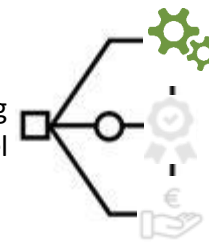# DECISION SUPPORT SYSTEM (DSS)

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

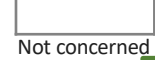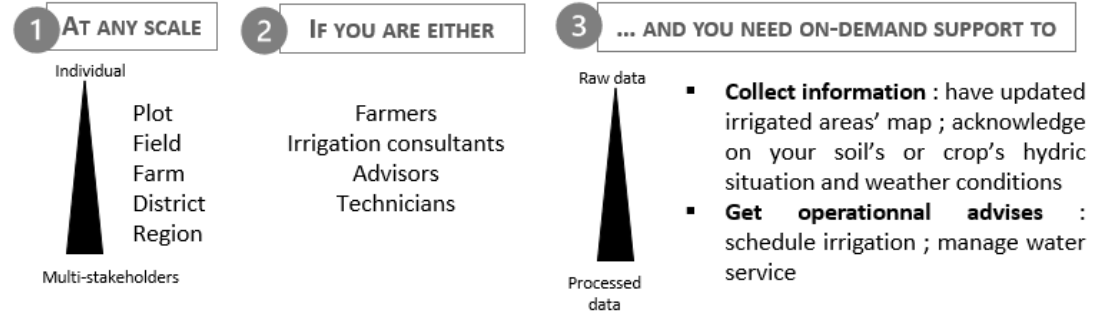|	
Production model	Requires low commitment
Competitivity	Not concerned
Revenue model	Not concerned
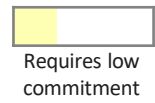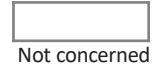
What is a decision support system?

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 **softwares** that enables the storage, organization, development and dissemination of processed-data. Based on descriptive, predictive or even prescriptive models, they deliver a **diagnosis or advise an indicator-based action** to the farmers. In agriculture, they respond to **a strategic decision** to fix long term objectives or a **tactical decision** to manage the farm on short term. **This good practice sheet focuses on irrigation management which concerns tactical decision.**

Why should you implement a decision support system to manage irrigation?

DSS allows to limit operating costs related to farming in water-restrictied areas.

1 AT ANY SCALE

Individual
Plot
Field
Farm
District
Region
Multi-stakeholders

2 IF YOU ARE EITHER

Farmers
Irrigation consultants
Advisors
Technicians

3 ... AND YOU NEED ON-DEMAND SUPPORT TO

Raw data
Processed data

- **Collect information** : have updated irrigated areas' map ; acknowledge on your soil's or crop's hydric situation and weather conditions
- **Get operationnal advises** : schedule irrigation ; manage water service

What are the environmental needs addressed by decision support system to manage irrigation ?

Enhance crop production with less water

Reduce overexploitation of natural water resources and recharge aquifers

Reduce water stress and regulate water availability

What are the socio-economic needs addressed by decision support system to manage irrigation?

€

Reduce water costs

Facilitate irrigation management with predefine schedule

VERTIGOLAB Water SHIFT MAVA FONDATION POUR LA NATURE

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 by DSS' implementation.

What are the key figures for decision support system to manage irrigation?

AGRO-ENVIRONMENTAL IMPACTS

Fields under DSS-irrigation management improved their water efficiency :

- Proportion of **deficit-irrigated fields 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**.

A year with high rainfall deficit, the DSS allow to **adapt the 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 perspective in quantifying the impact of the digital footprint.
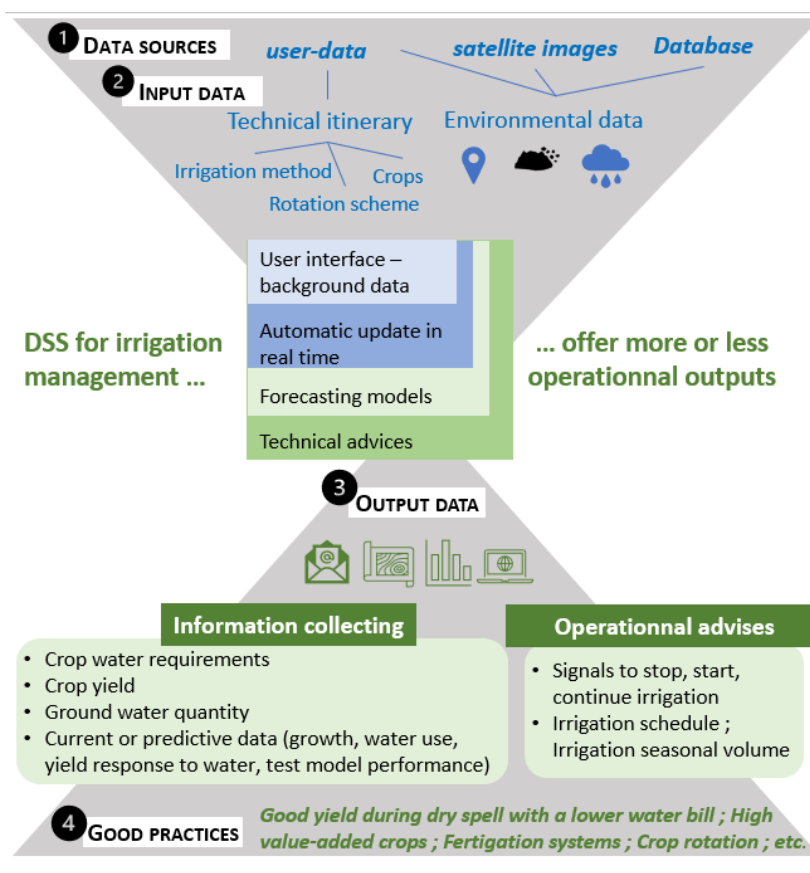
ECONOMIC IMPACTS

Emergence of highly industry-specific technologies and applications.

The **pay-back 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 **popularise and generalise access to quantitative field information** (in regions with a good digital access). 80% of french users believe that digital technology enable to have a better knowledge of plots and crop products. [4]

There is 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, so on the collect 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**.
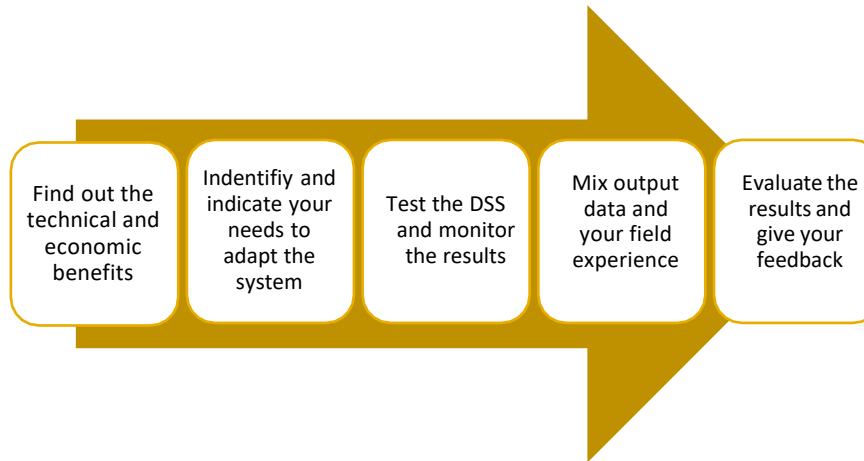
How to implement an agroforestry system?

On-farm issues

1. Give the right amount of water to the crops
2. High irrigation management time
3. Lack of water and competition for water ressources
4. Reduction of direct debit authorizations
5. Insufficient economic results

Key steps to a successful implementation

Find out the technical and economic benefits → Indentifiy and indicate your needs to adapt the system → Test the DSS and monitor the results → Mix output data and your field experience → Evaluate the results and give your feedback

Impacts and benefits

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

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 get used 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 or 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

Points of attention

Challenges to widespread adoption

- Improve accessibility of DSS in terms of costs and visibility.
- Find a compromise between friendly user-experience structure and scientific complexity data integration.
- Improve awareness-raising and training about DSS' implementation interest for farmers.
- Develop co-constructed DSS with farmers and shared them publicly.
- Increase interoperability between tools.

Questions raised

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

How to go further?

FOR MORE INFORMATION DOCUMENTS AND DATA	TO DISCUSS AND TEST PROJECTS, TOOLS AND NETWORKS	TO TAKE ACTION FUNDING SOURCES
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/	*Example of DSS developed in Mediterranean Areas:* **AQUATER (**Irrigation Management in Semi-Arid Mediterranean Areas) ; **ISS-ITAP (**crop water requirements information in Central Spain) ; **IRRINET**, **DSIRR** (Italia, 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 for monitor crops, check weather, find crop trends and create variable rate maps with high resolution images : https://e-stratos.eu/ *Companies who developed decision support tools:* **ITK – Predict and Decide** : an agronomic innovation company that develops technological solutions for food security around the world ; **Arvalis**	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. Ecoscheme of the new CAP would integrate resources for irrigation decision support system, 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).