

GOOD PRACTICE SHEET N° 5

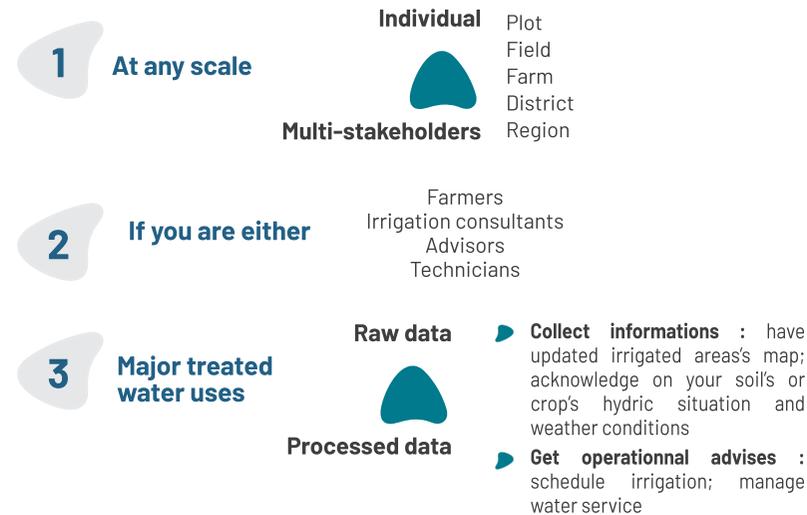
DECISION SUPPORT SYSTEM (DSS)

What is a decision support system?

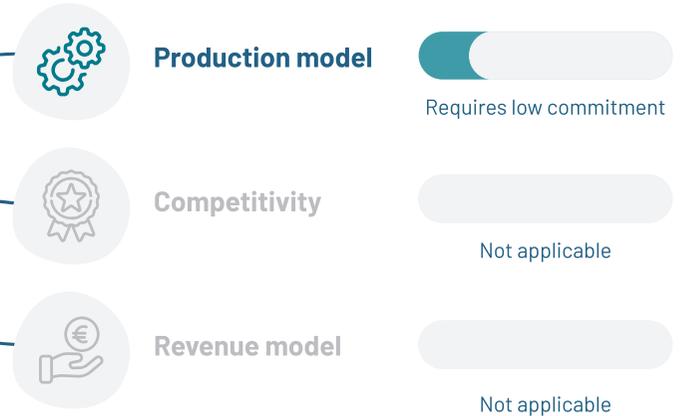
Decision support systems (DSS) collect, verify and process **data** to suggest the **most appropriate farming action**. They can be either **robotic tools** collecting real-time data or **software** that enables the storage, organization, development and dissemination of processed data. Based on descriptive, predictive or even prescriptive models, they deliver a **diagnosis or propose an indicator-based action** to farmers. In agriculture, they respond to a **strategic decision** to fix long term objectives or a **tactical decision** to manage the farm in the short term. **This good practice sheet focuses on irrigation management and focuses on tactical decisions.**

Why should you implement a DSS to manage irrigation?

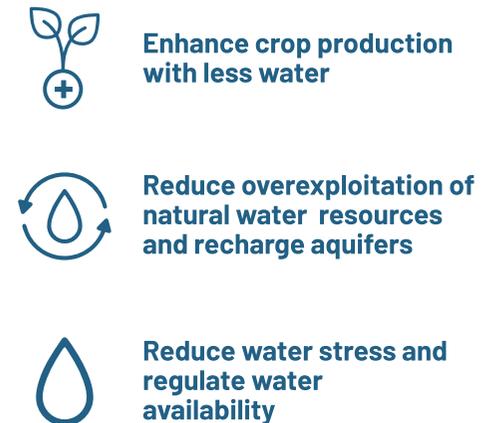
DSS helps to limit operating costs related to farming in water-restricted areas.



Which **impactful changes** can DSS bring to your business model transformation?



What are the environmental needs addressed by DSS to manage irrigation ?



What are the economic needs addressed by DSS ?



DSS allow farmers to access data and knowledge to reconnect with their work tools and use them in the most efficient way. The impacts described below are mainly indirect impacts caused implementation of DSS.

AGRO-ENVIRONMENTAL IMPACTS

Fields under DSS irrigation management improved their water efficiency :

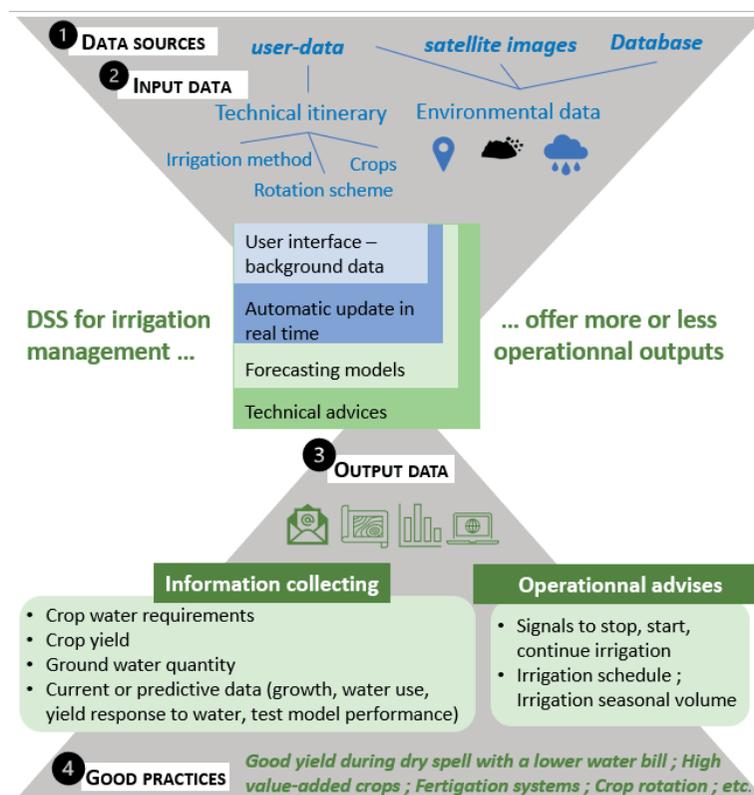
- ▶ Proportion of **fields with water deficit declined from 20 to 10%**.
- ▶ Proportion of fields which were **adequately irrigated increased from 50 to over 70%**.
- ▶ Proportion of **over-irrigated fields** which also had initially decreased from 20 to 10%, **went back to 20%** at the end of the study period.¹

The use of decision support tools could save from **15% to 25% of the water withdrawn**.

In a year with high rainfall deficit, DSS enable **adaptation to climatic conditions** with relatively low water savings (0 to 8%) **but without lowering the yield**.²

However, it is important to be aware of the direct environmental impact of these tools, which is their **digital footprint**: high energy and raw material costs. We lack sufficient data to quantify the impact of the digital footprint.

What are the key figures for DSS to manage irrigation?



ECONOMIC IMPACTS

Emergence of highly industry-specific technologies and applications.

The **ROI is 2 years** and the internal rate of return is 59.1%¹

Time and water saving, i.e., **20 €/ha** (considering water prices in France)³

Yields were higher in the DSS farms, from **8 to 34%**.¹

SOCIAL IMPACTS

DSS **popularize and generalize access to quantitative field information** (in regions with a good digital access). 80% of French users believe that digital technology allows them to gain better knowledge of plots and crop products.⁴

There has been an important **development of DSS since the 1990's via a technology pull** rather than an end-user pull. Applying DSS-related methods to support irrigation decision making is near to or less than 1% for both adoption and level of intensity.⁵

POTENTIAL DEVELOPMENT

The extent to which DSS outputs are adopted is rarely measured. **The development of DSS is conditional on more studies being carried out, as well as collection of feedback.**

Offer: **Irrigation scheduling** is an important decision problem in agriculture that has a major effect on yield, environment and gross margin in water-limited areas.

Demand: Demand-driven participatory processes engender greater adoption of DSS **knowledge**.

How to implement DSS?

ON-FARM ISSUES

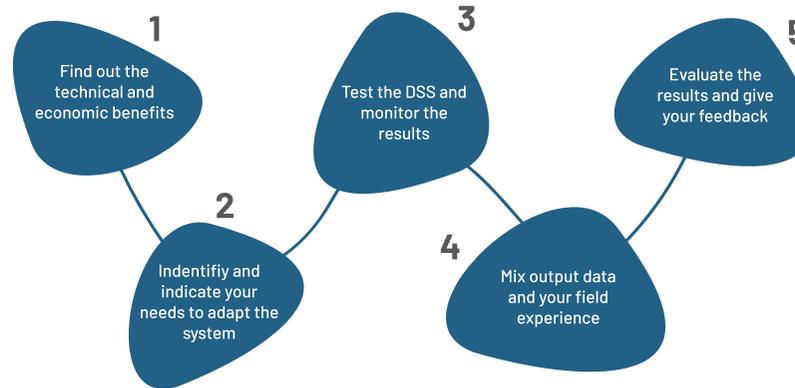
- 1 Giving the right amount of water to crops
- 2 High irrigation management time
- 3 Lack of water and competition for water resources
- 4 Reduction of direct debit authorizations
- 5 Insufficient economic outcomes

FIELD ADVICE

"Irrigation management is not to be taken lightly. Water stress between the 8-leaf and 50% grain moisture stages can have serious consequences on the yield components. This is why it is important to have a tool that supports my decisions, in addition to my field observations. Support is particularly necessary for starting irrigation, resuming irrigation after a storm or stopping it too early. My watering allowed me to cover 98% of my corn's water needs, while making the most of my soil's useful reserve. The ease of use is an important asset that allows the user to adapt to the tool very quickly. In a few clicks, you get a complete analysis of the soil water status with graphs and explanations that are within everyone's reach. The creation and recording of several plots is a very practical feature."
 Interview of Thierry O., farmer in France with 160ha of irrigated corn.

"This tool supports decision-making by giving a good appreciation of the plant's needs and the soil's hydric state, but it does not decide for us. It is the farmer who remains master of the final decision."
 Christophe Buisset, farmer in France, potato crop

KEY STEPS TO A SUCCESSFUL IMPLEMENTATION



IMPACTS AND BENEFITS

- 1 More data-based decisions
- 2 Working and time comfort, lower mental workload
- 3 Optimize water use
- 4 Reduce water withdrawals
- 5 Maintain yield and reduction of water bill

KEY CHALLENGES

Challenges to widespread adoption

- ▶ Improving accessibility of DSS in terms of costs and visibility.
- ▶ Finding a compromise between friendly user-experience structure and scientific complexity data integration.
- ▶ Improving awareness-raising and training about the benefits of DSS implementation for farmers.
- ▶ Developing co-constructed DSS with farmers and shared them publicly.
- ▶ Increasing interoperability between tools.

Issues raised

- ▶ Articulation between DSS advice and technical support / sales team.
- ▶ Delegation of all ecological decisions to the tools.
- ▶ Difficulties to appropriate the incorporated and encapsulated knowledge at the origin of the data and advice given by the DSS.



MORE INFORMATION DOCUMENTS AND DATA

Webconference : Definition, utilization and impact of the decision support tools ACTA, France.

<http://www.acta.asso.fr/presse/breves/breves/detail/a/detail/definition-utilisation-et-impact-des-outils-daide-a-la-decision-en-agriculture-oad-1330.html>

AQUATER Software as a DSS for Irrigation Management in Semi- Arid Mediterranean Areas - M. Acutis, A. Perego, E. Bernardoni, M. Rinaldi ; 2009.

Improving on-farm water management through an irrigation scheduling service - A. Montoro, P. Lopez-Fuster, E. Fereres ; 2010

Decision Support Systems to Manage Irrigation in Agriculture - Michele Rinaldi and Zhenli He ; 2010

Saving water for irrigation through changes in agricultural practices: comparative analysis of Shenli public policies and possible improvements improvement in France ; Oréade-Brèche ; 2016.

Application, adoption and opportunities for improving decision support systems in irrigated area - I. Ara, L. Turner, M. Harrison, M. Monjardino, P; deVoil, D. Rodriguez ; 2021

AgroTIC, The observatory of the uses of digital agriculture (arboriculture, market gardening, viticulture, field crops) : <https://www.agrotic.org/observatoiredesusages/>

How to go further?



DISCUSS AND TEST PROJECTS, TOOLS AND NETWORKS

Example of DSS developed in Mediterranean Areas:
AQUATER (Irrigation Management in Semi-Arid Mediterranean Areas); **ISS-ITAP** (information on crop water requirements in Central Spain) ; **IRRINET**, **DSIRR** (Italy, district & field scale) ; **IrrigDSS** (Serbia); Gisareg (Aral sea, district scale)

Multiple platform for referencing data or tools to manage irrigation:

HubIS - Open innovation platform for Mediterranean irrigated systems (in progress, end in 2023)

IoT Solutions for Agriculture and Farming : <https://thethings.io/iot-agriculture/>

Platform for referencing digital tools in agriculture : <https://www.lesoutilsnumeriquesdesagriculteurs.com/>

AgriData - Integrator of digital solutions dedicated exclusively to the agricultural and agri-food industry ; Pioneer operator in digitalization in Morocco.

E-stratos - A tool to monitor crops, check weather, find crop trends and create variable rate maps with high resolution images : <https://e-stratos.eu/>

Companies that have developed decision support tools:

ITK - Predict and Decide : an agronomic innovation company that develops technological solutions for food security around the world ; **Arvalis**.



TAKE ACTION FUNDING SOURCES

European Agricultural Fund for Rural Development (EAFRD). The “second pillar” of the Common Agricultural Policy (CAP) complements the system of direct payments to farmers. The Fund focuses on agriculture, forestry, environment and quality of life in rural areas. Action 16 of EAFRD resources can be used to finance decision support system to manage irrigation. The Ecoscheme of the new CAP seeks to integrate resources for irrigation decision support systems, according to the national strategies.

Water Europe is the European Technology Platform for Water, initiated by the European Commission in 2004 as an industry-led stakeholder forum. Water Europe has developed different Programs which are key to the objectives and implementation of the Water Europe strategy: “Collaboration and Working Groups Program” to foster collaborative initiatives between members and “The Investor Program” to facilitate the growth of investment in the sector.

Public-private partnerships can allow some projects to emerge (e.g : project El Guerdane in Morocco).