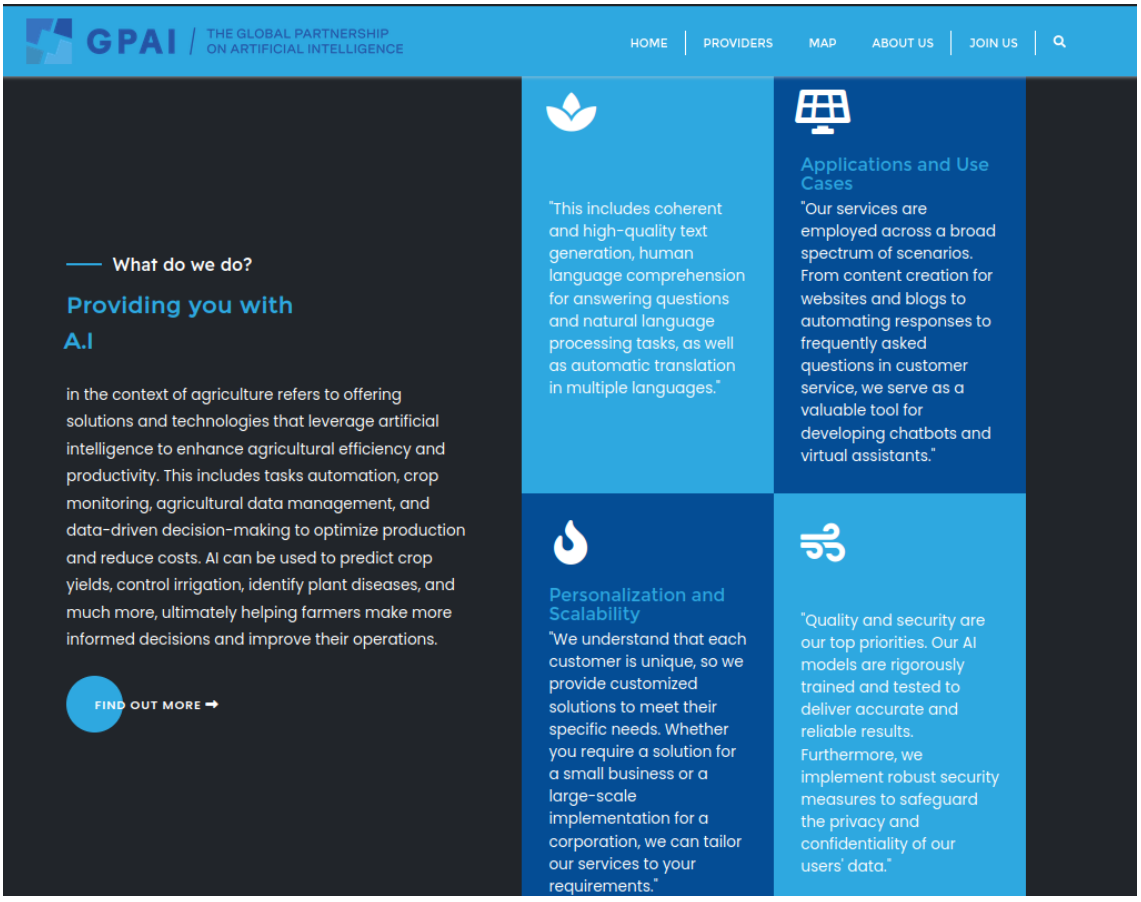
1. Home

Welcome page:

2. Index

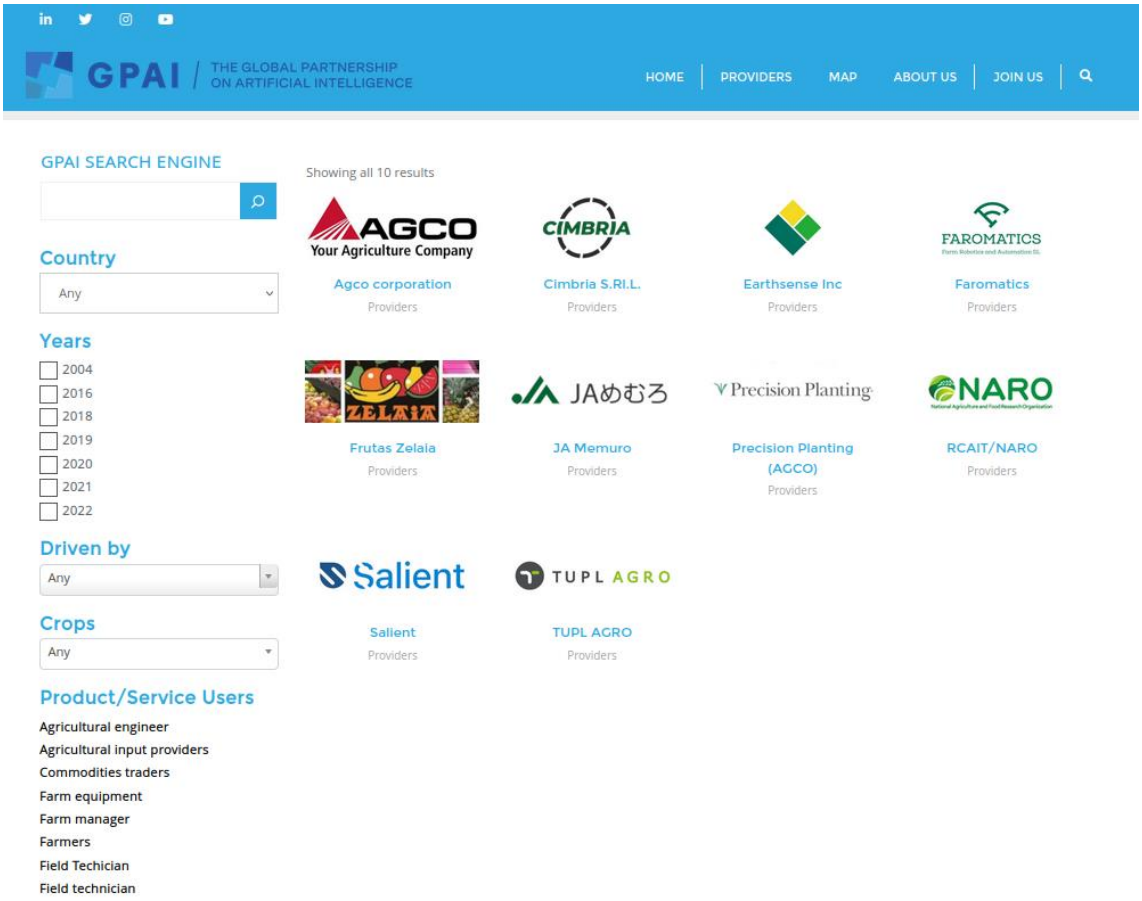


2.1. Index



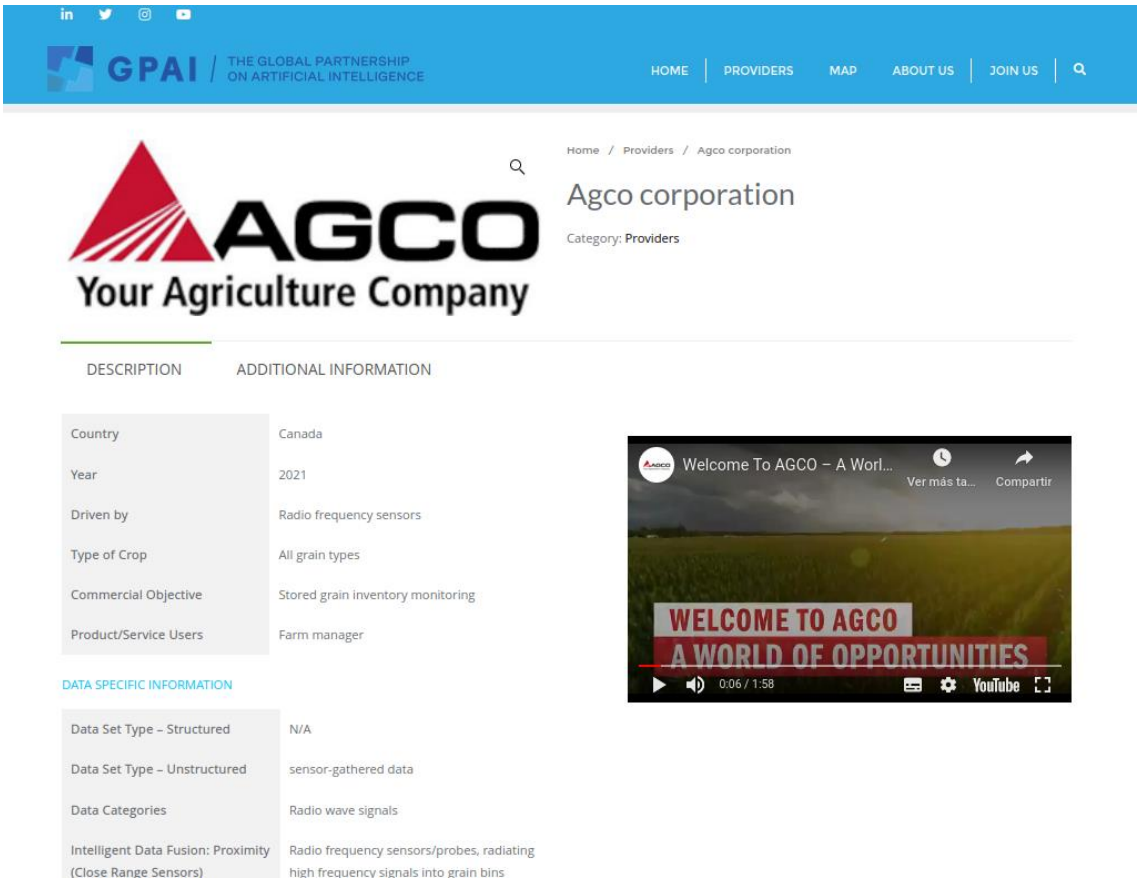
3. Providers

On this page, Loyola's InnoHub has implemented a filter plugin with provider products:



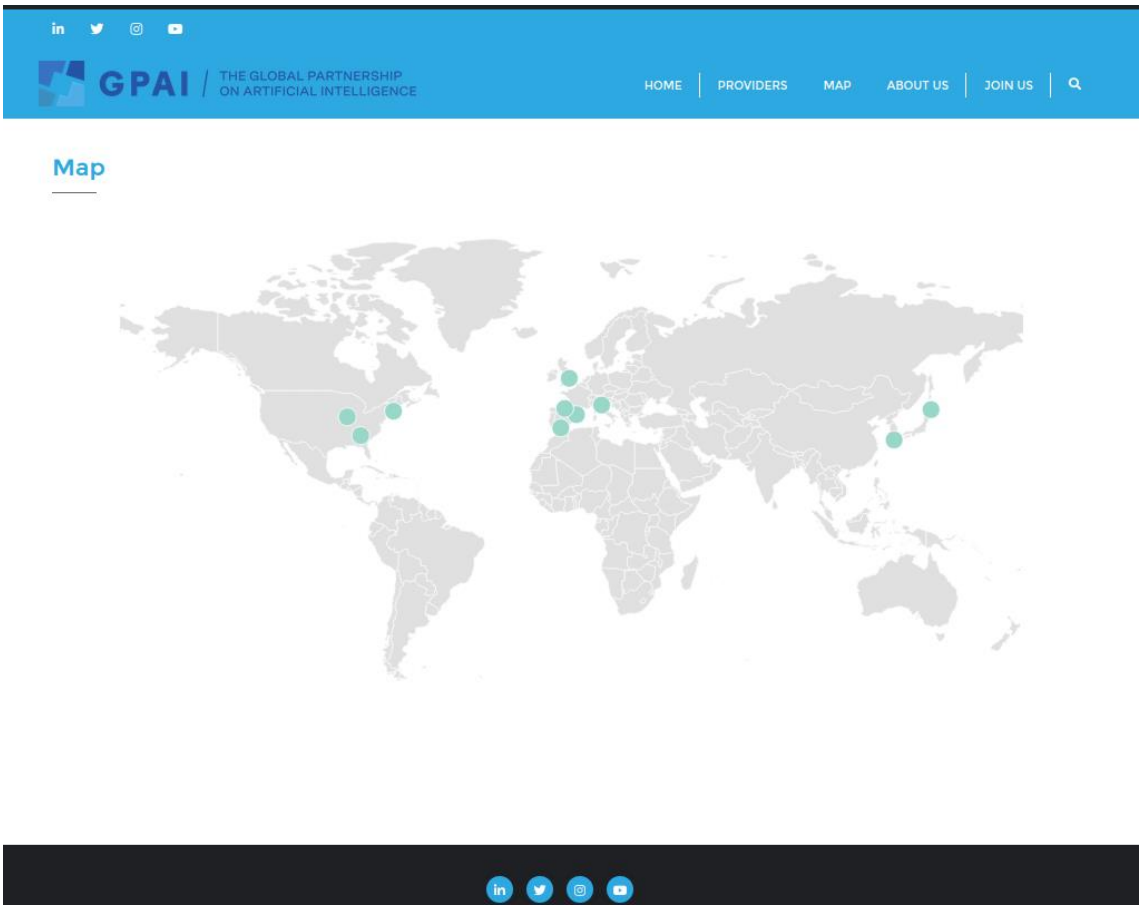
3.1. Providers

Within a provider, a user can see the company description, in addition to another tab for further information and the ability to add presentation videos:



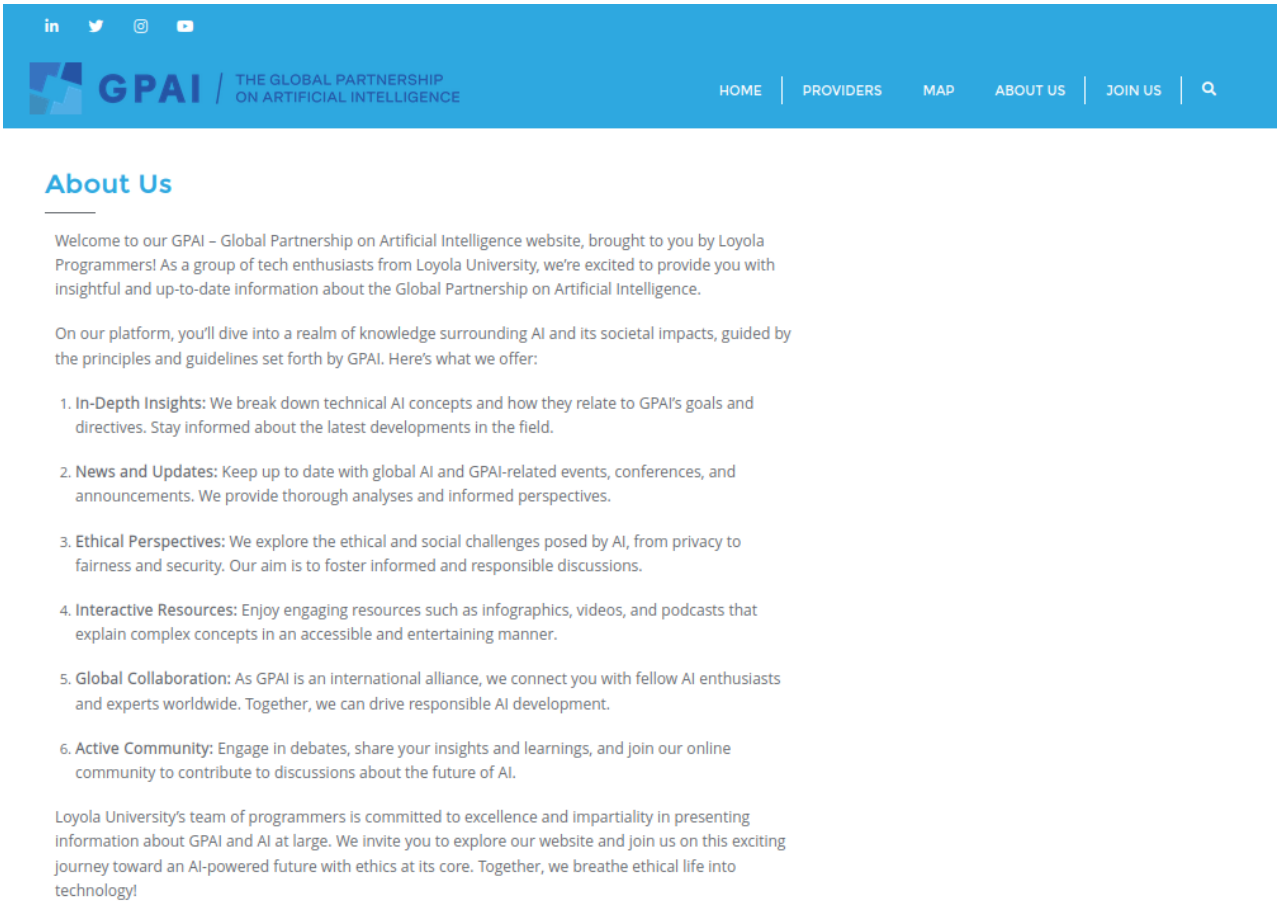
4. Map

Here a map plugin has been added, where all the providers can be marked with points. By hovering over the green points, you can see the address:



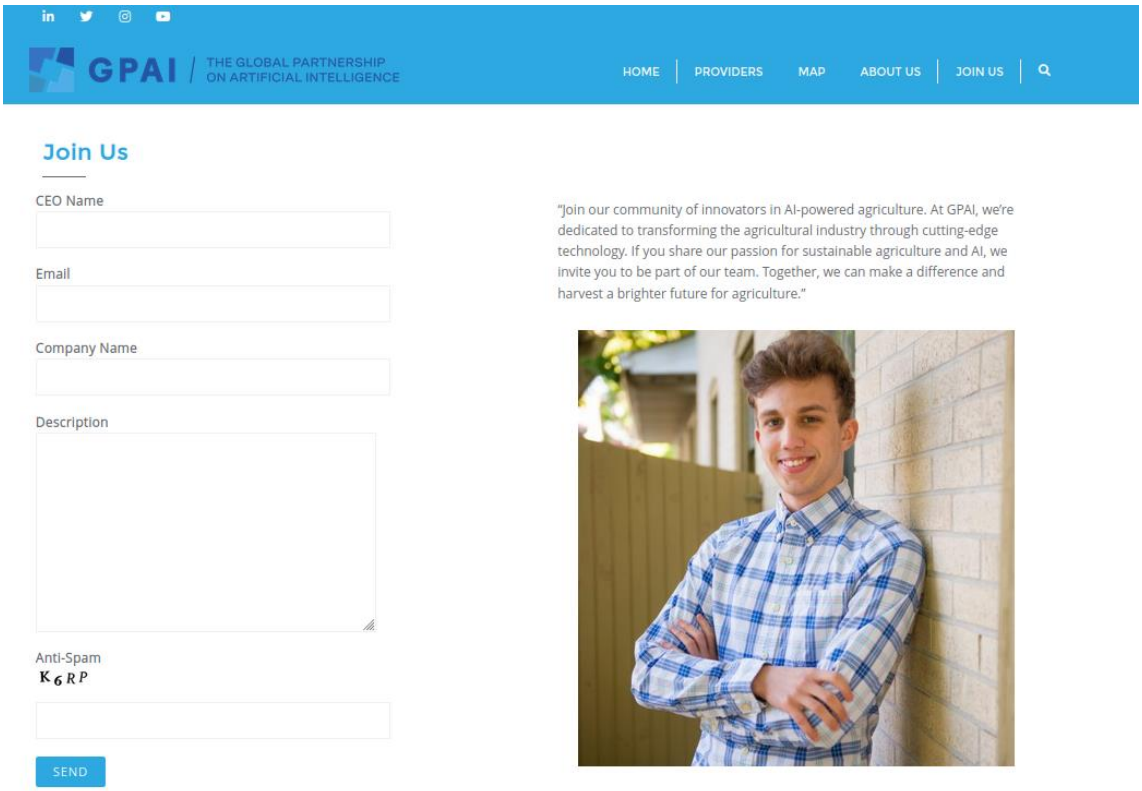
5. About Us

Information about what is done on the website:



6. Join Us

The last tab of the website is a form for future providers to contact the team. There is also a security captcha (anti-spam) added. When it is online, it will be changed to the original Google Captcha:



As for the security of the WordPress, Loyola's InnoHub has installed an All-In-One WP Security & Firewall: This plugin provides a wide range of security features, including a firewall, brute force protection, activity monitoring, and vulnerability scanning.

In addition to the security provided by the All-In-One WP Security & Firewall plugin, an SSL certificate has been implemented to ensure the security of user data, and regular backups are performed to prevent data loss.

The website design has been optimized for an intuitive and attractive user experience, with fast loading times and easy navigation. Emphasis has been placed on usability and accessibility to ensure that visitors can find the information they are looking for quickly and easily.