French, European and international projects in the field of smart digital agriculture

(Some original international projects using AI in agriculture)

Aygyul Epimakhova

Graduate of BIHAR ESTIA 2022

aygyul.epimakhova@gmail.com

General Plan

- Naïo Technologies : Agricultural robotics and AI (France)
- Farmstar (France : Airbus / Arvalis) based on satellite data
- Sencrop (France) : IOT Sensors
- Digifermes : network of experimental farms
- farmOS community (USA) : free and open-source web application
- Cropin Akṣara (India)
- xarvio Digital Farming Solutions (Germany)
- Climate FieldView (Bayer : United States/EU)
- Comparison of projects

Naïo Technologies : Agricultural robotics and AI

- **OZ ROBOT**
  - Assistant for market gardening and specialty crops
  - Soil preparation, seeding, weeding.
  - To operate, the OZ robot needs a map that the user can create in just a few minutes for each crop.

- **TED ROBOT**
  - The only autonomous straddler for vineyards
  - Inter-row maintenance, under-vine weeding, canopy management.
  - It is the lightest autonomous vineyard robot on the market.
  - To operate, the vineyard robot needs an accurate map of the vineyard that will be used every year.

- **JO ROBOT**
  - The crawler robot for narrow vineyards, nurseries & berries
  - Inter-row maintenance, under-vine weeding, canopy management.
  - It is ideal for fragmented plots and hard-to-reach vineyards.
  - It can mark planting lines with RTK accuracy.

- **ORIO**
  - The versatile tool carrier for vegetable crops and tree nurseries
  - Soil preparation, seeding, weeding.
  - RTK guidance combined with a camera-guided side-shift system ensures precise tool alignment, even when crop rows aren't perfectly straight.

Robots are manufactured in France using primarily European components and French-made electronic boards.

Farmstar : precision farming based on satellite data

Digital agronomic platform developed in France by **Airbus Defence and Space**, in collaboration with **Arvalis** and other agronomic institutes.

Goal — to optimize:
- **Yield and quality** (e.g., protein content in wheat)
- **Fertilizer efficiency**
- **Environmental balance** (by reducing nitrogen leaching)

- **Satellite crop monitoring**
  - Farmstar regularly acquires satellite images of fields (mainly from Sentinel and SPOT)
  - Assesses the **vegetation status** of crops (wheat, barley, rapeseed, etc.).
- **Agronomic indicators :** based on satellite imagery and weather data, the system calculates :
  - Biomass and nitrogen status of plants;
  - Development of the leaf area (LAI);
  - Stress levels (water, disease, etc.).
- **Fertilization recommendations (especially nitrogen)**
  - Farmstar generates **nitrogen recommendation maps (N-maps)**, showing how much nitrogen should be applied in each zone of the field — for the final or intermediate application stages.
  - These recommendations are based on the **actual crop condition**, not just on planned or average doses.
- **Compatibility with precision application equipment**
  - The maps can be exported in formats compatible with spreaders and tractors (ISOXML, Shape, etc.), enabling **variable-rate application** directly in the field.

Sencrop : IOT Sensors

- **Local weather stations**
  - Sencrop offers different models of equipment—for example for measuring rainfall and humidity, wind speed, air and soil temperature, soil moisture, etc.

- **Data platform**
  - The stations transmit data in real time (or near-real time), allowing you to see exactly the conditions on your plots.
  - There is an application / online interface: monitoring, alerts (for example, frost), and integration with agro-meteorological models.

- **Agronomic value.** Using data for:
  - monitoring weather conditions in the field (for instance, before fertilisation, spraying, irrigation)
  - forecasting risks (frost, diseases, drought stress)
  - making more precise decisions and optimising operations.

- **Collaborative network and data sharing**
  - Sencrop emphasises that their station-platform creates an ecosystem where farmers can see neighbouring stations, share data or use cooperative/regional networks.

DIGIFERMES : network of experimental farms

DIGIFERMES® is a French **network of experimental farms** labelled to test and demonstrate digital agriculture technologies under real-world conditions.
Enables collaboration between startups, research institutes and farms.

Mapping of the DIGIFERMES® network in 2025

Our strategic areas of focus

Digitalization of agricultural equipment

Robotics and precision agriculture are the new tools of tomorrow for finer modulation of interventions.

Tactical piloting

Decision support tools (DSTs) that rely on sensors and the Internet of Things (IoT) and allow the farmer to make the best decision for production at a given time.

Strategic management

Managing multi-year information, organizing work, market trends, digital technology will optimize the entire farming profession.

Agricultural data management

Reliability and real-time data will allow for increased responsiveness and efficiency.

Benefits :
- Provides **real-world testbeds** for digital agriculture technologies in diverse production systems, enabling validation before wide rollout.
- Helps farmers and advisors by providing **reference cases** and evidence of performance (technical, economic, environmental) of digital innovations.
- Supports more precise, data-driven farming: better decision timing, resource use efficiency, environmentally-responsible practices.

Di@gnoplant®-Vine : INRAE (open source)

French National Research Institute for Agriculture, Food and Environment

- **Di@gnoplant®-Vine** application, interactive and easy to use, allows visual identification of around fifty diseases and pests affecting grapevines in the vineyard.
- Two modes of use are available:
  - An **image-based identification module** lets you, through a series of images, gradually narrow down the cause of the observed problem, whether parasitic or not;
  - For more experienced users, an **index by common or Latin name** provides direct access to fact sheets summarizing current knowledge about each disease and pest.
- For each pest or disease, every fact sheet offers three sections, in addition to general information:
  - A description of symptoms
  - Their biological characteristics
  - Protection methods
- A **unique and original diagnostic tool**, this field application — gathering around fifty fact sheets and about 700 images — will quickly become an indispensable assistant for your vineyard investigations.
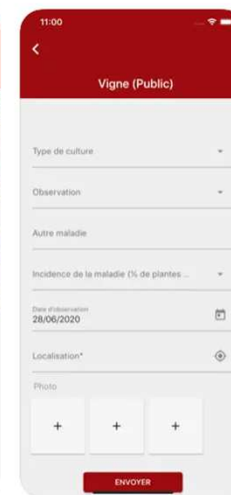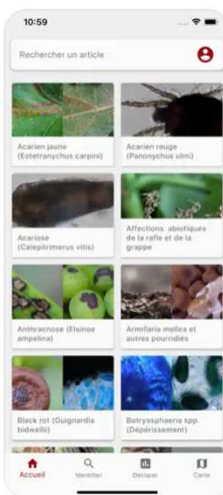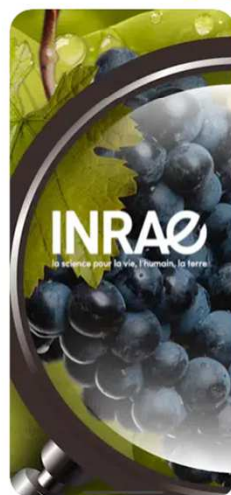
farmOS (USA)

farmOS is a free and open-source web application for farm management, planning, and record-keeping. It is built on the Drupal framework, making it modular, extensible, and secure.

| Module	Description
Farm Sensor	Adds a "Sensor" asset type so you can track environmental sensor data (e.g., soil moisture, temperature) and plot that data in charts.
Farm Sensor: Listener	A sub-module of Farm Sensor. Provides an HTTP endpoint for posting sensor data automatically (JSON) into farmOS.
Farm Nutrient	Module for nutrient-management planning: link plans to areas/fields, manage soil tests and amendments.
Farm Soil: Compost	A module to manage compost as an asset type: helps track compost activities, inputs, harvests etc. Useful for soil health and organic amendments.
Farm Map	Enables interactive map features: drawing/editing field boundaries, overlays, GIS integration—key for precision ag.
Farm Soil NRCS	Adds integration with soil survey data (e.g., from the US NRCS) so you can import baseline soil attributes for fields/areas.
Farm Plan	Enables creating strategic-level farm plans (crop plans, fertiliser schedules, area maps) linking to assets & logs.
Farm Water	Module for water management: tracking water assets (irrigation systems, wells) and water-related logs/tests. Especially relevant for precision irrigation.
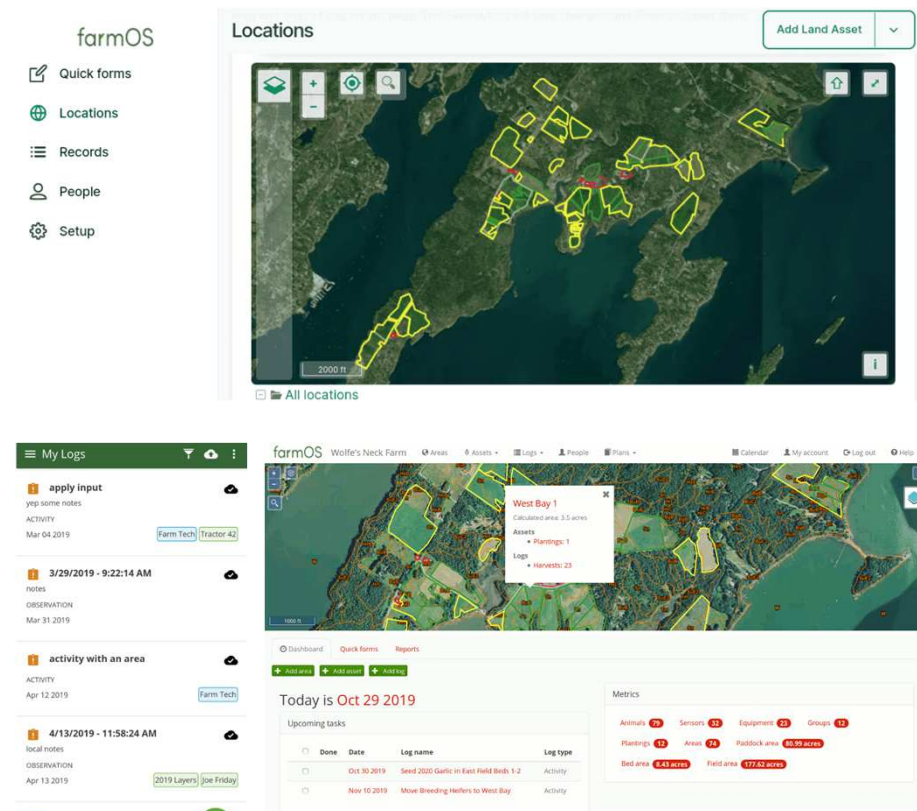
Cropin Akṣara (India)

- ākṣara is a **micro-language model (µ-LM)** specifically tailored for agriculture.
- It is built upon the **foundation of the Mistral-7B-Instruct model** (7 billion parameters) and then fine-tuned using agricultural domain data.
- The training data includes thousands of question-answer pairs (e.g., over 5,000) and over 160,000 tokens of context specific to agriculture.
- It uses techniques to optimise efficiency: **compressed from 16-bit precision down to 4-bit via QLoRA** (Quantization + Low-Rank Adapters) to reduce model size and computational resources.
- The domain of knowledge is **focussed on climate-smart agriculture** (CSA) and regenerative agriculture practices in its target regions and crops.
- It covers nine major crops (e.g., paddy/rice, wheat, maize, barley, sorghum, cotton, sugarcane, soybean, millets) and five countries in the Indian sub-continent (India, Bangladesh, Pakistan, Nepal, Sri Lanka) in its initial version.
- It is released under the Apache 2.0 **open-source** licence (allowing free use, modification, distribution) with no additional restrictions.
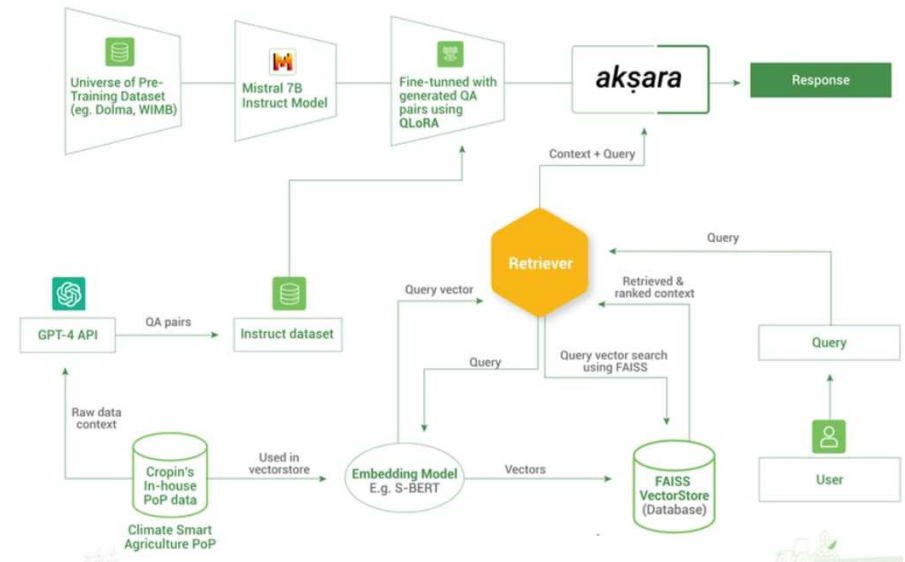
xarvio® (BASF, Germany)

Its strength lies in the deep integration of BASF's agronomic knowledge and precision farming technologies.

- xarvio® is a brand of BASF Digital Farming GmbH (part of BASF SE) focused on digital agriculture and crop-production optimisation.
- The goal is to provide farmers with tools that deliver **field-zone-specific agronomic advice, enabling more efficient and sustainable crop production**.
- Their products are based on a SaaS model and often have a modular structure, adapted to different needs :
  - xarvio **FIELD MANAGER**: A digital platform/app for managing crops from sowing to harvest, offering field- and zone-based insights (e.g., seeding, crop protection, nutrition) for major crops.
  - xarvio **HEALTHY FIELDS**: A service offering agronomic strategies for crop protection, aimed at guaranteeing plant health, often via a season-based subscription model.
  - xarvio **SCOUTING**: A mobile app used for quick in-field identification of crop stress, weeds, diseases, etc., via smartphone
  - **ONE SMART SPRAY**: A precision spraying solution developed by the joint venture of Bosch BASF Smart Farming GmbH (Bosch + BASF) that integrates hardware (high-resolution cameras, sensors, LED lighting), software (real-time weed detection, selective spraying) and the agronomic and digital expertise of xarvio.
- **Connectivity/integration**: xarvio has worked to integrate with major agricultural machinery platforms and OEMs such as CNH Industrial (Case IH, New Holland, STEYR) and John Deere, enabling data sharing between machines and the digital platform.
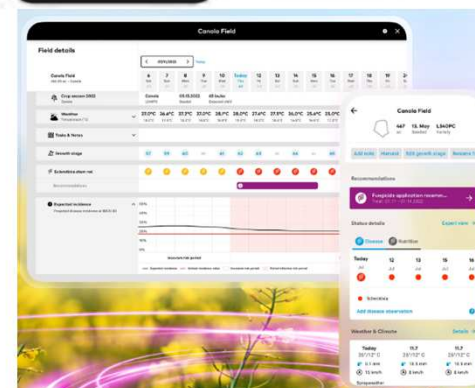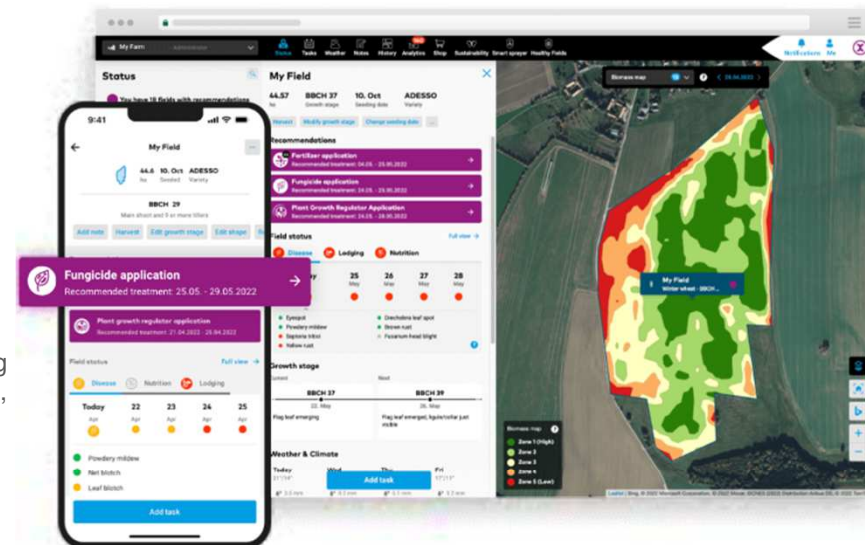
Climate FieldView (Bayer, EU/USA)

- Climate FieldView is a digital farming platform **developed by The Climate Corporation**, a subsidiary of Bayer Crop Science.
- It helps farmers collect, visualize, and analyze field data from different sources — including machinery, sensors, and satellite imagery — all in one place.
- The goal is to enable data-driven decisions in the field: **optimizing planting, input use, and yield management**.
- Centralizes all field data in one digital platform.
- Improves transparency and decision-making — **helps identify underperforming zones and understand yield drivers**.
- Compatible with many equipment brands and digital agriculture systems.
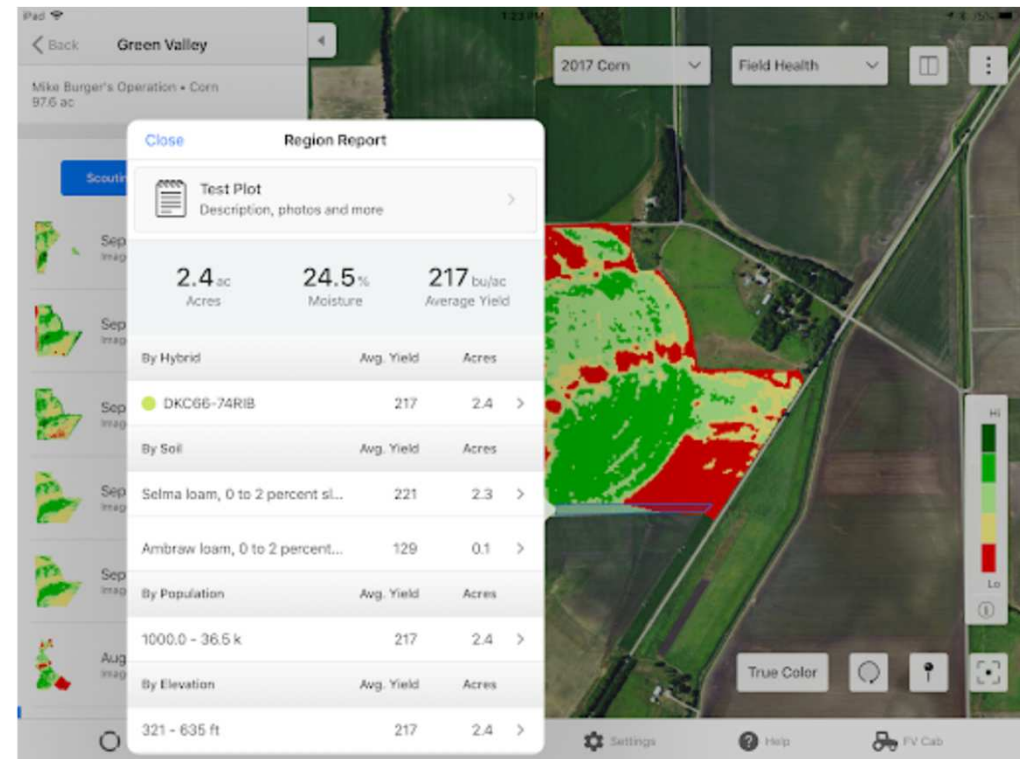
Comparison of projects

Project	Sensors	OAD / AI	Connectivity	Modularity	Data quality	Interoperability	Technical support	Adaptation to conditions	Agronomic impact
Naïo Technologies (France)	GPS, cameras, LiDAR	Autonomous robots, weed detection (CNN)	4G/LoRa	Supports different hitching tools	High positioning accuracy	Limited	Commercial support	Weather-resistant robots	Reduction of herbicides
Farmstar (France)	Satellites, multispectral cameras	Biomass estimation, fertilization	Satellite networks	Integration with ERP	Medium resolution	APIs available	Airbus + Arvalis	Cereal crops	Optimization of fertilizers
Sencrop (France)	Weather stations, humidity, temperature	Weather forecast, disease risk	LoRa, Sigfox	Possible to add sensors	Good, but depends on network	Open APIs	Large network in France	Various crops	Reduction of phytosanitary risks
Digifermes (France)	IoT, drones, satellites	Testing of digital technologies	LoRa, 5G	Yes	High (R&D)	Yes (tested platforms)	INRAE + partners	Various climatic zones	Pilot projects for cost reduction
farmOS (Open source, USA, global)	IoT integration, drones	Data aggregator, ML plugins	Internet, API	Very high	Depends on sensors	Yes, open standards	Community	Global	Flexible configuration
Cropin Akṣara (India)	Satellites, IoT	µ-LM for recommendations, crop insights	4G/5G, API	Yes	High (regional models)	API	Global deployment	Local crops	Increased yield
xarvio® (BASF, Germany)	Satellites, IoT	Digital farming, disease prediction	4G/5G	Yes	High	Yes, API	BASF	Europe, globally	Optimization of insecticides
Climate FieldView (Bayer, EU/USA)	IoT, satellites, tractor sensors	Yield analysis, crop insights	4G/5G	Yes	High	Yes (API)	Bayer	US / EU	Increased yield

Data Security, AI Models, and Governance

Project	Data Security	AI Models	Open Source / Proprietary	Local Adaptation	Integration	Ethics / Data Governance
Naïo Technologies (France)	Robotic data (images, trajectories) stored locally or on client servers. Encrypted transmission, GDPR compliance, and data anonymization tested in new versions.	Uses computer vision models based on CNN and deep learning for crop and weed detection. Robots (Oz, Dino, Ted) have onboard AI systems for autonomous navigation, real-time image segmentation, and obstacle recognition. Reinforcement Learning algorithms are also being tested.	Commercial	Limited	Compatible with GPS/ISOBUS	GDPR compliance
Farmstar (France)	Data hosted by Airbus Defence & Space on European GDPR-compliant servers. Access limited to farmers and cooperative partners. Minimal data openness.	CNN for satellite image analysis + supervised agronomic regression models for yield prediction.	Commercial	Yes (by crop type)	Compatible with ERP	GDPR compliance
Sencrop (France)	Weather data stored on AWS Europe (Ireland), GDPR compliant. Users retain data ownership; sharing possible with OAD partners via explicit consent.	Machine-learning-based weather forecast models (Random Forest, LSTM for time series) integrated into OAD partner platforms.	Commercial	Partial	API for OAD	GDPR compliance
Digifermes (France)	Experimental data managed by INRAE and Chambers of Agriculture under public research protocols. Strong transparency and open governance, full GDPR compliance.	Experimental platform testing multiple ML/DL models (CNN, U-Net, LLM for agricultural NLP). Interoperability between several algorithms, no single model.	Mixed (partially open)	Yes	Tests with various ERPs	GDPR compliance
farmOS (Open source, global)	Data stored locally or on user-chosen servers. Open data–friendly, security depends on configuration. TLS encryption and voluntary GDPR compliance.	No built-in model, but supports integration with external frameworks (TensorFlow, PyTorch, scikit-learn). Several open-source extensions use CNN and LLM for disease recognition.	Open source	Yes (fine-tuning)	API for ERP	Voluntary GDPR compliance
Cropin Akṣara (India/Europe)	Cloud storage (AWS, Azure) with regional partitions (EU/India). GDPR compliant in Europe; Indian law allows limited aggregated analytics. Secure API-based access.	Multimodal language model based on Mistral 7B (LLM) + CNN for satellite and drone vision. Specializes in crop diagnostics and contextual recommendations.	Open source / Commercial	Yes (fine-tuning)	ERP / IoT	GDPR compliant in Europe
xarvio® (BASF, Germany)	Data hosted on European servers (BASF Cloud, Germany). Strict GDPR compliance, but internal data processing remains opaque (proprietary models).	CNN and deep neural networks for disease and weed detection + decision models optimizing input doses.	Commercial	Yes	Compatible with ERP	GDPR compliance
Climate FieldView (Bayer, US/EU)	Data is stored on servers in the EU and the US. It claims to be GDPR compliant but has been criticized for data centralization and ownership (Bayer retains certain rights to analysis).	Deep learning models (LSTM, CNN) for time series and spatial analysis; proprietary models for yield prediction and field segmentation.	Commercial	Partial	ERP / IoT	GDPR / CCPA

Conclusion

Smart digital farming is a combination of
- robotics
- satellites
- IoT sensors
- artificial intelligence platforms.

Together, they help farmers work more efficiently and protect the environment.

French, European, and international projects show a strong movement toward precise, efficient, and sustainable agriculture.

These technologies support farmers today and help ensure food security for the future.

URL GRAPHY

1. Home - Naïo Technologies

2. https://www.myfarmstar.com

3. https://sencrop.com/fr/

4. GTagri-02_05b-DigifermeBG-Article_cle812835.pdf

5. Digifermes : Le numérique au service d'une agriculture durable – APECITA

6. https://farmos.org

7. https://v1.farmos.org/development/projects

8. https://www.cropin.com/blogs/introducing-aksara-a-digital-agronomist

9. Cropin unveils 'aksara' micro language model for climate-smart agriculture, targeting the Global South - Agriculture Post

10. https://agritechinsights.com/index.php/2023/12/14/digital-farming-leap-xarvio-joins-cnh-for-smart-agriculture

11. xarvio Digital Farming Solutions® About page

12. https://www.basf.com/global/en/media/news-releases/2024/05/p-24-190

13. https://ephytia.inra.fr/fr/CMS/74/Diagnoplant

14. https://play.google.com/store/apps/details?hl=fr&id=com.inra.DiagnoPlant.Vigne

15. https://play.google.com/store/apps/details?hl=fr&id=com.inra.DiagnoPlant.Biocontrole