Funded by the European Union

QuantiFarm

INTERVENTIONS FOR DATS ADOPTION - GUIDELINES

WORKPACKAGE 1 – BEHAVIOUR INNOVATION AND STAKEHOLDER ENGAGEMENT

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About the guidelines

- The goal of the QuantiFarm project is to quantitatively and qualitatively assess the impact of Digital Agricultural Technologies (DATSs) on sustainability in the farming practice. This also encompasses understanding on a behavioural level how DATSs become (well) integrated/applied on farms. In other words, understanding the journey of how DATSs actually find their place on the farm, and can be (well) applied.
- To this end, Work Package 1 has collected data on behavioural determinants of DATS adoption through desk study, farm visits, interviews and surveys. The result is an extensive dataset with forthcoming insights that can support different stakeholders (most notably farmers, farm advisors, DATS providers and policy makers) in this adoption journey via interventions of all sorts (such as trainings, tools, services, communication, peer programs, etc.)
- These guidelines have been created to comprehensively guide QuantiFarm stakeholders through the found data and insights, and their resulting implications with suggestions for interventions.
- The document is clickable; feel free to click through the information that suits your role. Often the information per role is comparable, and sometimes the information is more targeted.

I am a…*

Farmer

Farm advisor

DATS provider

Policy maker

* These roles are broad generic categories, and can be performed by the same person. Please feel free to click through any role you find applicable or interesting.

FARMER

What do you want to learn more about?

Understand

the adoption of DATSs by farmers

Implications

behaviourally-informed services, tools, etc

Understand – experiences by peers

- In the following slides, you will read more about what we found in the QuantiFarm project about how farmers adopt DATSs (or not).
- We gathered these insights via farm visits and interviews with farmers, desk study and surveys. Maybe your story is in here, too!
- These (generalised and anonymised) insights may be recognisable for you, or not at all. Please feel free to share with us your story, or reach out via Contact us – QuantiFarm if you would like to be connected to peers you think you can learn from.
- Do you want to learn more about the farmers in QuantiFarm? Find our material on the QuantiFarm website: quantifarm.eu

Understand – the adoption process

Adoption of a DATS is not a binary yes/no moment: it is a journey

- The adoption journey starts with an encounter with (a) DATS(s), either by chance, marketing campaigns, mentioning by peers, an advisor, your network, research programs, etc.
- This is followed by an elongated phase of consideration, in which many determinants (~ influencers) are at play that can in turn be clustered into 4 groups, which all come together in the decision sphere of the farmer and their farm. These 4 groups can be found on the next slide.
- After going through this process of consideration follows an implementation decision, which may be not to implement anything (for now); to conduct a trial, to do a full-blown roll-out, or variations in between, such as trialing just one part of the DATS solution first.
- Last but not least, is the usage phase, in which still many factors influence how a DATS is actually adopted and whether it can perform optimally. This is where expectations, e.g. on performance, ease of use, or interactions with other technologies, are met (or not) in practice.

Understand – the adoption process

4 groups of factors (“determinants”)

- Personal factors, such as age, gender, education level, skills, and time to spend on learning new things;
- External factors, which are not individual determinants as such, but rather circumstances and contextual factors that nevertheless do influence choices and behaviour, such as scale of the farm, farming type, local traditions and complexity of the DATS;
- Balancing factors, which are the factors that can make you weigh decisions, such as perceived risks of implementing (or not implementing) a DATS, expected maintenance costs, and expected returns;
- Decision influencers, that can be regarded as a subjective layer around the balancing factors and which are not always necessarily based on rational weighing of costs and benefits. In this category we fit determinants such as attitude towards risk taking; how you perceive to be actually capable of working with technology, life goals, and, prominently, social influences of the people around you.

Some of these determinants are fixed (such as age); others can be influenced (such as skills)

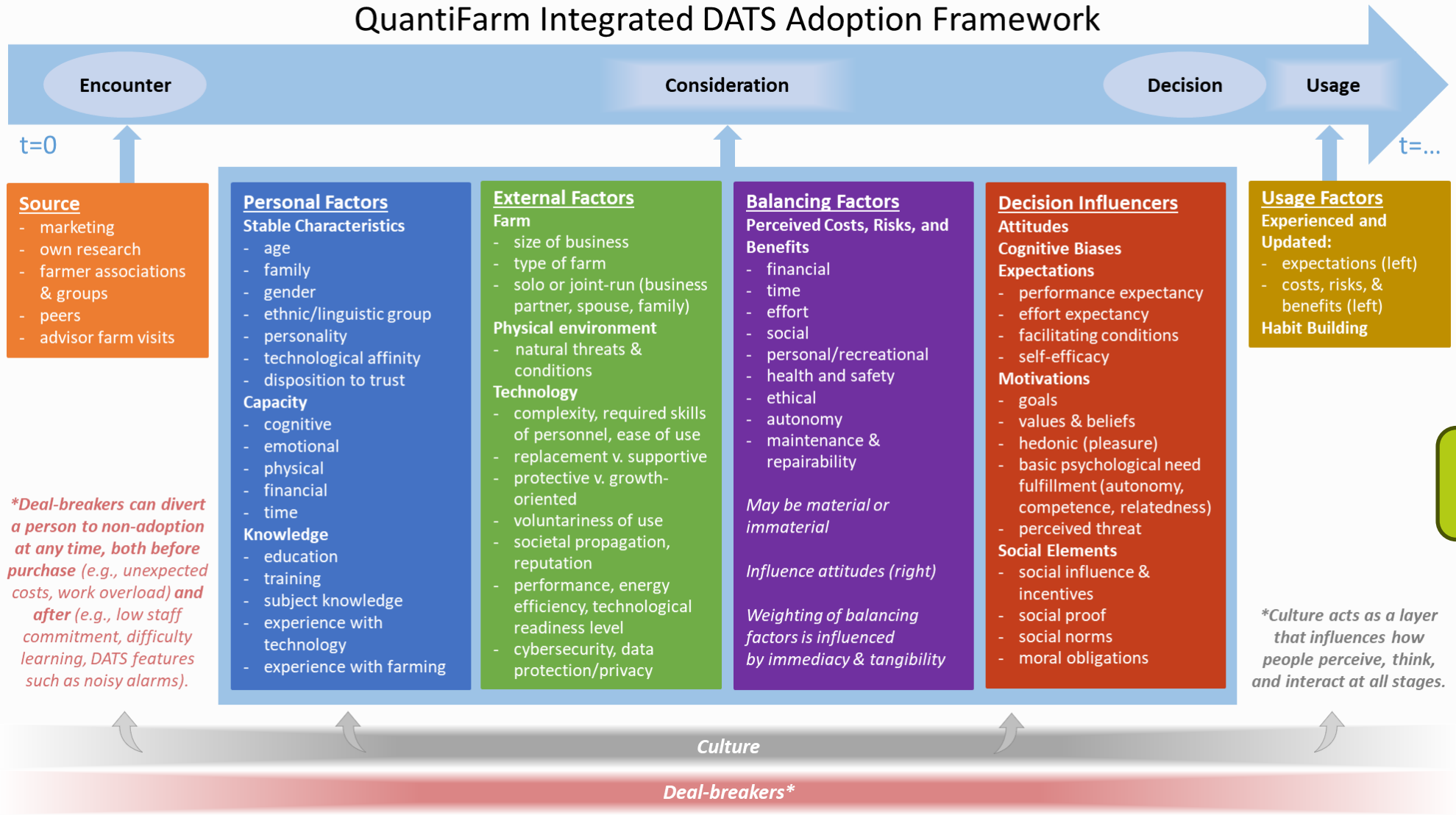
Understand – the adoption process

What is important to you as a farmer?

- On the next slide, we put together all our findings about determinants so far, per category of factors, for each adoption phase (encounter; consideration; implementation; usage).
- During the whole journey, we see there are also cultural factors and dealbreakers at play.
- We call this the QuantiFarm Integrated framework of DATS adoption

- Which factors do you recognise?

Understand – the adoption process INTEGRATED FRAMEWORK



Click here for the explanation of the factors

Understand – farmer stories

- DATS adoption is a complex and interactive decision journey, co-produced by the farmer and their surroundings. And although the overview of factors is quite comprehensive, it can still be hard to imagine an individual farmer's decision process with the select determinants that are especially salient to them.
- We therefore turned our key findings into distinct farmer stories that vivify the factors. These are not existing farmers as such, but closely resemble many that took part in our research. The stories start on the next slide.
- Maybe there is a story you relate to?
- Overall, we also found that regardless of place or sector, every farmer in our research shares these same challenges when it comes to DATS adoption:
  - Worry about climate change;
  - Uncertainty about changing regulations;
  - A drive to stay autonomous as a farmer, both business-wise and in relation to technology;
  - And being faced with changing consumer perceptions about farming.

Farmer stories

Understand

- Go to the stories

Implications – what is important to you?

- There are many things that can be distilled from the aforementioned factors in a DATS adoption journey. Our aim is to support farm advisors, DATS providers and policy makers with doing so and help them to design tools, programs and the like that can truly support the farmer in the adoption process.
- Curious how we do this? Check out the “Implications” part for the other roles in this Guidelines document.
- Your role is crucial here, too. Communicate to your advisors and providers what you need. Maybe the stories have shown you elements that you did not consider before, but turn out to be important to you, too.
- It is also not uncommon for farmers to become advocates of DATSs and even support other farmers in the adoption process. Maybe, if you have not done so, you can formalise this role and suggest a form of reward to the DATS provider for giving support during the aforementioned crucial Usage phase.
- Stay connected! Doing this together farmers remains crucial

Implications – preparing for the DATS adoption journey

- Ask yourself, in an ideal world, what you would like your farming to represent (e.g., thriving business, providing nourishing food, connecting the local community through knowledge sharing, healthy animals, combatting climate change, innovating high-tech methods of working, having fantastic working conditions for workers, being efficient to give more you a strong work-life balance, etc.).
  - Which of these would make you feel proudest and most fulfilled?
  - How is this connected to (potential) DATS; which one(s) could be of value for your goal(s)?
  - Which one(s) would compromise this, why?
  - How does this uphold if you consider the future, for instance 5 years from now?
- Include others in your decision-making process (seasonal workers, parents, spouse, children, advisors, farmer groups)
- Use the QuantiFarm toolkit to inform yourself about possibilities
- What essential roles do others have on the farm? Could technology help them?
- Articulate your information need: do you want to understand the technology, know the support line, see an example of the dashboard in practice, pilot the DATS first?

ADVISOR

What do you want to learn more about?

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Implications

behaviourally-informed services, tools, etc

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- Last but not least, is the usage phase, in which still many factors influence how a DATS is actually adopted and whether it can perform optimally. This is where expectations, e.g. on performance, ease of use, or interactions with other technologies, are met (or not) in practice.
- Who plays a dominant role in these different phases is good to establish explicitly. For instance, who is the farmer's primay support during the usage phase? You, the DATS provider or another farmer (which can be the same person, of course)?

Understand – the adoption process

4 groups of factors (“determinants”)

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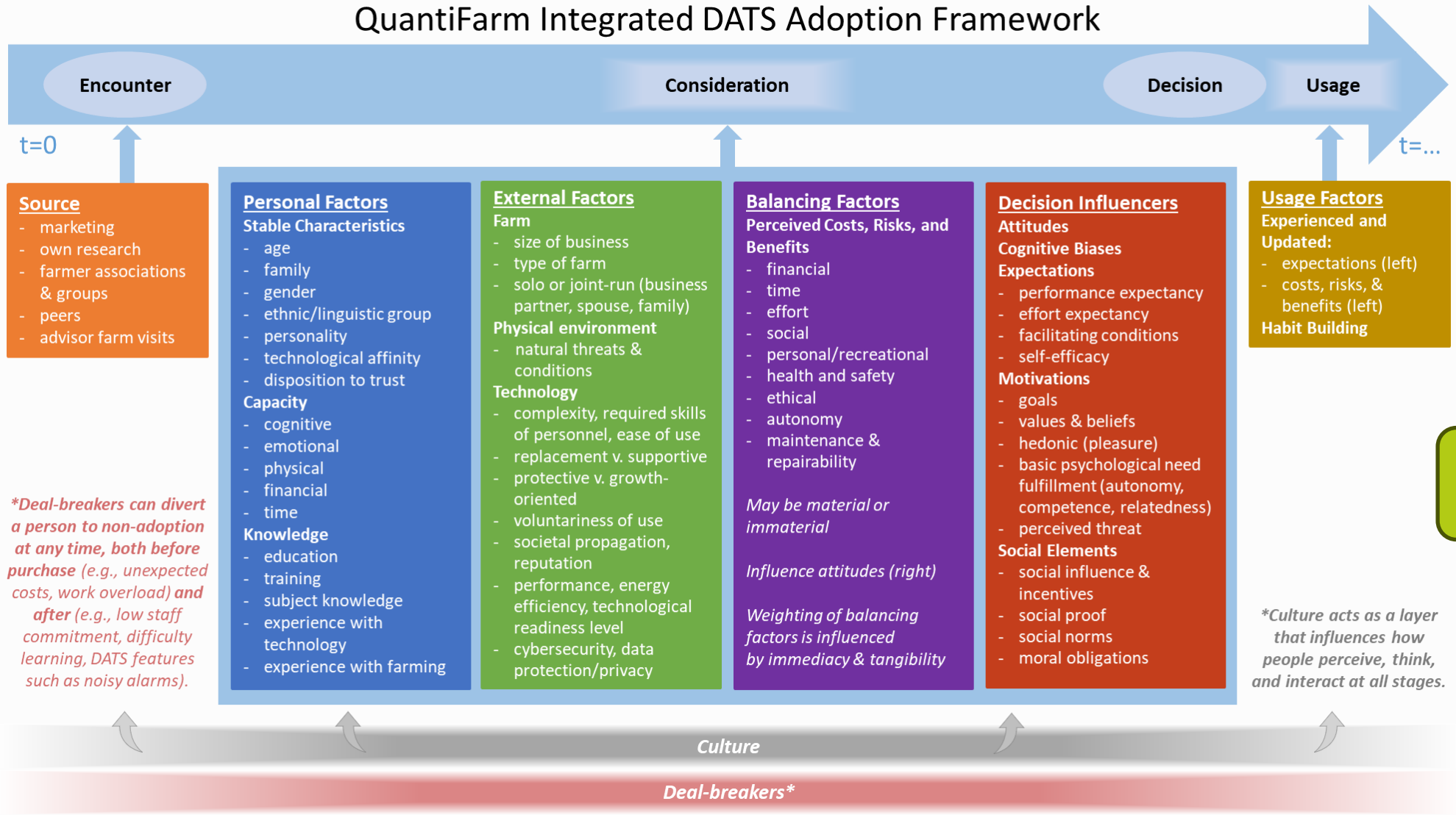
Some of these determinants are fixed (such as age); others can be influenced (such as skills)

Understand – what is important to your farmer?

- As an advisor, it is important to find out which factors are most important to the farmer you are advising on the (possible) adoption of a DATS.
- The main factors we have found in the project so far (through farm visits and interviews, desk study and surveys) have been brought together in the QuantiFarm Integrated DATS adoption framework (next slide). In the slide afterwards, we connected the adoption phases of the farmer to the activities you can conduct as an advisor.
- Finding out what drives your farmer, and what concerns occupy their mind when it comes to DATS adoption, requires asking questions, and then asking the consequent question: **why?** For instance:
  - What is most important to you in your work? Why?
  - You mentioned ‘x’ is very important to you, how do you think a DATS will affect this? Why?
  - What opportunities and challenges do you see with introducing DATSs on your farm? Why?
- Be patient and truly interested. Create an atmosphere of trust. You do this by making enough time for a conversation, and being flexible as to what questions you ask and how you ask them.

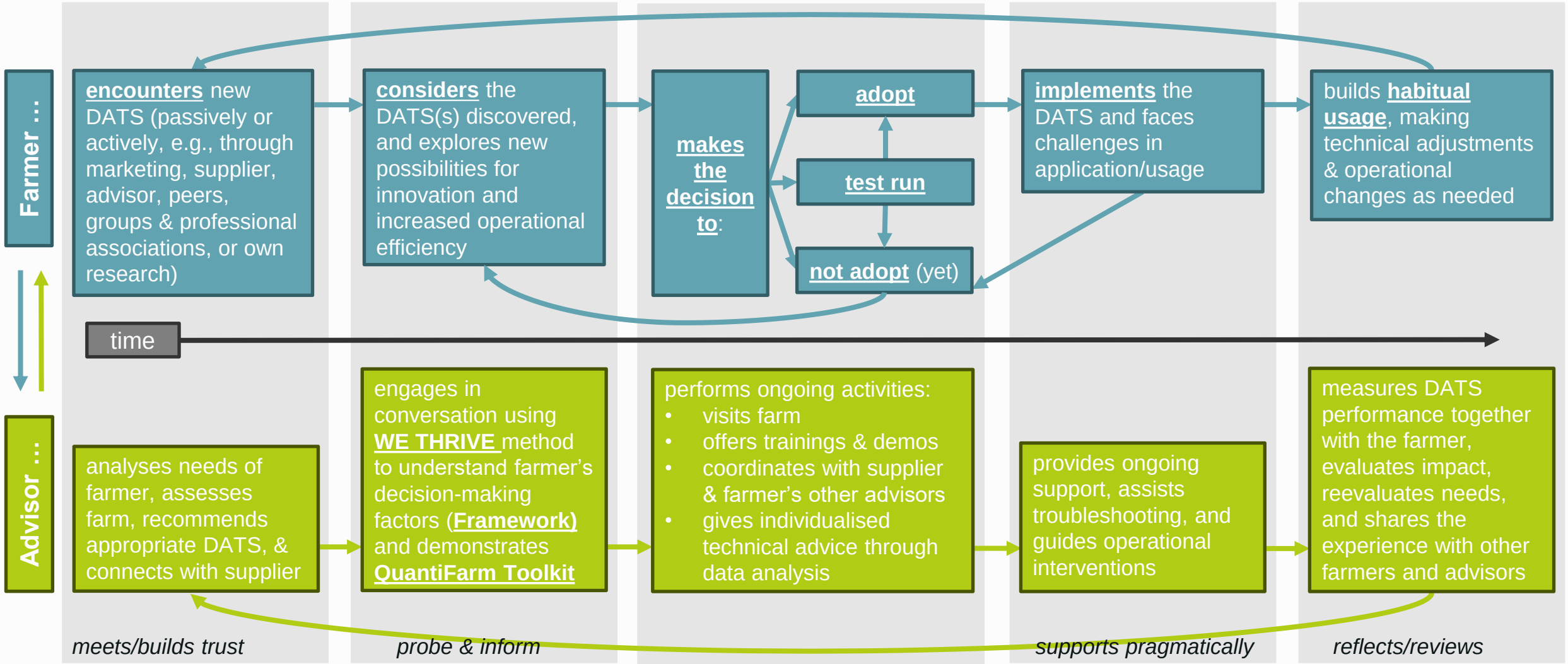
We created a mnemonic device, “WE THRIVE” to help you touch upon the main categories in the conversation; see the Implications section!

Understand – the adoption process INTEGRATED FRAMEWORK



Click here for the explanation of the factors

Advisor Guide to Supporting a Farmer's DATS Adoption Journey



Advisors can also use the Integrated Framework, WE THRIVE Method, and the QuantiFarm Toolkit to better understand & support farmers' decision-making.

Understand – what is important to your farmer?

- Every farmer is unique, and every situation is unique. Interestingly however, a few determinants have been found that seem to unite farmers all over Europe, regardless of their sector or situation:
  - Worry about climate change (a potential driver for DATS adoption)
  - Uncertainty about changing regulations (a potential barrier for DATS adoption)
  - A drive to stay autonomous (can be both a driver or barrier for DATS adoption)
  - Being faced with changing consumer perceptions about farming (can be both a driver or barrier for DATS adoption)
- In the ‘Implications’ part of the guidelines we will deal with the consequences of these omnipresent determinants.

Understand – farmer stories

- To gain insight into an individual farmer's experience, conversation is key.
- However, in case you are not using these guidelines for direct farmer interactions, but rather want to inform yourself on a more general level, we have written farmer stories to make the factors from the framework come more alive.
- Each story introduces a farmer character and highlights the circumstances and influences that lead them to adopt a DATS (or not). The stories exemplify what a hypothetical farmer's "DATS adoption journey" could look like.
- The stories start when clicking on the link on the next slide.

Understand – farmer stories

- Go to the stories

Implications

Omnipresent determinants and interventions 1/3

- Let's first deal with the determinants that we found with every farmer we researched. What do they mean for you as an advisor? How can you address these in conversations with your farmer? You can find some suggestions below.
- Worry about climate change
  - Arguments in favour of DATSs: many DATSs are aimed to reduce inputs on the farm. Precision irrigation for instance helps to be more resilient when fresh water becomes more scarce; DATSs can also help to manage the soil better and target interventions for soil improvement; and from the angle of contributing to lowering emissions, DATSs have also proven to reduce the need for movement of large vehicles.
  - What is your farmer especially worried about? The QuantiFarm Recommendation Tool provides an overview of DATSs addressing climatic circumstances.
- Uncertainty about changing regulations (a potential barrier for DATS adoption)
  - Farmers in many countries have been faced by, sometimes even conflicting, changes in regulations over relatively short timespans. This poses a significant barrier to investing in new technologies on the farm.
  - From an EU perspective, the CAP can give more support for cost-benefit analyses with ROIs over a longer time-span. You can use the QuantiFarm cost-benefit tool for support!

Implications

Omnipresent determinants and interventions 2/3

- A drive to stay autonomous (can be both a driver or barrier for DATS adoption)
  - These are aspects to be mindful of when having a dialogue with your farmer: when deploying the DATS, who will be the owner of the data? What does the farmer require to stick to their decision, and which dimensions are flexible for them? As an advisor, you can support the farmer in going through the contractual agreements for the DATS. Where does the data go to, for how long?
  - Discuss the risks with the farmer. For instance, what if the DATS does not work? Can the farmer easily switch to working without it? Note that for autonomous solutions there is often no legislation fully in place, e.g. regarding liability.
  - And what are aspects of the farmer's profession he or she wants to maintain as is? A dialogue on what type of relationship the farmer wants to have with a DATS (what may be automated; what always needs the farmer's ok) can help to prevent a feeling of unease that a farmer's position is being compromised by a tool.
  - A DATS can also support to maintain the feeling of autonomy. For instance, farmers have indicated that the insights from their soil sensors, or drone images, make them feel far more knowledgeable about their land and thereby feeling far more equipped to make the right decisions for it.

Implications

Omnipresent determinants and interventions 3/3

- Being faced with changing consumer perceptions about farming (can be both a driver or barrier for DATS adoption)
  - Sometimes it can seem consumers want it all; a sustainable sector preserving the countryside, that provides artisanal products that are not too costly.
  - Some farmers have indicated that they are not to keen on digitalising their operations as they feel it will indeed compromise the artisanry; others said they have digitalised but are not very forward with that to maintain the perception of artisanry for the public (even though they operate more sustainable thanks to the DATS). How does your farmer see this? And how can digitalisation and artisanry go hand in hand towards the consumer? Is it an idea for instance to show consumers around on the farm to see how both can positively interact?
  - More and more farmers find their way on internet and social media to more closely connect to consumers and shorten the supply chain. It could be interesting to explore how digitalisation could even help to improve this online presence and the dialogue with consumers.

Cultural and gender variation

Implications

- Omnipresent determinants and interventions apply to farmers across Europe, but the extent to which for example climate change or changing regulations affect individual farmers depends on the country they live in;
  - For example, the location of a farm determines the crop, the size, and climatological aspects; harsh climatological circumstances, such as extreme high or low temperatures or rainfall, may motivate a farmer to adopt DATS in order to deal with these challenges
  - Bordering an unstable region, such as Ukraine, may discourage farmers to make high-risk investments in DATS.
  - In some regions labour is very scarce. A lack of workers in their area (which can also be due to a cultural position on migration) may motivate farmers to adopt DATS.
- Cultural factors influence the adoption process and, consequently, the role of the advisor:
  - The basis of trust varies strongly across countries. People in some countries tend to rely only on people they know, and people in other countries tend to rely on people because of what these people do (e.g. exemplary behaviour).

- The basis of trust varies strongly across countries. People in some countries with a more collectivist nature (e.g. Portugal, Greece, Spain) tend to rely only on people they know, and people in other, more individualistic countries (e.g. the Netherlands, Germany, Sweden) tend to rely on people because of what these people do (such as, being an advisor). Source: Hofstede's cultural country comparison tool

- Gender roles differ across countries. Generally, countries in the North and West of Europe endorse more egalitarian gender roles, whereas people in the South and East endorse more distinct gender roles. Are you addressing the person that will actually work with the DATS most?

Helpful conversations

- In the Integrated Framework shown before, many determinants that address all different sorts of famers in their own context are brought together. It is up to you address those that match your farmer's situation. Of course, many factors are already known to you, such as age and farm size, but also probably some specific traits of your farmer such as risk aversiveness or openness to experimentation. Or need for autonomy, as described earlier.
- For the more implicit determinants, finding out what drives your farmer most, and keeps him or her occupied most when it comes to DATS adoption, requires asking questions, and then asking the consequent question: **why?**
- To support you in that doing that, we have created a mnemonic device to make sure all relevant topics are touched upon (see next 2 slides).

We don’t survive…

WE THRIVE!

WE THRIVE

Before your visit		
W	**World**	Go into the farmer's world – the farm, the greenhouse, the kitchen table. Meet the farmer, and important people around the farmer, in their space to understand the farmer's reality.
E	**Earnest**	When you interact, be earnest, sincere, warm, curious, and non-judgmental in order to establish a safe and trusting relationship.

During your visit		
T	**Technological affinity**	Savviness/Training/Tinkering: How tech-forward is the farmer? What is his/her formal training, knowledge, and education? Does the farmer enjoy learning, problem-solving, and experimenting?
H	**Heritage**	History: What culture(s) is the farmer from? What is the work culture at the farm? What are guiding assumptions, perspectives, beliefs, and values e.g. regarding technology usage and sustainability?
R	**Risks**	What are the farmer's concerns, fears, worries? These go beyond financial limitations, to social risks in the community, climate change, and (free) time concerns?
I	**Individuality**	Consider personal characteristics (e.g. an open personality), gender (which might affect one's position in the industry), and independence/autonomy (e.g., does the farmer value the connection to animals/crop and resist constrictive technology, or is technology considered a tool that provides more control, or freedom?
V	**View forward**	What are the farmer's long-term dreams and wishes for the farm, for him/herself, and for the family?
E	**Everyone**	Who else is involved? Consider everyone. Is it a family farm? How are the parents/spouse/children involved? How is impact on the family a consideration in farm decisions? Also note other relationships (e.g., business partners, advisors).

NB: WE THRIVE is relevant for all other decision-makers on the farm, too!

Potential conversational approaches based on WE THRIVE

Before your visit		
W	**World**	You start with this beforehand; prepare your visit by getting a good idea about the farm (size, workers, level of digitalisation, etc).
E	**Earnest**	Read the room: would a more informal approach be ok?

During your visit		
T	**Technological affinity**	With low tech affinity; assure about the support line, low maintenance, impact on other processes
H	**Heritage**	Is there a lot of legacy on the farm (both in technology and beliefs) that may hinder DATSs adoption? Interactions with and trust in institutions can differ amongst countries. This influences the motivation with which farmers will want to comply and/or expose their data.
R	**Risks**	Go through the contractual agreements, data ownership, liability of things go wrong, potential downside of the DATSs, etc.
I	**Individuality**	What are aspects of the work that the farmer wants to maintain as is? Define together what the interaction level with the DATSs should be.
V	**View forward**	For instance, the outlook on succession (often by the children) influences the propensity to innovate.
E	**Everyone**	The spouse may have a more signifcant role in decision-making than first assumed. It might be you have to invest in understanding the behavioural determinants for the spouse, too.

Implications

From farmer determinant to intervention 1/3

- Although each farmer and situation is unique, and the mosaic of determinants will look different in every case, there are general guidelines you can follow to be helpful to the farmer during the adoption process. The helpful actions we call interventions. Some handy interventions are summed up here. Maybe you can think of fitting ones yourself based on the conversation(s) you had on DATS adoption with your farmer.
- <u>Related to the 'Encounter' phase in the framework:</u>
  - As an advisor you may facilitate exchanges amongst farmers on specific DATSs to demonstrate and interact on usage in practice
  - Are you well aware of the regional/national/European subsidy schemes, or pilot projects that the farmer can join?
  - Social media has become a primary source of first encounters for DATSs*. Is the technology that you are an expert in already on social media? And do you know the channels the farmer likes to check and might be influenced by?
  - Our agricultural sector may seem dominated by male farmers, but that is not a true representation. An increasing number of women are farm owners, albeit overrepresented in smaller-sized farms, and often already focused on sustainability. Are these female farmers in scope of your marketing activities, e.g. represented in brochures and at events? Also, in family-farm constellations, the women seem to play a key role in farm's accounting, and in the decisions about large investments. Obviously, this orientation on inclusivity is relevant more broadly, e.g. age categories, health conditions or impairments, etc.

*Dilleen, et al., Investigating knowledge dissemination and social media use in the farming network to build trust in smart farming technology adoption - n. March 2023 (funded by the H2020-funded project DEMETER, grant agreement 857202)

Implications

From farmer determinant to intervention 2/3

- Related to the ‘Consideration’ phase in the framework:
  - Have you got an idea about what a farmer enjoys to do (e.g. inspect the land) and what less so (e.g. paperwork)? This can help define what benefits of a DATS to prioritise
  - The farmer will often not make decision to invest in DATSs in isolation. Facilitate conversations with key persons on the farm, such as the spouse, children, former and future farm owners.
  - Offline interactions with other users are key to a farmer’s adoption process. Yet with other farmers often being the most trusted source, advisors can for instance host Q&A sessions using online tools. In parallel, for those farmers not proficient in using social media, they could benefit from education and training on how these tools can be used to stay informed.
  - Team up with the providers/vendors of the DATS, who have a significant role in the adoption process and are key to establishing trust (see the part on the DATS provider). Think of hosting joint sessions with them.
  - Bring a colleague sometimes, representing another age/gender/ethnicity. Showing a diverse team makes it able to connect with a broader and wider spectrum of your stakeholders.
  - Consider adding creative methods to facilitate your dialogue; sketching is often of surprising help, for instance to sketch the main farm tasks that may be digitised, and who or what is involved.
  - Keep an eye on the QuantiFarm tools to help during this phase, such as the Recommendation tool and Cost-benefit analysis

Implications

From farmer determinant to intervention 3/3

- Related to the ‘Implementation’ phase in the framework:
  - Map out all the changes that need to take place during implementation so everyone feels prepared: who needs to do what differently, when, and how? You can even take the sketch mentioned on the previous slide as a starting point!
  - Have help ready for questions about implementation: these can be official support lines, help from you as an advisor, or from peers that have experienced the same implementation process

- Related to the ‘Usage’ phase in the framework:
  - Set goals together with the farmer; what are results we want to see, and when?
  - Define the support channel during daily practice; who can the farmer contact, and in what case?

DATS PROVIDER

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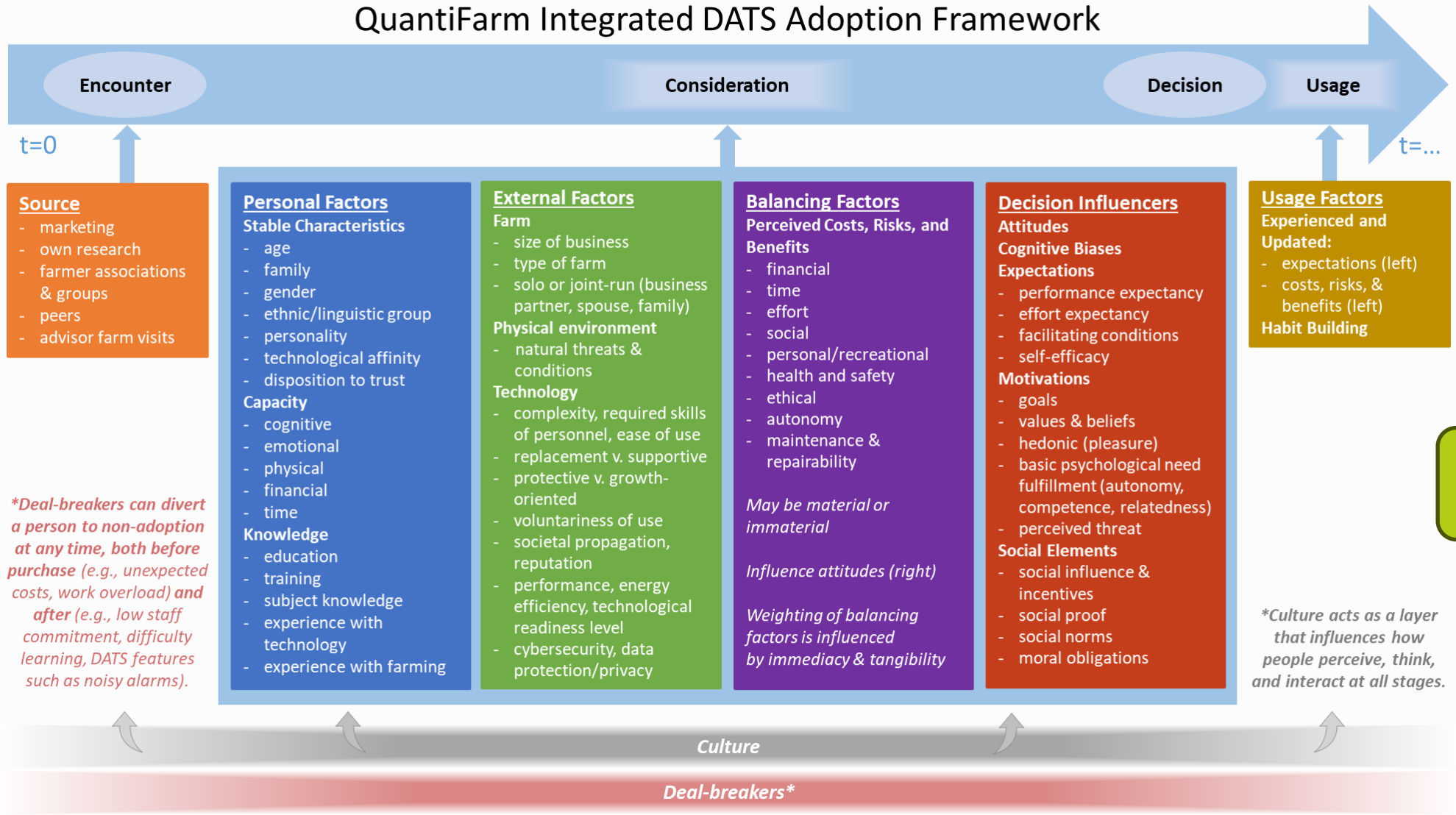
Some of these determinants are fixed (such as age); others can be influenced (such as skills)

Understand – the adoption process

What is important to farmers?

- As a DATS provider, it is important to be aware of all the factors that are at play when it comes to DATS adoption as it can influence how you design your product and accompanying customer (support) processes.
- The main factors have been brought together in the QuantiFarm Integrated DATS adoption framework (next slide).

Understand – the adoption process INTEGRATED FRAMEWORK



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- Overall, we also found that every farmer in our research shares these same thoughts when it comes to DATS adoption:
  - Worry about climate change (although the most suitable DATS depends on what climatological condition prevails, e.g. heavy rainfall or drought, or both);
  - Uncertainty about changing regulations;
  - A drive to stay autonomous as a farmer, both business-wise and in relation to technology;
  - And being faced with changing consumer perceptions about farming.

Understand – farmer stories

- Go to the stories

Implications for the DATS provider

- As you probably know, there are many ways the DATS, and processes related to the DATS, directly influence the adoption journey of the DATS by the farmer. This can go a long way. It would not be the first time that simply because of a complex interface, a digital service remained underused. Or that lack of support turns users away.
- The implications of the factors mentioned in the “Understand” part of the guidelines, with suggestions for interventions, are given in the following slides.

From farmer determinant to intervention 1/3

- Although each farmer and situation is unique, and the mosaic of determinants will look different in every case, there are general guidelines you can follow to be helpful to the design process of DATSs. The helpful actions we call interventions. Some handy interventions are summed up here. Maybe you can think of fitting ones yourself based on your own experiences.
- <u>Related to the 'Encounter' phase in the framework:</u>
  - Farmers like to see DATS in action before deciding to invest. Invite farmers to events, test sites, or other farmers already using the DATS. It is important to bolster and invest in this last group, as they can serve as ambassadors ("micro influencers").
  - Social media has become a primary source of first encounters for DATSs. Is your DATS already on social media, such as X or YouTube? Also consider sponsored content.
  - Our agricultural sector may seem dominated by male farmers, but that is not a true representation. An increasing number of women are farm owners, albeit overrepresented in smaller-sized farms, and often already focused on sustainability. Are these female farmers in scope of your marketing activities, e.g. represented in brochures and at events? Or are you even hosting female-centered events? Obviously, this orientation on inclusivity is relevant more broadly, e.g. for age categories, health conditions or impairments, etc. Hence, how diverse is your marketing team and strategy?
  - And have you considered cultural factors in your DATS? See next slide for more on this!

From farmer determinant to intervention 2/3

- Related to the ‘Consideration’ phase in the framework:
  - Be vocal about assurances you give such as guarantees and regulations and also how you deal with data (how is it generated, managed, stored, used, etc). You are not just a supplier; you are (to become) a trusted partner.
  - Co-designing elements of the DATS with farmers, male and female, can prove highly valuable; e.g. what is the preferred way to design the main interface / dashboard? Also make sure your DATS and the interface are designed in a culturally sensitive way, possibly through involving a cultural advisor. Cultural factors are sometimes at the core of hesitancy top adopt! For instance language issues, but also looks: in some countries it is preferred that an investment is clearly visible (e.g. a big shiny camera); in others maybe less so.
  - Work together with advisors, as they often know the farm and farmer really well and potential barriers to using your DATS (not only practical, but also perceived risks, insecurities, etc).
  - A farmer does not make decisions in isolation, especially not on investing in new DATSs. Does your supporting informational material address the different roles on the farm that deal with the DATS, e.g. the administrative work (often done by the spouse)? And are you aware of the considerations of the others on the farm regarding new technology? You could even consider technology features that facilitates family / children / other stakeholders to think along with the adoption process, for instance through gamification.
  - Consider that farming and agriculture could likely be an important part of the farmer's identity, and consider how your DATSs interact with (e.g., enhances, interrupts, replaces, digitalises) practices that might hold great symbolic and identity value to the farmer.

From farmer determinant to intervention 3/3

- Related to the ‘Implementation’ phase in the framework:
  - Have you tested your DATS with everyone on the farm, also the spouse, or seasonal workers?
  - Give generous support in the set-up of the system and the implementation steps. Are you aware of the problems the farmer might run into? And who can then help him or her?
  - Trial with going from your application or dashboard to actual action, in other words, the part where the actual value of your DATS lies. What are consequences of actually using the DATS?

- Related to the ‘Usage’ phase in the framework:
  - First offering your DATS in pilot form can help establish a basis of trust and give farmers a risk-free opportunity to get used to it.
  - How is your support program organised? For accute questions (helpdesk?), maintenance, training of new users, and so on? Besides own support channels, it can work very well to create a community where FAQs are answered and your DATS users can find each other for help. Also consider facilitating a Women's Network around your DATS, as sometimes women are more open to adopting in an environment with fellow women in agriculture.
  - What if results from the DATS are not as expected?

POLICY MAKER

What do you want to learn more about?

Understand

the adoption of DATSs by farmers

Implications

behaviourally-informed policies, tools, etc

Understand – the adoption process

Adoption of a DATS is not a binary yes/no moment: it is a journey

- The adoption journey starts with an encounter with (a) DATS(s), either by chance, marketing campaigns, mentioning by peers, an advisor, your network, research programs, etc.
- This is followed by an elongated phase of consideration, in which many determinants (~ influencers) are at play that can in turn be clustered into 4 groups, which all come together in the decision sphere of the farmer and their farm. These 4 groups can be found on the next slide.
- After going through this process of consideration follows an implementation decision, which may be not to implement anything (for now); to conduct a trial, to do a full-blown roll-out, or variations in between, such as trialing just one part of the DATS solution first.
- Last but not least, is the usage phase, in which still many factors influence how a DATS is actually adopted and whether it can perform optimally. This is where expectations, e.g. on performance, ease of use, or interactions with other technologies, are met (or not) in practice.
- Who plays a dominant role in these different phases is good to establish explicitly. For instance, who is the farmer's primay support during the usage phase? You, the DATS provider or another farmer (which can be the same person, of course)?

Understand – the adoption process

4 groups of factors (“determinants”)

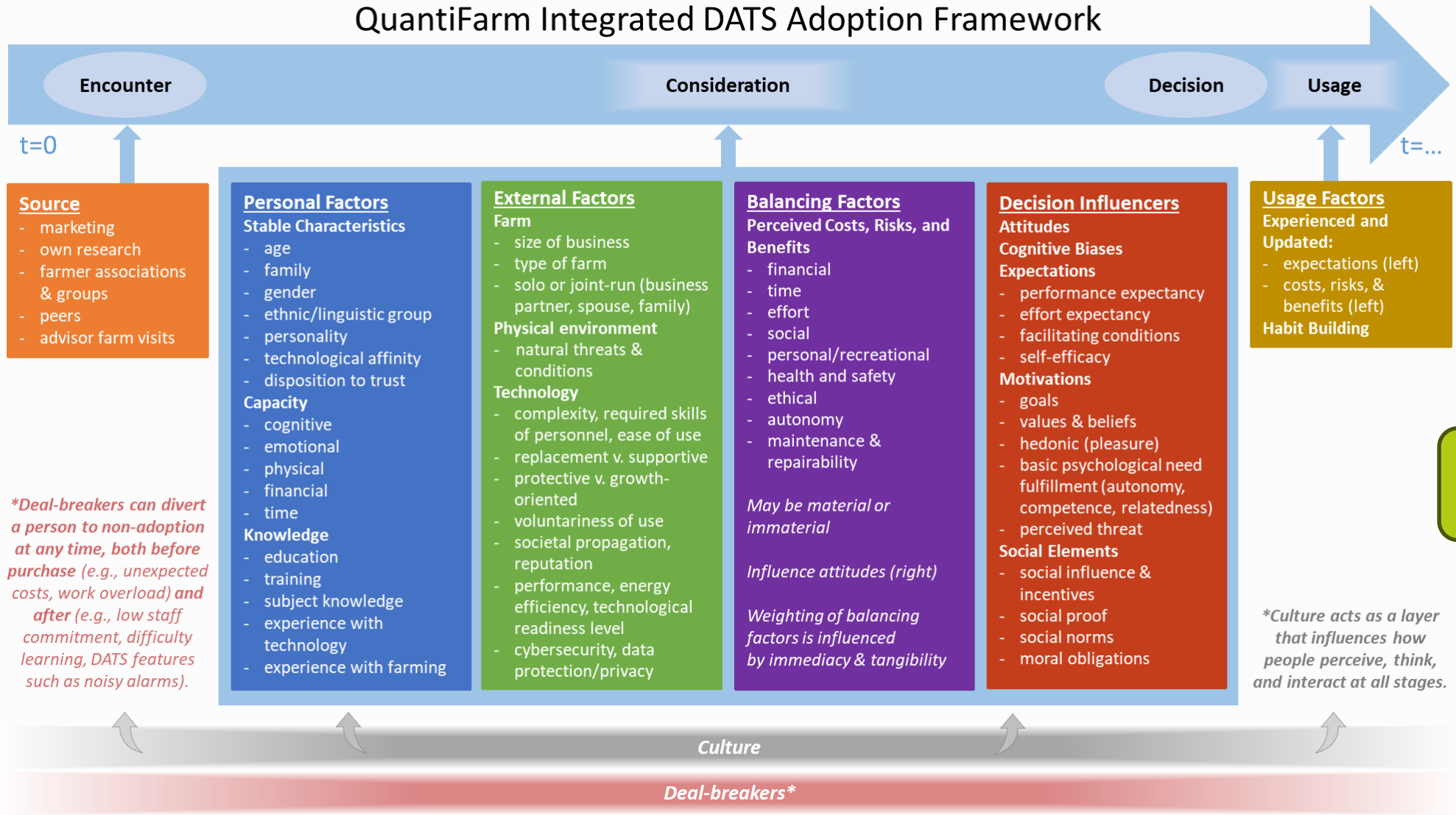
- Personal factors, such as age, gender, education level, skills, and time to spend on learning new things;
- External factors, which are not individual determinants as such, but rather circumstances and contextual factors that nevertheless do influence choices and behaviour, such as scale of the farm, farming type, local traditions and complexity of the DATS;
- Balancing factors, which are the factors that can make you weigh decisions, such as perceived risks of implementing (or not implementing) a DATS, expected maintenance costs, and expected returns;
- Decision influencers, that can be regarded as a subjective layer around the balancing factors and which are not always necessarily based on rational weighing of costs and benefits. In this category we fit determinants such as attitude towards risk taking; how you perceive to be actually capable of working with technology, life goals, and, prominently, social influences of the people around you.

Some of these determinants are fixed (such as age); others can be influenced (such as skills)

Understand – what drives DATS adoption of farmers?

- As an policy maker, it is important to know which factors are most important to the farmers in order to develop and finetune the most fitting policies and interventions for DATS adoption.
- The main factors we have found in the project so far (through farm visits and interviews, desk study and surveys) have been brought together in the QuantiFarm Integrated DATS adoption framework (next slide).

Understand – the adoption process INTEGRATED FRAMEWORK



Click here for the explanation of the factors

Understand – what is important to most farmers?

- Every farmer is unique, and every situation is unique. Interestingly however, a few determinants have been found that seem to unite farmers all over Europe, regardless of their sector or situation:
  - Worry about climate change (a potential driver for DATS adoption)
  - Uncertainty about changing regulations (a potential barrier for DATS adoption)
  - A drive to stay autonomous (can be both a driver or barrier for DATS adoption)
  - Being faced with changing consumer perceptions about farming (can be both a driver or barrier for DATS adoption)
- In the ‘Implications’ part of the guidelines we will deal with the consequences of these omnipresent determinants.

Understand – what is important to most farmers?

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  - Worry about climate change (a potential driver for DATS adoption)
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  - Being faced with changing consumer perceptions about farming (can be both a driver or barrier for DATS adoption)
- Although generally perceived, the nature of these determinants van vary on the basis of cultural and geographical differences.
- In the ‘Implications’ part of the guidelines we will deal with the consequences of these omnipresent determinants, and their cultural variations.

Understand – farmer stories

- To gain insight into an individual farmer's experience, conversation is key.
- However, in case you are not using these guidelines for direct farmer interactions, but rather want to inform yourself on a more general level, we have written farmer stories to make the factors from the framework come more alive.
- Each story introduces a farmer character and highlights the circumstances and influences that lead them to adopt a DATS (or not). The stories exemplify what a hypothetical farmer's "DATS adoption journey" could look like.
- The stories start when clicking on the link on the next slide.

Understand – farmer stories

- Go to the stories

Implications

Working with the omnipresent determinants 1/3

Let's first deal with the determinants that we found with every farmer we researched. What do they mean for you as a policy maker?

- <u>Worry about climate change (a potential driver for DATS adoption)</u>
  - Farmers are just as much concerned about the changing climate, and are faced with the consequences of it every day. Whether a farmer searches for ways to deal with water scarcity on the farm and policy makers are finding ways to deal with droughts, the end goal remains comparable. On this level, communication e.g. about DATSs is better ensured to find it's way onto farms.

- <u>Uncertainty about changing regulations (a potential barrier for DATS adoption)</u>
  - Farmers in many countries have been faced by, sometimes even conflicting, changes in regulations over relatively short timespans. This poses a significant barrier to investing in new technologies on the farm.
  - Essential is thus to match regulatory timespans as much as possible with ROI timespans of DATSs. Of course, these timespans may differ per DATS, so in turn a few variants should be considered depending on the dype of DATS (e.g. precision irrigation; robotics, etc.)

Working with the omnipresent determinants 2/3

- A drive to stay autonomous (can be both a driver or barrier for DATS adoption)
  - These are aspects we have found to be of concern to many farmers: when deploying the DATS, who will be the owner of the data? And where does the data go to, for how long?
  - And what about contractual agreements, and responsibilities? Note that for autonomous solutions for instance there is no clear legislation in place regarding liability.
  - This is an area that farmers would feel well supported with if there is a regulatory framework in place that ensures the farmer stays in control of the data.

  - A DATS can also support to maintain a sense of autonomy. For instance, farmers have indicated that the insights from their soil sensors, or drone images, make them feel more deeply knowledgeable about their land, thereby feeling far more equipped to make the right decisions for it.

Working with the omnipresent determinants 2/3

- Being faced with changing consumer perceptions about farming (can be both a driver or barrier for DATS adoption)
  - Sometimes it can seem consumers want it all; a sustainable sector that preserves the countryside, which provides artisanal products that are not too costly.
  - Some farmers have indicated that they are not to keen on digitalising their operations as they feel it will indeed compromise the artisanry; others say they have digitalised but are not very outspoken about that in order to maintain the perception of artisanry for the public (even though they operate more sustainable thanks to the DATS).
  - Positively influencing DATS adoption can thus benefit from transparent communication about both its merits and its myths towards the broader public (rather than towards the farming sector alone).

Cultural variations 1/2

Implications

In our research, we have found that the cultural differences, which are often* connected to geographics and topology, can influence DATS adoption, which makes cultural sensitivity by policy makers more imperative. For example:

- In wealthier countries with higher GDPs there is more room for investing in new technology, and for supporting individual farmers financially in doing so. Opportunities to venture (more) into digitalisation are not the same for farmers in less affluent areas, which should get the attention of policy makers.
- In countries with a large division between urban and rural areas, farmers may feel less connected to governmental policy, which effects their trust. This requires more effort in connecting to farmers. Also, with DATSs it is appealing to promote data sharing networks, but also knowledge sharing networks are highly important to facilitate trust building and collaboration between farmers and the DATS providers.
- In some regions labour is very scarce, and also the openness towards migrant workers can be limited. A lack of workers in their area may motivate farmers to adopt DATS. Also regarding labour: DATSs may impact in several ways, e.g. it can change or even replace their jobs, or it can improve their conditions. Explicate these factors, as farmers take into account (and may include) their workers in a decision to adopt DATSs.
- Bordering unstable regions, which is the situation for Romania for instance given the ongoing war of Ukraine with Russia, may discourage farmers to make high-risk investments in DATS as there is a general sense of insecurity.

* Of course, there are also other forms of culture, e.g. related to group identity, such as what it means to be a farmer. For these factors, please refer to the previous slides to see what we found in QuantiFarm in this regard.

Implications

Cultural variations 2/2

- The geographic location of a farm determines the crop, the size, and climatological aspects; harsh climatological circumstances, such as extreme high or low temperatures or rainfall, may motivate a farmer to adopt DATS in order to deal with these challenges.

- Trust in authorities determines whether a policy will have the desired effect. But trust is dependent on many factors. For example, growing up in a post-communist society may have effects on the level of autonomy that farmers now seek, as well as the general level of trust in authorities, and even other farmers. Exhibiting trustworthiness in these countries is thus important, and implies being consistent in communication and policies alike, with built-in safeguards such as contracts and data protection measures.

- The basis of trust varies strongly across countries. People in some countries with a more collectivist nature (e.g. Portugal, Greece, Spain) tend to rely only on people they know, and people in other, more individualistic countries (e.g. the Netherlands, Germany, Sweden) tend to rely on people because of what these people do (such as, being an advisor). Source: Hofstede's cultural country comparison tool

- Values are said to be the dominating forces in life and identities represent who we are and to whom we belong. Both shape the political landscape in democracies and have gained in importance in recent decades. The JRC report Values and Identities - a Policymaker's Guide (2021) contains important insights for policymakers to adapt their work to the challenges of our time, including a dedicated toolbox section.

Implications

Gender differences

Gender differences do not always get the attention they deserve. This is also evident in DATSs adoption. We found the following to be important implications in this regard:

Consider women's major role in farming

- On family-led farms, the female is often responsible for the paperwork. Hence, digital portals and paperwork processes should be enhanced, together with women, to improve working conditions and job enjoyment, and ease the strain of these activities
- Furthermore, focus on reducing redundancy and repetition in the paperwork farmers
- Facilitate "Women in Agriculture" events specifically for DATSs adoption (with topics such as knowledge sharing and user support)
- Promote the viability and appeal of agriculture especially to women

- And: farms run by women tend to be sustainable and smaller sized: policies targeted at women should address this, rather than staging the more industrial nature of farms currently adopting DATSs.

Further implications for policy makers 1/3

Stemming from the phases in the Integrated DATS adoption framework, there are also some implications for policy makers per phase:

- **Encounters** can be facilitated by peer exhanges amongst farmers. In fact, research demonstrated that this is the main source of information for farmers on DATSs. And as one of the QuantiFarm farmers put it: “make farm visits by farmers a mandatory part of the CAP”. Also, in communication about digital agriculture from policy makers, try to address main determinants mentioned here, such as how DATSs serve to deal with climate change on farm level while making the farmer even more knowledgeable.
- Policy makers can also facilitate sharing adoption experiences by gathering data from the larger European farming population.

Further implications for policy makers 2/3

- For the **Consideration** phase, see where policies can give more assurances:
  - By guarding that regulatory timespans match ROI timespans of the DATSs you endorse. And do local regulations match the ones just across the border?
  - In fact, are the funding possibilities at all clear to farmers? For the many monitoring tools available to policy makers, there are less instruments on policies and subsidies available to farmers. A comprehensible monitoring tool for policies and subsidies may a good way to influence DATS adoption, too.
  - Many farmers rely on a second income stream to keep their head above water, such as providing (land for) renewable energy, tourism, or other ecosystem services. Consider this when making subsidies available (can digitalisation options serve both purposes for instance?) and especially make sure regulations are not conflicting, as now happens sometimes regarding renewable energy on agricultural land.
  - Besides financial factors, farmers are also motivated by more intangible benefits of DATSs, such as improved work-life balance and positioning the farm well of succession by a new generation.
  - Furthermore, policies play an important role in the aforementioned assurances around data governance.

Further implications for policy makers 3/3

- In the **Implementation** phase, access to training and education are key, together with support for any challenges that may arise.
- And how do DATSs interact with other technologies on the farm? Systems like ISOBUS help to make technologies interoperable. How is that for the wider array of digital technologies? And how about vendor lock-ins in that regard?

- Lastly for the **Usage phase**, besides continued support and updates trainings whenever relevant, certain guarantees may be given that for instance certification standards are met.
- Also being mentioned by farmers, is the worry that increased usage of DATSs may undermine farming knowledge, intuition, and experimentation. A significant point for policy makers, to support the uptake of DATSs, is to address this worry for instance via promoting the archivation of ancient knowledge, and endorsing experimentations in parallel to DATS application.

Integrated DATS adoption framework factors: explanations and examples

The following pages provide a brief explanation or an example of how each factor from the Integrated Framework might influence DATS adoption for a hypothetical farmer. The examples are not true of everybody. They serve merely to illustrate one way that a factor could express to influence decision-making.

Source

Explanation: Farmers first hear of DATSs through a range of mediums. These encounters include hearing about the DATS from a neighbour, finding it online when researching innovative methods, learning about it when attending farmer association meetings, being visited by an advisor or supplier, and being exposed through marketing. Some encounters are more passive on the farmer's part (e.g., hearing from a neighbour and being the target of marketing), whereas others are more active (e.g., participation in association outings and directed research).

Personal factors

Stable characteristics

Age

- Explanation: Age can be related to many factors, such as affinity for technology and plans for farm succession.
- Example: An older farmer may be reluctant to digitalisation if they have less familiarity with technology, more intuitive expertise upon which they can rely, and an overall more traditional approach to farming. Alternatively, aging may be a reason that a farmer becomes more open to adopt a DATS, for instance because it can reduce the burden of physical or mental labour.
- Example: A middle-aged farmer makes an explicit effort to involve DATSs because their child is considering taking over the family farm and the farmer wants the business to be sustainable and appealing to their child.

Gender

Explanation: Gender is related to other factors, such as risk-taking; in general, men tend to take more financial risks than women, whereas women tend to take more social risks than men. Gender is also important because female farmers face more barriers and different barriers than male farmers do, across countries.

- Example: A son is more readily assumed to be a successor than a daughter, and as such by default is socialized more into the farming business (e.g., by being taught to drive a tractor as a child).
- Example: A female farmer is less integrated in male-dominated farming associations and needs to search for information elsewhere.
- Example: A female farmer feels that she has less room for error due to a spotlight being on her because of her gender and different expectations around experimentation, tinkering, and risk-taking.

Ethnic group

Explanation: A farmer's ethnicity may be relevant in terms of circumstances such as whether local associations tend to group according to ethnic lines, whether there are historical tensions in terms of land ownership or stewardship, whether a farmer is of the ethnic/linguistic majority or minority, whether a farmer's farm has generations of heritage, whether a farmer is a newcomer with practices and crops that are less common in the area, etc.

Technological affinity

Explanation: A person's technological affinity refers to their general relationship with technology and their tendency to either interact with or avoid it.

- Example: A farmer enjoys playing with technology that is new to them, feels fairly competent with technology overall, and has a generally positive attitude towards technology, so they approach it more than someone with a more negative relationship with technology who might have feelings of intimidation, mistrust, stress, or boredom.

Personality

Explanation: Personality is too nuanced to draw clear examples. However, as an advisor, it makes sense to know your farmer. Keeping these types of personality traits in mind, in conjunction with other factors, will enhance the relationship between advisor and farmer.

- Example: Extroversion. Are they extroverted and willing to talk to other farmers and have regular visits? Or, are they more comfortable doing their own online searches?
- Example: Openness to Experience. Are they open to and curious about new things or do they prefer familiarity and routine?
- Example: Stubbornness. Depending on what the stubbornness pertains to (e.g., being in charge, being independent, being environmentally friendly, maintaining tradition), the effects on deciding whether or not to use DATSs differ.
- Example: Flexibility. In general, farmers demonstrate flexibility regularly in the sense that they all experience limitations and obstructions from policy and bureaucracy, and must also continually adapt to natural and market conditions. That said, some do so much more gladly and effortlessly than others.

Disposition to trust

Explanation: People have different dispositions to trust. Some people are more likely to trust their fellow human beings, technology, and/or institutions, such as the government, than other people are. When building relationships with farmers, advisors should be aware that farmers may want to build trust in different ways (e.g., by demonstrating a reliable track record of task performance vs. by building a personal relationship). Advisors should also be aware that farmers may have different levels of trust (positive expectations), mistrust (cautious uncertainty), and distrust (active negative expectations) in different actors and objects, such as government, strangers, advisors, suppliers, and technology (in terms of data security, privacy, reliability, etc.).

- Example: Less trusting farmers typically have more hesitancy when adopting a DATS.

Capacity

Explanation: To implement a new DATS, a farmer first needs the time and space to research and think about the decision. They must also foresee having the time and capacity after purchase to learn to use the DATS, train staff, and endure the challenges and adjustment period that come with changing protocol. In addition to time and cognitive capacity, financial and emotional capacity are also important. They would also need the physical capacity to use the DATS. Alternatively, a farmer may be motivated to adopt a DATS if it helps them with a task that is currently physically challenging.

- Example: A farmer who is busy with four young children may not have the capacity to explore new ways of working even though it may improve his efficiency once implemented.

Knowledge

Explanation: Subject knowledge can come from a range of sources, such as hands-on experience, practical training, formal education, familiarity from general proximity, etc.

- Example: A farmer who has formal education and training but who lacks hands-on experience with a certain crop in a new region may turn to technology to supplement their perceived shortcomings and gain data insights tailored to the specific environment.
- Example: A farmer who has extensive farming experience with farming may feel secure enough in their expertise and in their ability to have a feel for their crops and for the conditions that additional data from technology may not be as appealing.

External factors

Farm

Explanation: The farmer will certainly consider the characteristics of their farm (e.g., size, crop, ownership structure, organic or not) when considering the suitability of a DATS.

- Example: A corporate-owned farm has a bigger budget and more financial float than a neighbouring small family-owned farm.
- Example: A certain DATS is differentially suitable (and worthy of investment) to a farm with diverse crops than to a farm with a single crop.

Physical environment

Explanation: Because of (a lack of) natural resources, farmers need more or fewer DATSs to assist them in bringing in the crops. These conditions might include soil salinity, heat for crops and animals, drought, pests, shifting harvest season, etc.

- Example: A farmer experiencing increasing drought conditions sees increasing appeal in water-saving DATSs.
- Example: A farmer in a region where a certain pest has not been eradicated but EU-wide policy bans a pertinent pesticide sees early detection DATSs as more appealing.

Technology

Explanation: The DATS itself is a critical component. Characteristics of the technology determine its relevance to the user and to their farm. All these factors should be considered. Whether or not a farmer chooses to adopt a DATS is influenced by their perception of these DATS features (e.g., it's complexity), but whether or not a farmer integrates the DATS into habitual usage is influenced by their experience of these DATS features.

Complexity, required skills of personnel, ease of use

Explanation: A more complex DATS costs more time and effort to implement, especially if it will be used by workers.

Replacement vs. supportive

Explanation: Technologies range in terms of whether they help the human perform the task (support) or perform the task for the human (replacement). People's perception of a DATS' position on the support-replacement spectrum influences their attitude and openness towards the technology.

- Example: A farmer who identifies strongly as a farmer and with their work may find a DATS less appealing if it replaces them in doing that task.
- Example: A replacement DATS might be very appealing if it replaces a back-breaking and repetitive task done by workers who can instead be moved to other tasks.
- Example: A farmer who is keen to hone their skills and increase their knowledge may be very attracted to a supportive DATS that they can learn from and use to validate their intuitions.

Protective vs. growth-oriented

Explanation: Does the DATS protect against losses and uncertainties, or does it offer potential growth and expansion?

- Example: A farmer more worried about the effects of climate change may see the appeal of a protective DATS.
- Example: A growth-oriented DATS may be more appealing to a farmer with more financial resources and entrepreneurial ambitions than a farmer who is uncertain about the future of their farm's succession and may therefore be more focused on maintaining what already exists.

Voluntariness of use

Explanation: Is the DATS required for compliance with policy or is use entirely voluntary? If a new standard has been set, the DATS may be one (though not the only) way to meet the requirement.

Reputation, societal propagation

Explanation: Does the DATS have a well-established reputation and is it used widely, or is it relatively unknown?

- Example: It may take a more risk tolerant farmer or one who is confident in their hard research skills (instead of relying on anecdotal evidence) to be comfortable investing in a DATS that is less widely used.

Performance, technological readiness level, energy efficiency

Explanation: Technological Readiness Level is a 9-point scale used to rank the maturity of a technology from concept through to prototype and, finally, to proven usage.

- Example: A farmer with lower technological affinity or lower risk taking may be less willing to “experiment” with a DATS that is earlier in development and whose performance has not been as concretely proven.
- Example: A farmer in a region with less reliable energy may be more reluctant to invest in a DATS with high energy consumption or which could cause harm to the crops in the case of a disruption.

Cybersecurity, data protection/privacy

Explanation: What data does the DATS collect, where are they stored, and who has access to them? Some people are more concerned with security and privacy than others.

- Example: A farmer who is more concerned with data privacy and security may be more reluctant to a DATS that collects photographs of his farm and crops.

Balancing Factors

Explanation: “Balancing factors” refers to the pros and cons that people weigh. Although these “pros and cons” are often considered a more intentional and objective method of reasoning, the weight that people attribute to different balancing factors is often emotionally driven. The more tangible and the more immediate a factor is to a person, the more weight they give to that factor. “Perceived” precedes all three categories because, in a person’s decision making, it is not the true costs, risks, and benefits that matter as much as those that they perceive. These factors can be material or immaterial.

- Costs are cons that will occur.
- Risks are cons that may occur. People have different levels of risk aversion/tolerance. Moreover, an individual can have different levels of risk tolerance towards different types of risks. Note: There are also risks associated with not adopting a DATS (e.g., financial: of not updating; social: of rejecting the ideas and wishes of those around you).
- Benefits are pros that will or are expected occur.

- Financial
  - Cost: the price of the DATS.
  - Risk: making an investment that doesn’t pay off financially.
  - Benefit: futureproofing, added revenue, subsidies, and profitability.
- Time
  - Cost: the DATS takes time to research and implement.
  - Risk: the DATS takes longer to learn to use than anticipated.
  - Benefit: the DATS increases efficiency and creates more free time or more flexibility to be away from the farm.
- Effort
  - Cost: the DATS costs effort to research and implement, especially if it performs a new capability instead of replacing an existing one on the farm.
  - Benefit: once the DATS is implemented, less effort is required.

- Social
  - Risk: of upsetting relationships, e.g., with partners, family, other farmers, workers. This could occur, for example, if the equipment creates unwanted noise for neighbours, upsets family by altering the traditions of a family farm, or disrupts family life by taking up time and money.
  - Benefit: happier workers
- Personal/Recreational
  - Cost: decreasing time enjoyed working hands-on with the crop.
  - Benefit: enjoyment of the DATS' aesthetic, enjoyment from exploring new and innovative method (epistemic value), knowledge that farm is more futureproof, sense of mastery or autonomy, fulfilment of basic psychological needs.
- Health and safety
  - Risk
    - Of adopting: accidents, stress associated with investment and learning curve.
    - Of not adopting: sun exposure, chemical exposure, old equipment use.
  - Benefit: health benefits don't only refer to reduced sun exposure and back-breaking work. They also include reduced stress, and more time spent with family.
- Ethical
  - Cost: a farmer may resent turning to new methods that involve high-tech solutions from larger corporations or diverting from traditional ways of farming that were used by previous generations.
  - Benefit: knowledge that you are decreasing your impact on the environment.
- Autonomy
  - Cost: the DATS will automate some factors so that the farmer isn't as involved in every decision.
  - Risk: the DATS may not provide all the raw data that the farmer would like to tinker with themselves.
- Maintenance and repair
  - Cost: the DATS will eventually incur costs related to maintenance and repair.
  - Risk: repairs may be greater or more frequent than anticipated, or even permanent

Decision Influencers

Explanation: This category of factors relates more to psychological processes and constructs. Decision-making, like all cognition, is subject to the many filters and falters of the human brain.

Attitudes

- Is the farmer's general evaluation of and feeling toward the DATS positive or negative? Attitudes have emotional, behavioural, and cognitive components. They are influenced by balancing factors (left) as well as decision factors (below). Attitudes influence behavioural intention.

Cognitive Biases

- Explanation: Human thinking (including decision-making) occurs through cognitive processes that are built on recognising patterns and making short cuts. As such, thinking is inherently biased and prone to some degree of error. Cognition is also heavily influenced by emotion. Awareness of biases can help mitigate their impact.
- Example: framing effects describe people's tendency to prefer messages that are framed positively (i.e., in terms of gains) than messages that are framed negatively (i.e., in terms of losses). For example, a farmer would likely be more open to a DATS framed as reducing pests (a positive outcome) than to a DATS that warns of an increase in pests without the DATS (a negative outcome).
- Example: people tend to overvalue and over-rely on emotional information when making decisions. Additionally, pre-existing emotional associations (positive or negative) can bias people towards or against things. Emotions are not a bias, per se, but they do exert powerful, complex, and diffuse influence on decision-making and are therefore worthy of note.

Expectations

- Performance expectancy
  - Explanation: the amount of improvement in performance the farmer expects to gain through using the DATS. Similar to another construct in the literature: outcome efficacy (a belief about the likelihood of the behaviour leading to a specific outcome).
- Effort expectancy
  - Explanation: The ease of use or effort that the farmer expects the DATS will require. Similar to another construct: perceived behavioural control.
- Facilitating conditions
  - Explanation: the infrastructure to support using the DATS
  - Example: having space for DATS, the provider being available for troubleshooting and training, and the workers speak the language of the DATS interface.
- Self-efficacy
  - Explanation: Self-efficacy refers to how confident a person feels that they have the skills and abilities necessary to succeed in a certain environment or with a certain task.
  - Example: A farmer who has high self-efficacy is likely to have a more positive attitude towards the challenge of integrating a new DATS into their process.

Motivations

- Goals
  - Explanation: What is the farmer's view of the future and what do they want to achieve? Consider their goals and outlooks regarding personal development, farm expansion, work-life balance, sustainability, heritage, retirement, (family) succession, etc.
- Values & beliefs
  - Example: A farmer who believes strongly in the value of hard work may be less motivated to adopt a replacement DATS, if the task is one that they value highly.
  - Example: A farmer who values time with their family may be more motivated to adopt a DATS that allows them to do some remote monitoring.
  - Example: A farmer who holds traditionalist beliefs may be resistant to change in general but may be more willing to accept a DATS that supports their traditional ways than one that disrupts and innovates.
- Hedonic motivations (desires & preferences)
  - Explanation: the enjoyment, fun, or pleasure that the farmer expects to get out of using (or not using) the DATS
  - Example: A farmer who enjoys working in the fields with their crops will be less likely to adopt a DATS than a farmer who enjoys tinkering with new technology.
- Fulfillment of basic psychological needs
  - Explanation: Psychological research has established a few basic psychological needs that are universal across cultures: the needs for autonomy, competence, and relatedness. When these needs are met, wellbeing and motivation increases.
  - Example: A farmer who gets a sense of satisfaction working with her hands and whose values prioritize feeding her local community may be less interested in a DATS that reduces her time in the field and facilitates broader distribution. Her original way of working may better satisfy her need for autonomy.
  - Example: A farmer who places heavy value on their sense of independence may be more resistant to a DATS that will help with compliance with new stringent policies, because the policies (and the DATS) make the farmer feel that they are not in charge of their decisions and actions.
  - Example: A farmer whose work is challenging them at the right level would find it rewarding and motivating and would have more confidence to take on a new challenge (such as learning a new DATS). The need for competence speaks to life in general and need satisfaction can come from many sources.
- Perceived threat
  - Explanation: Is the farmer motivated to consider a DATS because of a specific problem/threat, or are they simply open to general improvement?
  - Example: A family farmer feeling the weight of the rising cost of living and a challenging market decides to make more prudent financial choices for the next few years.
  - Example: A farmer acutely aware of changing patterns in heat waves and drought conditions decides to put more time in to researching protective solutions.

Social Elements

Social influence & incentives:

- Explanation: As social creatures, people are constantly influenced by those around them. Social influence can be exerted intentionally or unintentionally, as well as felt to differing degrees of intensity.
- Example: A farmer feels pressure from members of their association to update and digitalize.
- Example: A farmer is often visited by neighbours who stop by and end up discussing the farm.
- Example: A farmer feels pressure to invest in an early detection DATS, not only to prevent pests on their own farm, but also to avoid risking spread with neighbouring farms.

Social proof:

- Explanation: The tendency of people to look at the behaviour of those around them to inform their own behaviour (often following what they see).
- Example: A farmer who is not an early adopter of technology waits to see how a DATS works out for his neighbours before deciding to adopt.

Social norms:

- Explanations: Whether they are explicitly or implicitly stated, social norms are a strong source of behavioural influence.
- Example: A farmer's wife chooses a job that is less demanding in the summer months so that she can help more on the farm, following a typical local norm.
- Example: A farmer feels compelled to avoid noisy work on Sunday due to local religious and cultural norms.

Moral obligations:

- Explanation: People have internal beliefs about what is right and what they are comfortable doing.
- Example: A farmer whose faith tells them that it is important to feed their community may be more open to DATS that facilitate that goal.
- Example: A farmer who is concerned about climate change (i.e., problem perception, perceived threat) and believes it is their duty to try to protect the environment for future generations is more likely to adopt a DATS that supports sustainability.

Usage Factors

- Explanation: Usage factors describe how the DATS is experienced in practice, and help explain how quickly and how well a DATS becomes integrated into habitual usage. Not all DATSs that are purchased go on to be permanent fixtures. Focusing on optimizing these factors is especially important when the DATS is being used on a trial basis or as part of a pilot, to maximize the likelihood of adoption.
- Experienced and updated
  - Expectations (see left)
    - Explanation: In practice, is the DATS smooth and easy to use or is it clunky and challenging?
  - Costs, Risks, and Benefits
    - Explanation: What were the actual costs and benefits experienced? Which risks manifested? What are the perceived costs, risks, and benefits going forward?
    - Example: Were there unexpected fees? Did the change create frustration or excitement amongst workers? How much free time has the farmer had to dedicate to the DATS, and how long do they see this continuing?
- Habit Building
  - Explanation: To be completely integrated into protocol, DATS usage should be habitual. Habits are not always easily changed though. The degree to which habit change can occur relates to factors such as motivation, ease of use, and the DATS itself.
  - Example: If the DATS provides new information to the farmer, but doesn't replace their old methods, habitual usage may come more slowly than a DATS that replaces an old method and thus is automatically used every day.

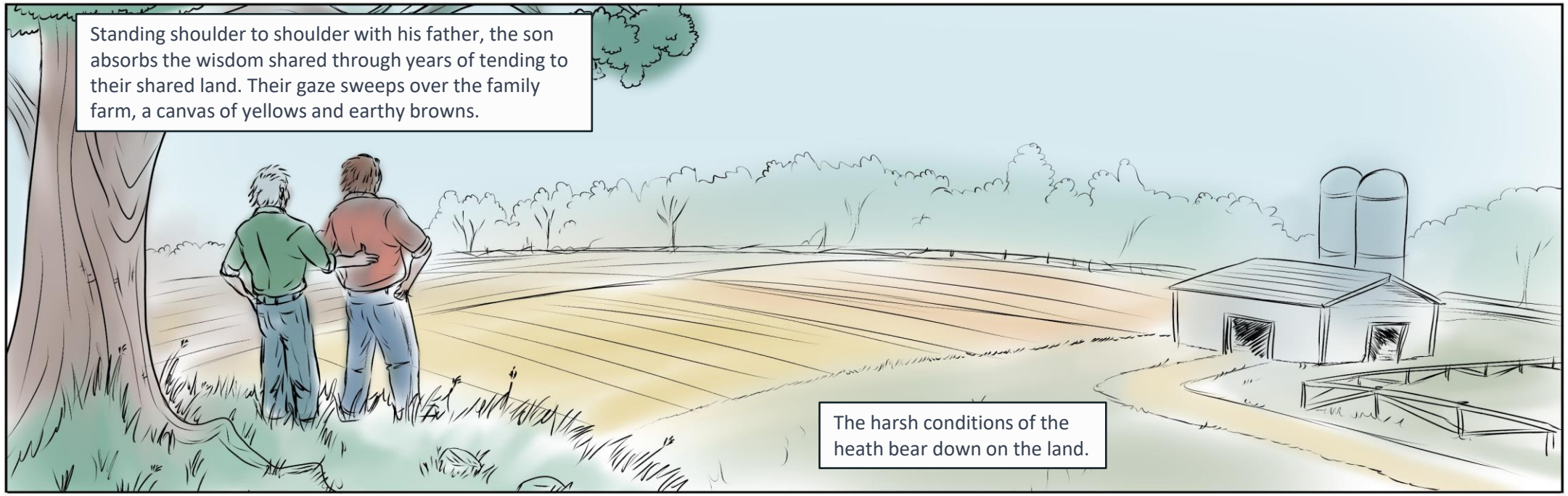
Dealbreakers

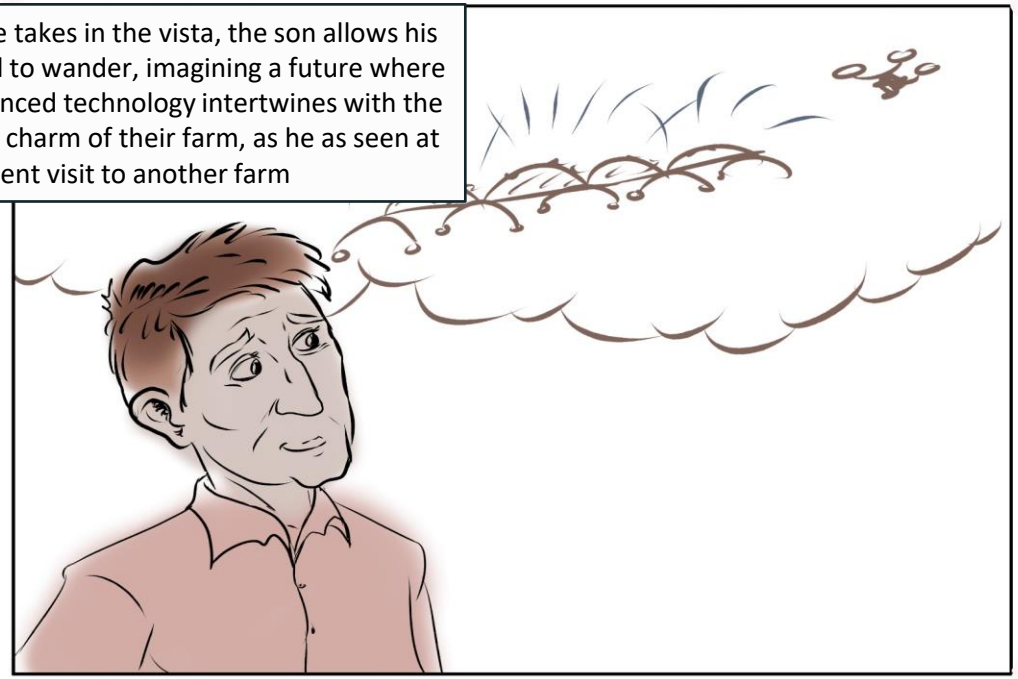
- Explanation: As illustrated in the Advisor part in the Guidelines, where a flowchart is shared to support a farmer's DATS adoption journey flowchart, dealbreakers can occur at any time and divert a farmer from their path to adoption back to non-adoption. This can be temporary (if the farmer later chooses to reconsider) or permanent.
  - Example: A farmer is overloaded and overwhelmed. In other words, they do not have capacity. This would likely be a temporary dealbreaker, until such time as they do have the capacity to resume consideration.
  - Example: A farmer has difficulty learning how to use the DATS. This is likely to more seriously impact the chances of adoption during a trial phase with the DATS than after significant investment.
  - Example: Very basic DATS features, such as noisy alarms, can be the difference between a farmer using the DATS or not.
  - Example: Price, customer service, and personal matters (e.g., life events/choices) can also be dealbreakers.

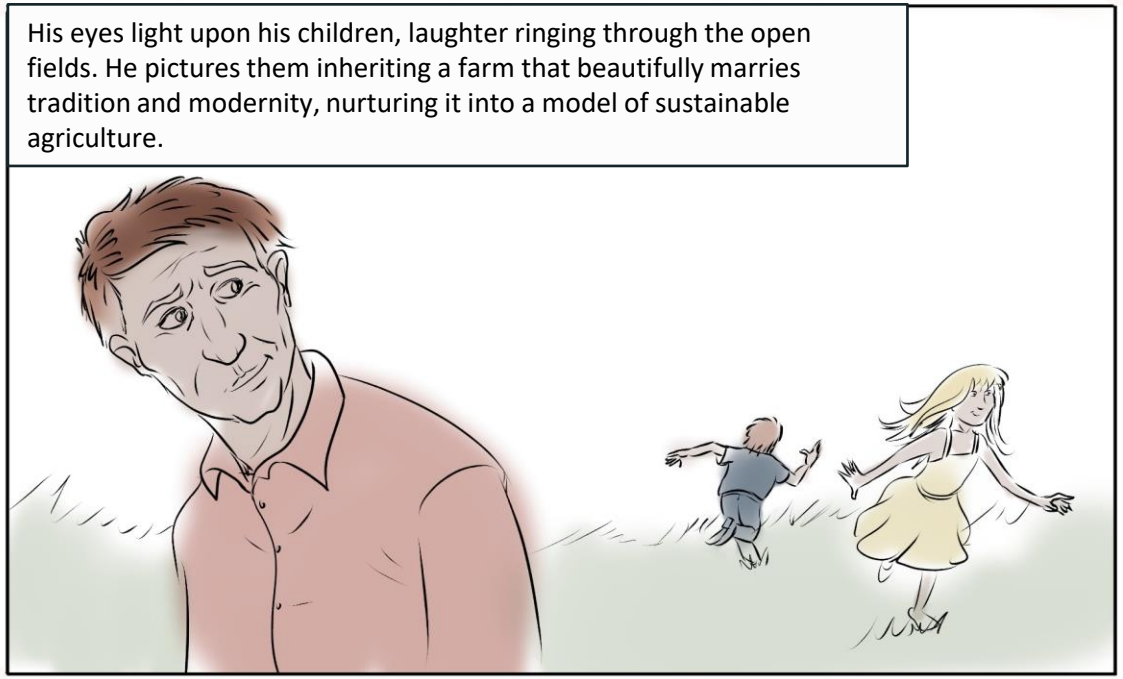
Farmer stories

FARMER 1

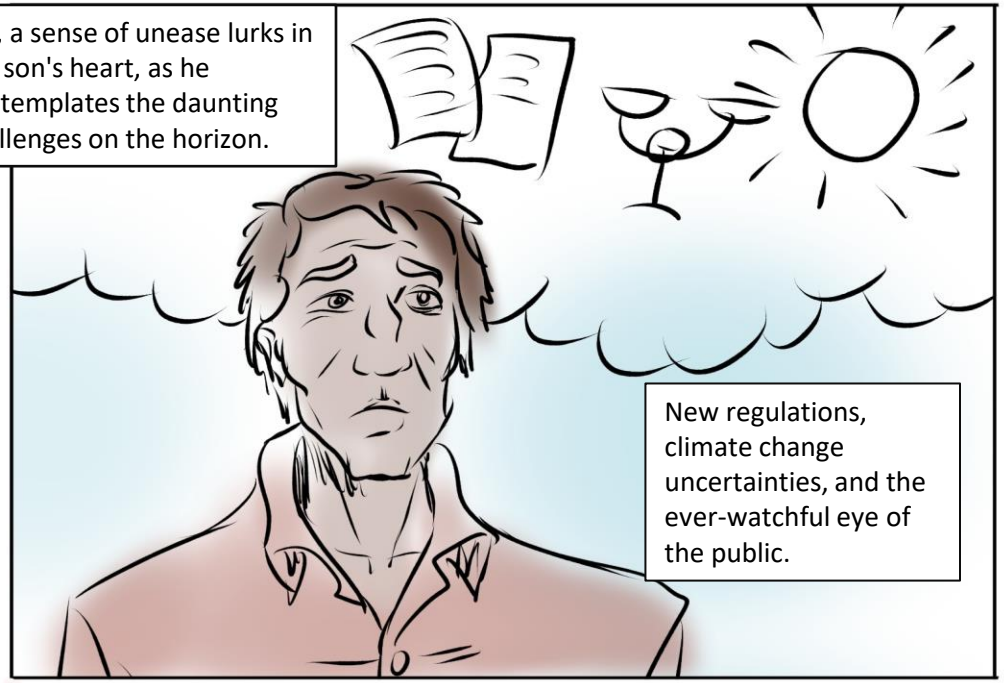
Securing the legacy through digitalisation


Standing shoulder to shoulder with his father, the son absorbs the wisdom shared through years of tending to their shared land. Their gaze sweeps over the family farm, a canvas of yellows and earthy browns.
The harsh conditions of the heath bear down on the land.

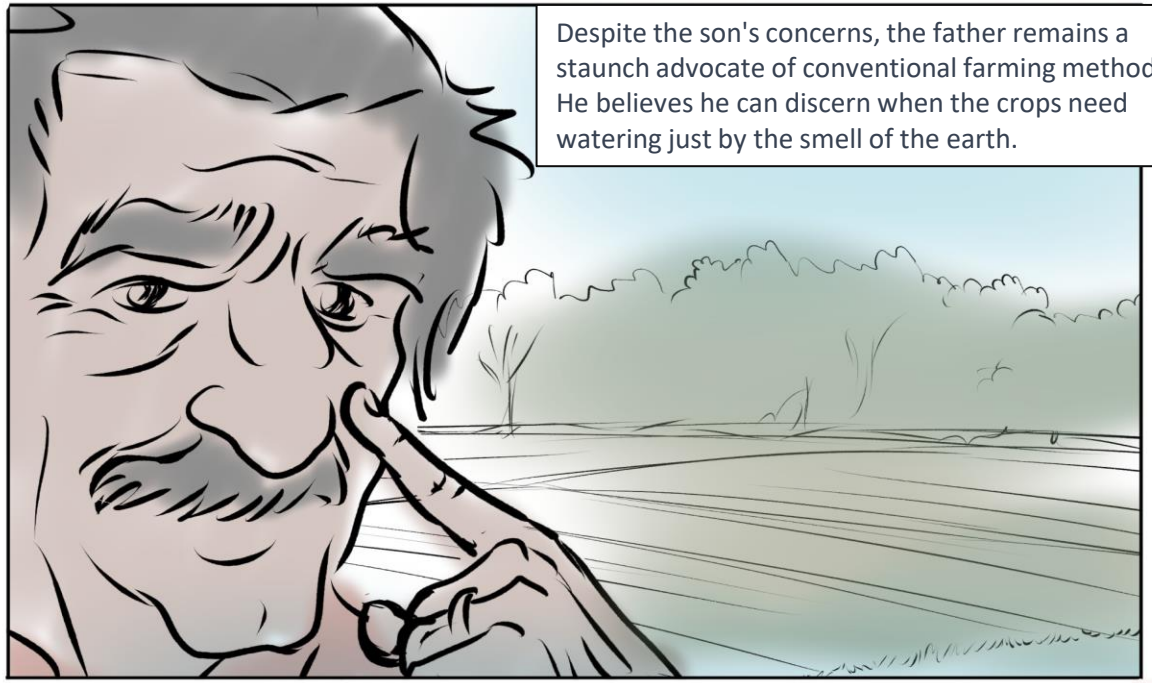

As he takes in the vista, the son allows his mind to wander, imagining a future where advanced technology intertwines with the rural charm of their farm, as he as seen at a recent visit to another farm


His eyes light upon his children, laughter ringing through the open fields. He pictures them inheriting a farm that beautifully marries tradition and modernity, nurturing it into a model of sustainable agriculture.

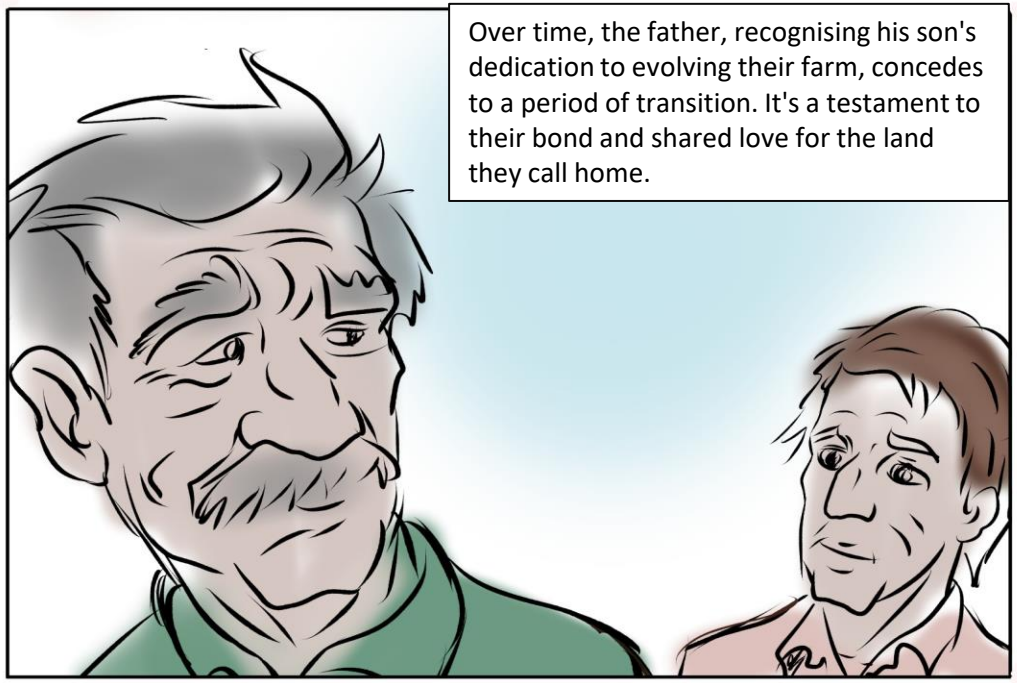
Yet, a sense of unease lurks in the son's heart, as he contemplates the daunting challenges on the horizon.



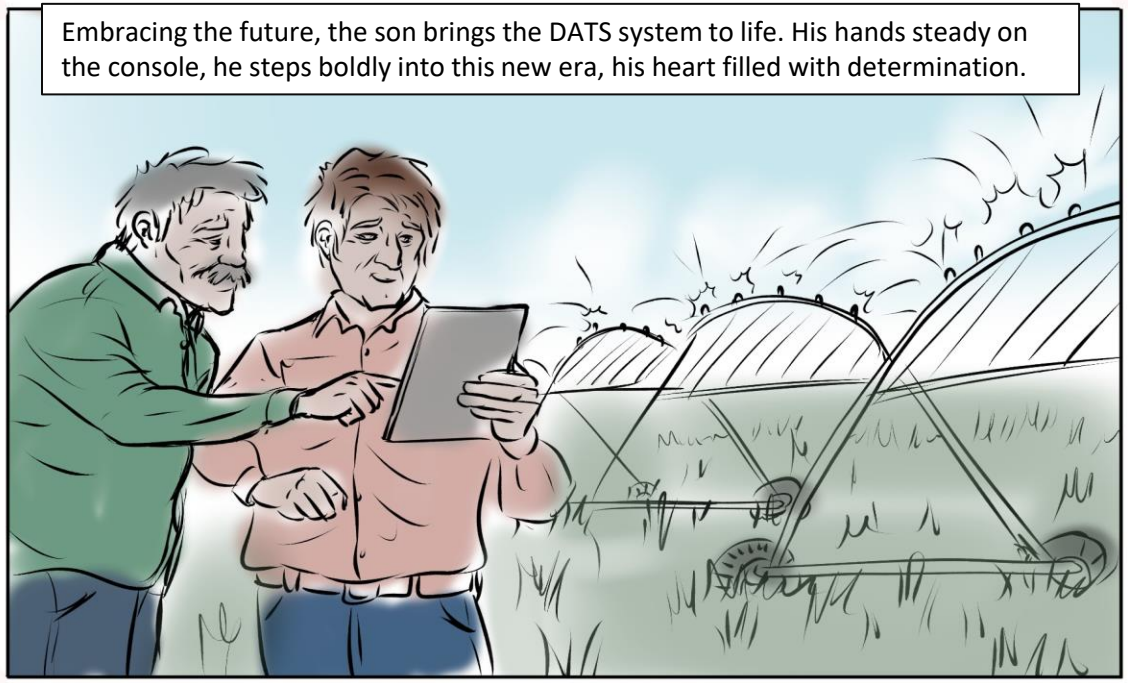
New regulations, climate change uncertainties, and the ever-watchful eye of the public.



Despite the son's concerns, the father remains a staunch advocate of conventional farming methods. He believes he can discern when the crops need watering just by the smell of the earth.

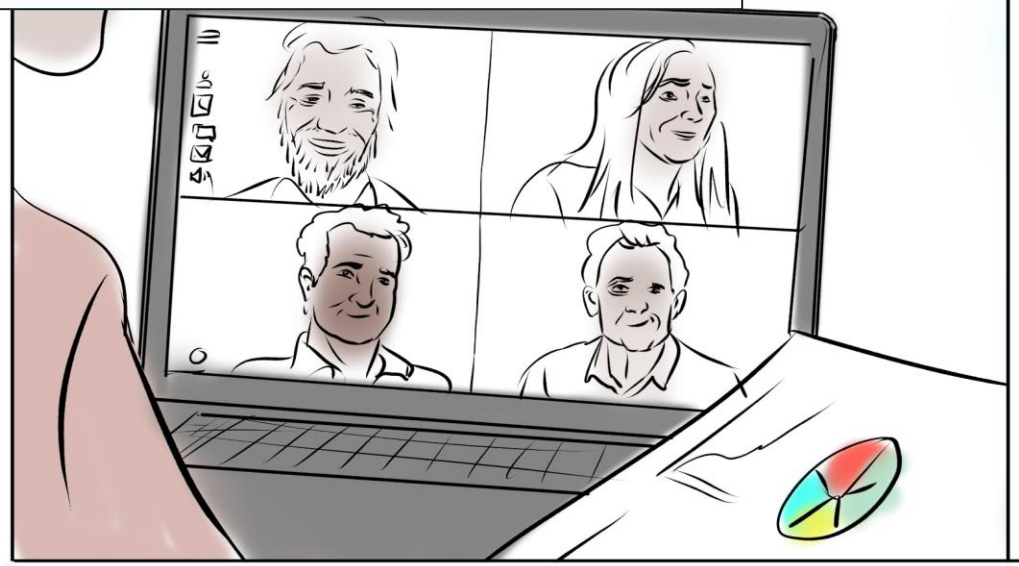


Over time, the father, recognising his son's dedication to evolving their farm, concedes to a period of transition. It's a testament to their bond and shared love for the land they call home.

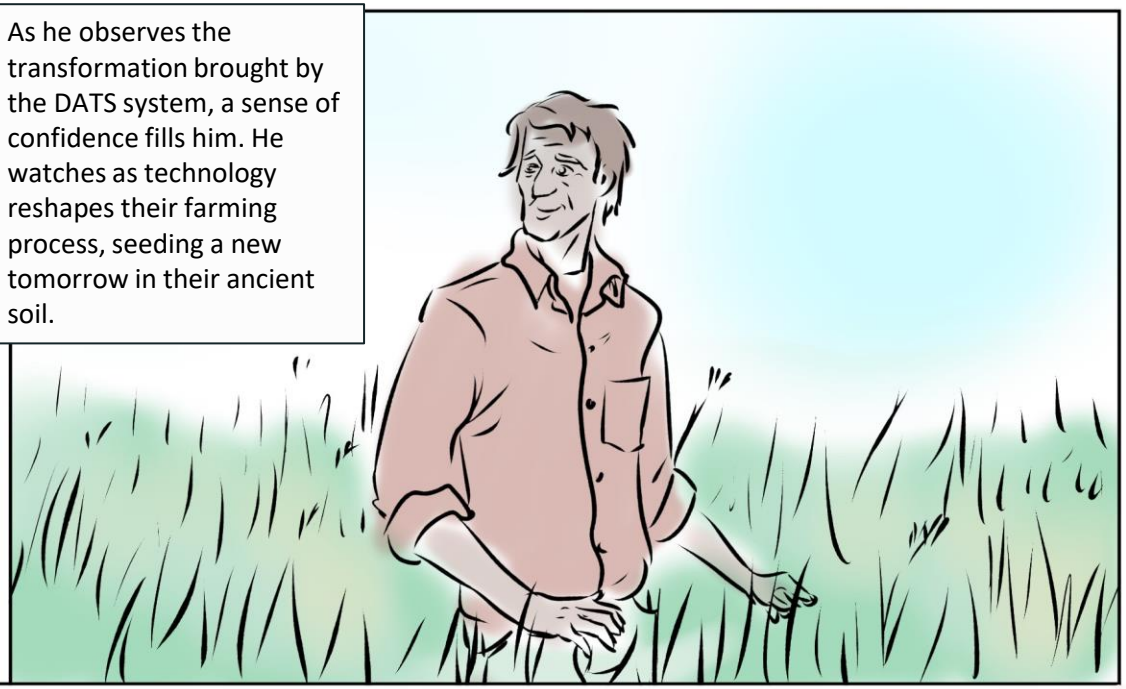


Embracing the future, the son brings the DATS system to life. His hands steady on the console, he steps boldly into this new era, his heart filled with determination.

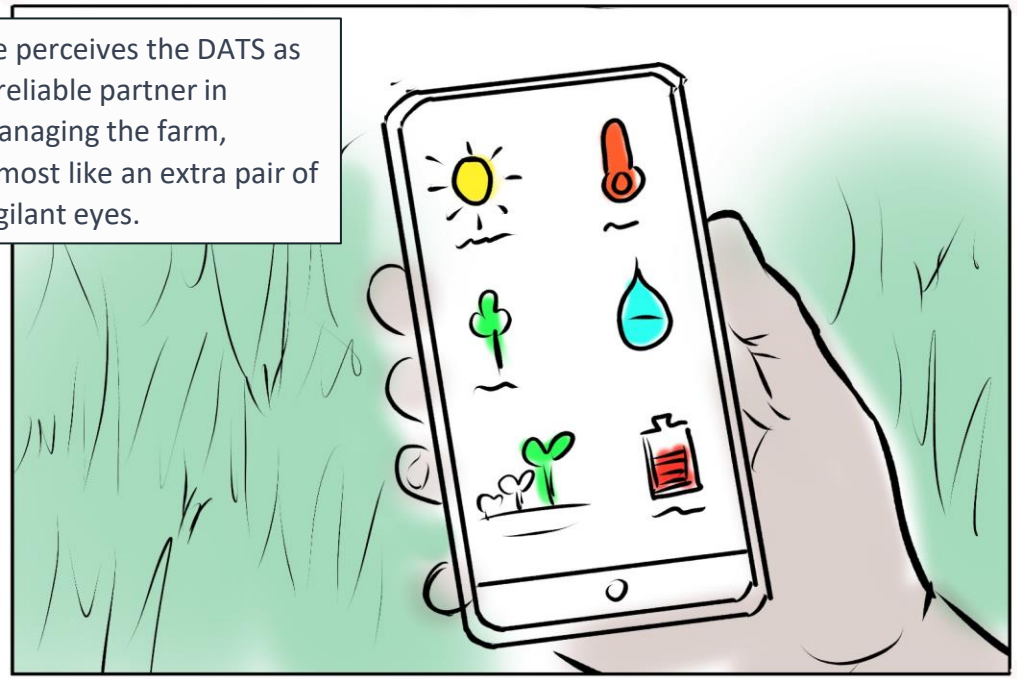
An inquisitive spirit propels him forward. He seeks knowledge, makes connections, ready to learn from the experiences of other farmers and experiment with new farming methods.



As he observes the transformation brought by the DATS system, a sense of confidence fills him. He watches as technology reshapes their farming process, seeding a new tomorrow in their ancient soil.

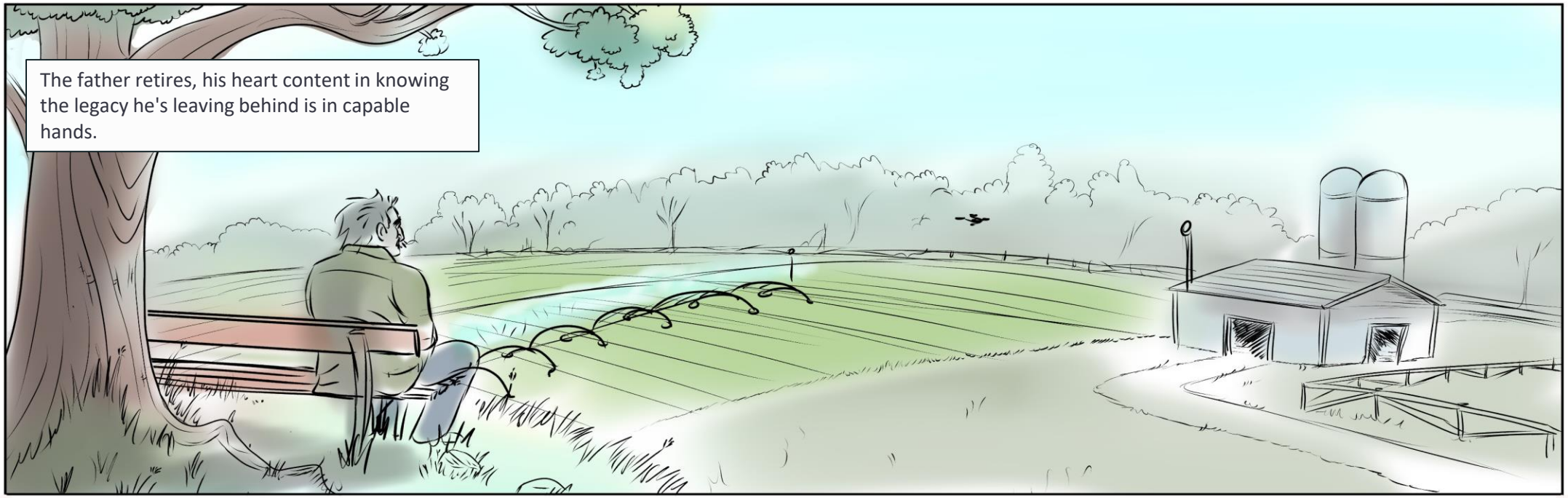


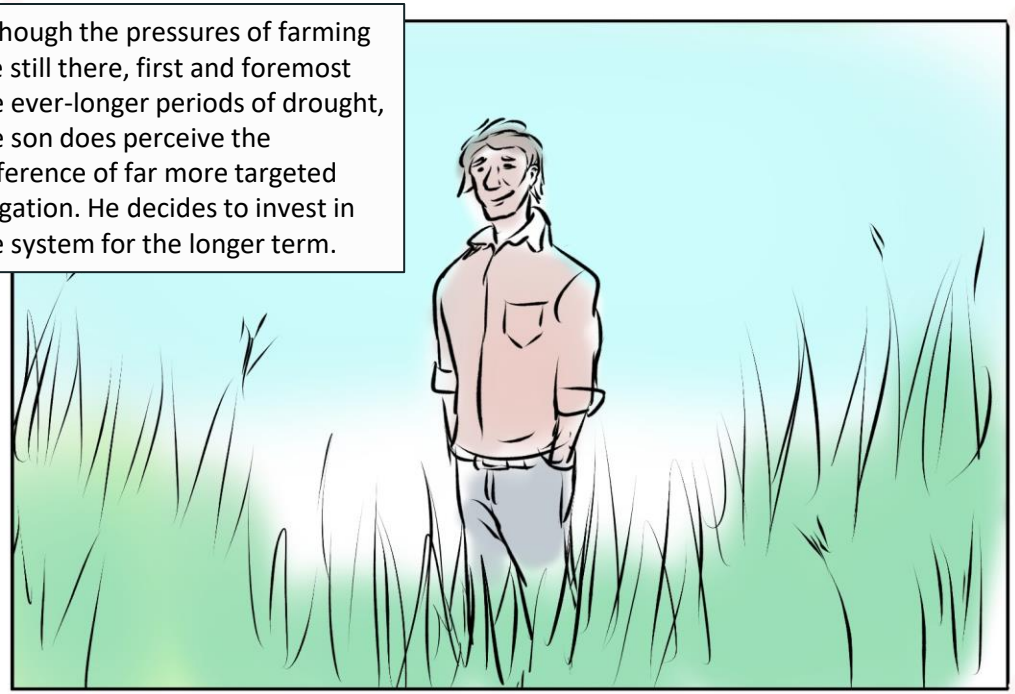
He perceives the DATS as a reliable partner in managing the farm, almost like an extra pair of vigilant eyes.

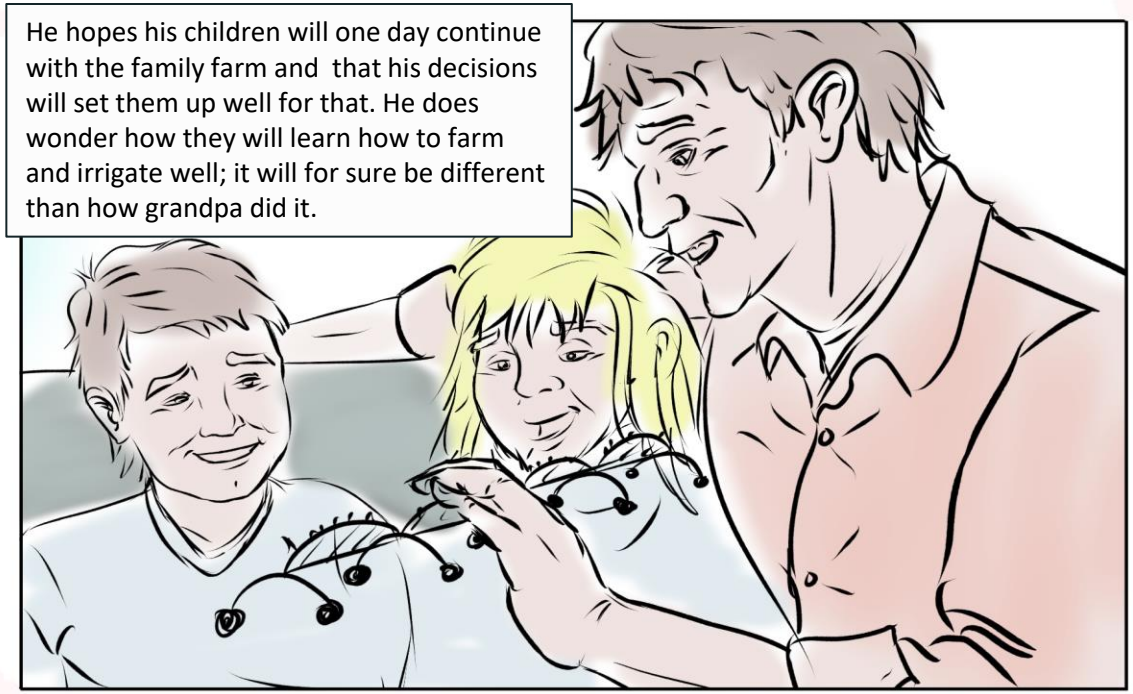


Thanks to the DATS, the son finds himself enjoying an improved work-life balance.

He savors these moments, cherishing time spent with his family amidst the technology at work.

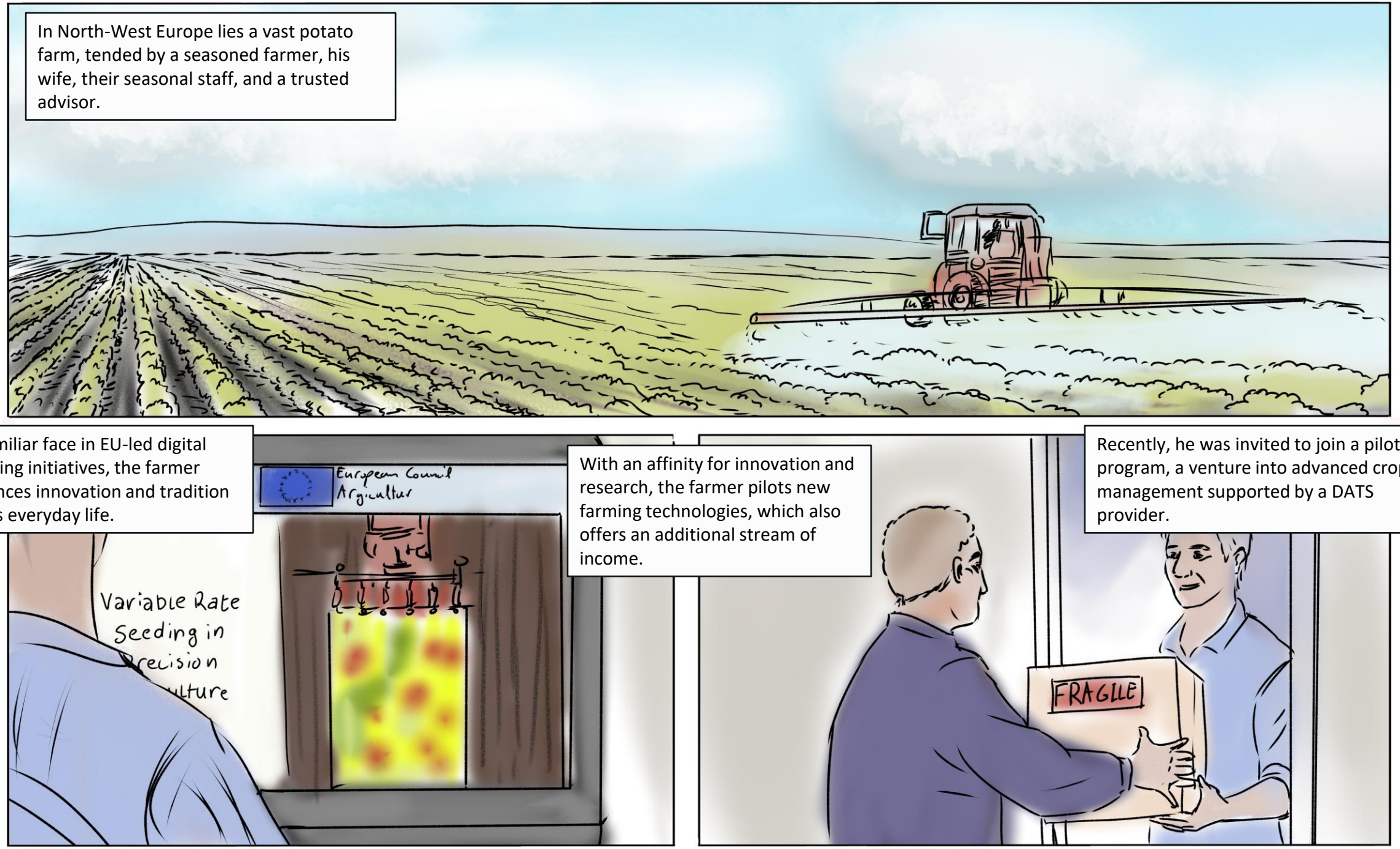

The father retires, his heart content in knowing the legacy he's leaving behind is in capable hands.

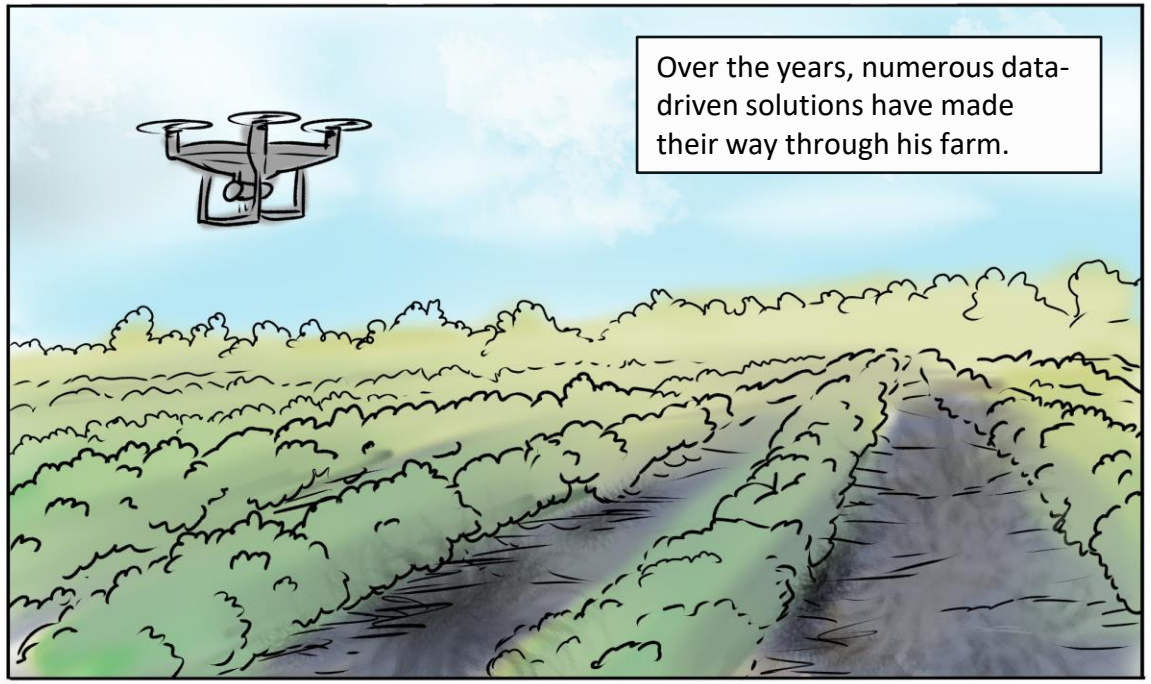

Although the pressures of farming are still there, first and foremost the ever-longer periods of drought, the son does perceive the difference of far more targeted irrigation. He decides to invest in the system for the longer term.

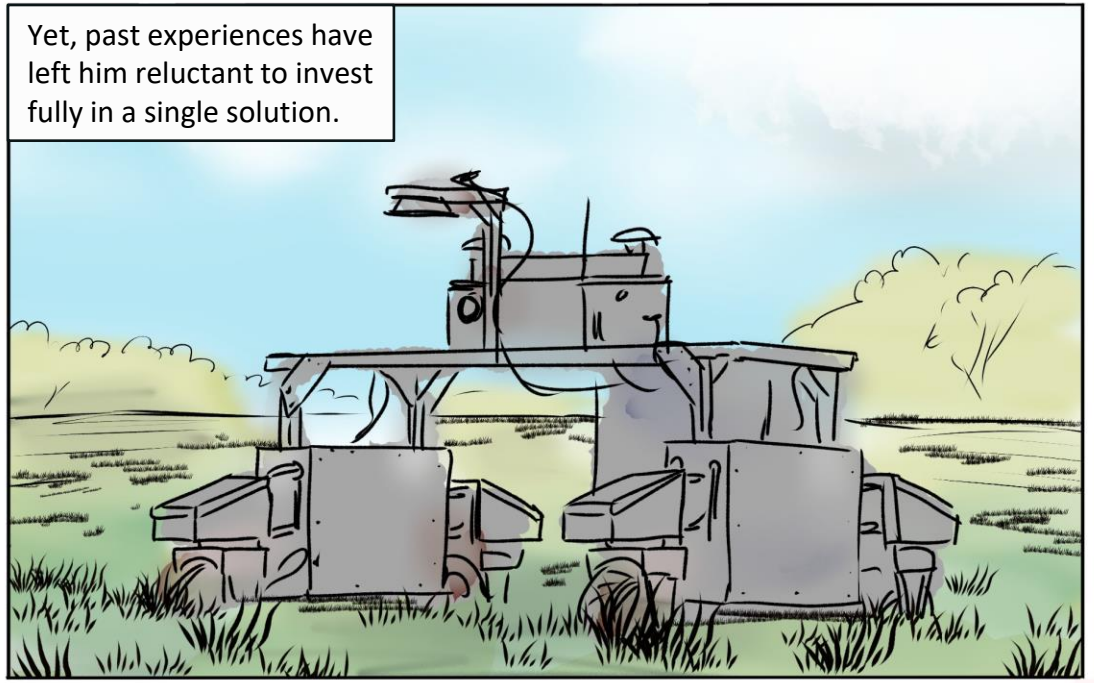

He hopes his children will one day continue with the family farm and that his decisions will set them up well for that. He does wonder how they will learn how to farm and irrigate well; it will for sure be different than how grandpa did it.

FARMER 2

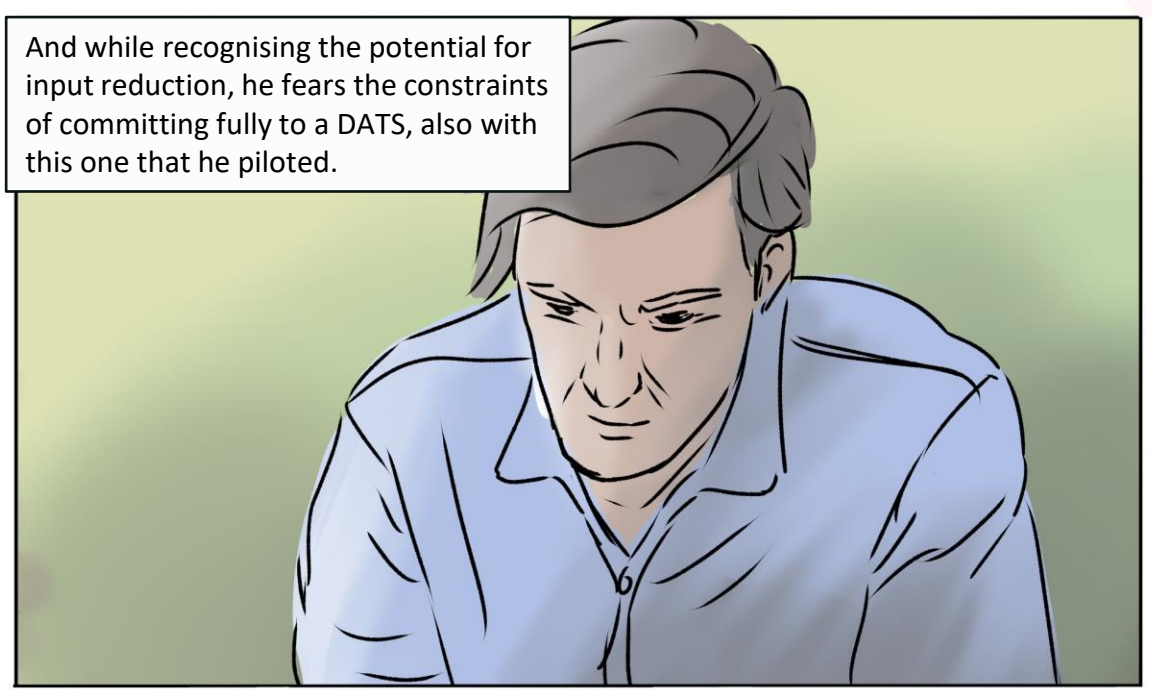
Digital autonomy


In North-West Europe lies a vast potato farm, tended by a seasoned farmer, his wife, their seasonal staff, and a trusted advisor.
A familiar face in EU-led digital farming initiatives, the farmer balances innovation and tradition in his everyday life.
European Council
Variable Rate Seeding in
With an affinity for innovation and research, the farmer pilots new farming technologies, which also offers an additional stream of income.
Recently, he was invited to join a pilot program, a venture into advanced crop management supported by a DATS provider.
FRAGILE


Over the years, numerous data-driven solutions have made their way through his farm.


Yet, past experiences have left him reluctant to invest fully in a single solution.


No technology yet could replace his intimate knowledge of the land, prompting him to always double-check.


And while recognising the potential for input reduction, he fears the constraints of committing fully to a DATS, also with this one that he piloted.

He wonders about the fate of the data his farm produces.

And what if the decision support fails? Where would he stand then?

Could this make him too dependent on a specific DATS supplier?

Unfortunately, his trusted advisor is unable to clear his doubts.

His wife, his equal in all decisions, agrees. They need clarity before committing to such an investment.

FARMER 3

Ardent and prudent pig farmer

In a village we find a medium-sized pig farm…

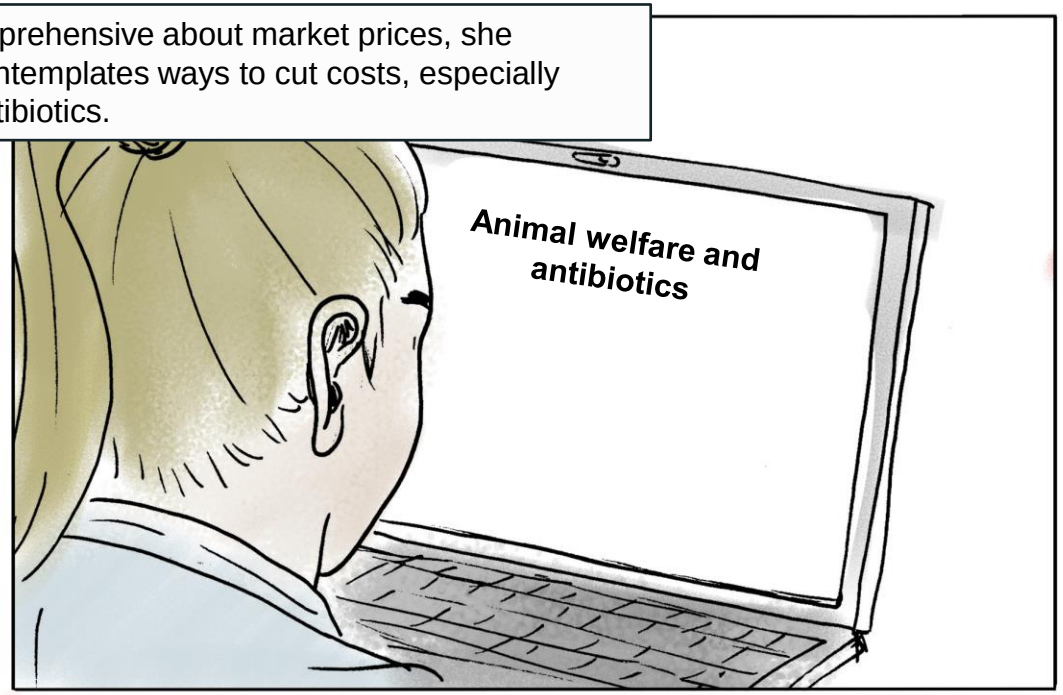
… run solely by a determined 55-year-old woman.

Generations of her husband's family built a growing farm.

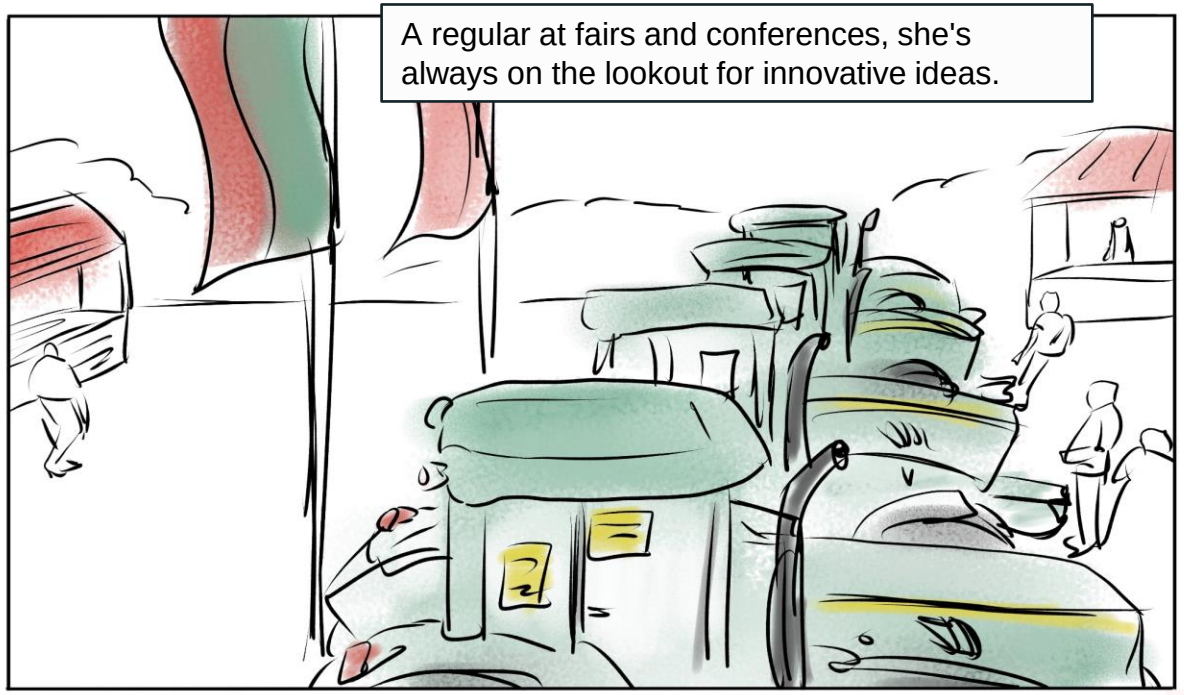
Now, she bears the responsibility.

The rest of her family is earning an income in other ways as the margins on pig meat shrink. Her husband runs a campsite at the edge of the village.

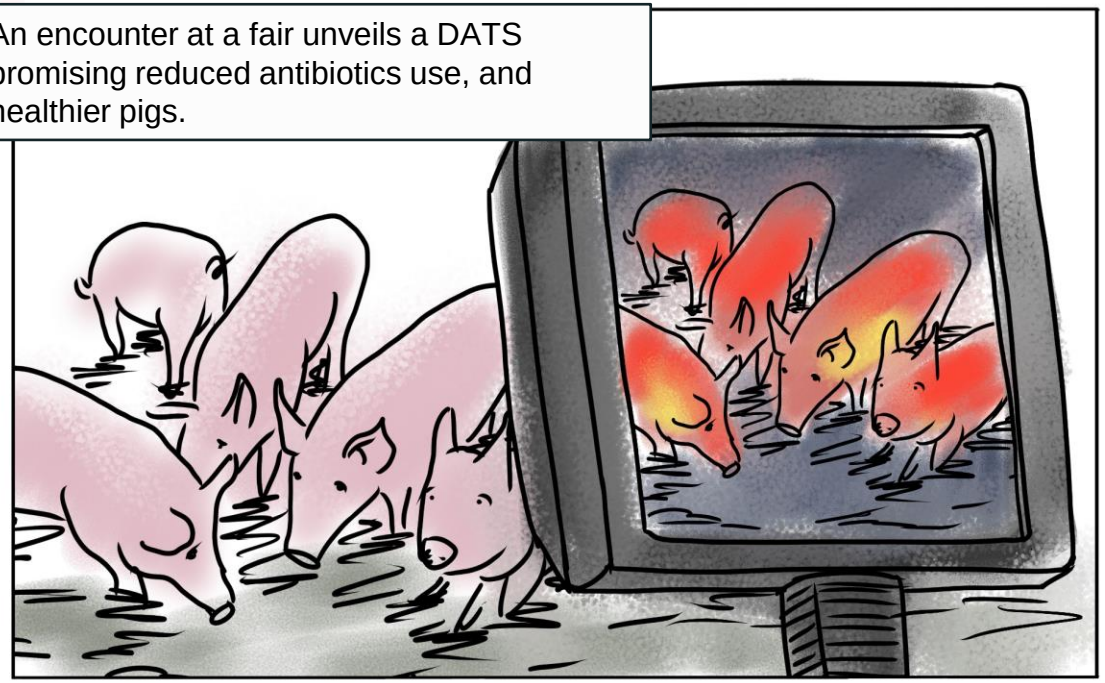
Apprehensive about market prices, she contemplates ways to cut costs, especially antibiotics.



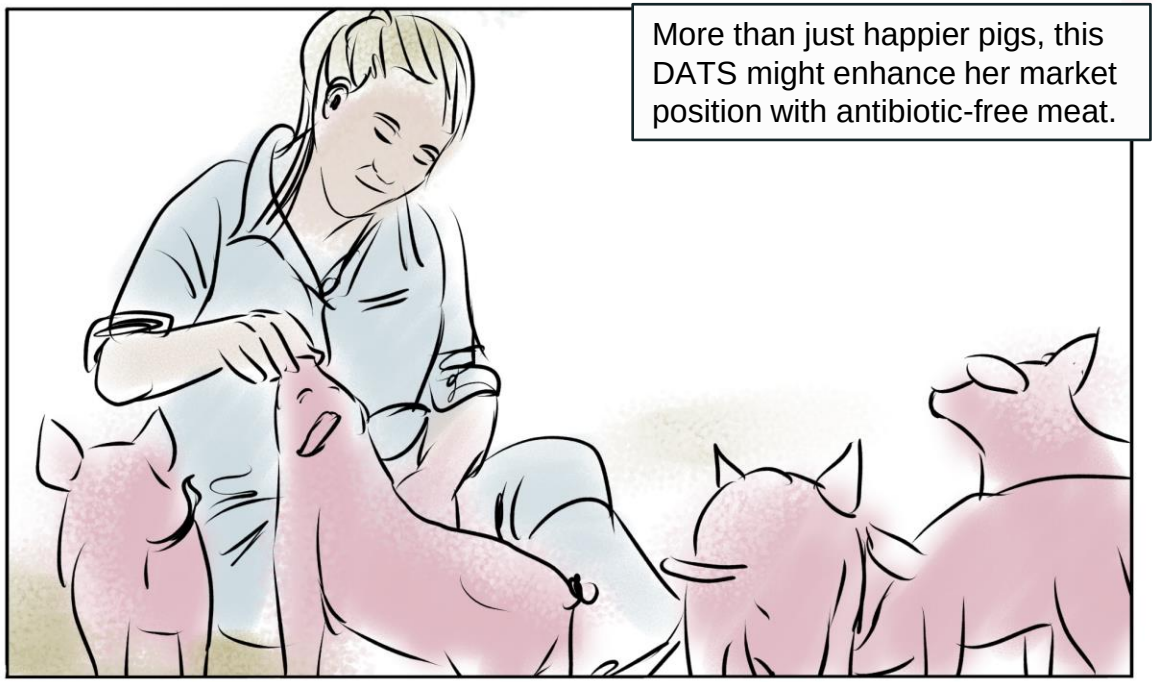
A regular at fairs and conferences, she's always on the lookout for innovative ideas.



An encounter at a fair unveils a DATS promising reduced antibiotics use, and healthier pigs.

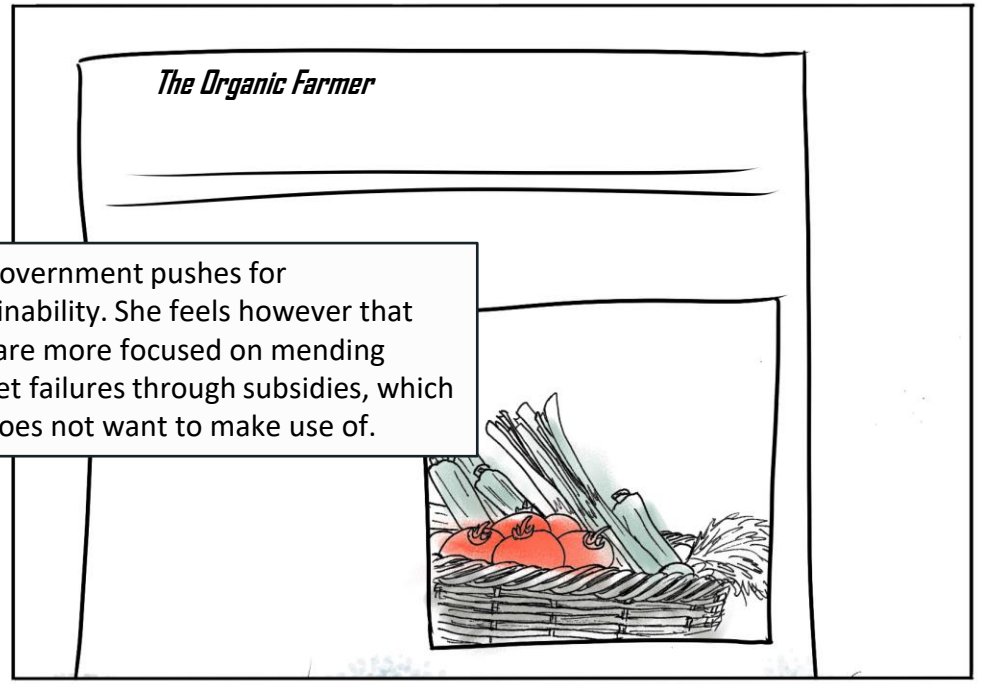


More than just happier pigs, this DATS might enhance her market position with antibiotic-free meat.



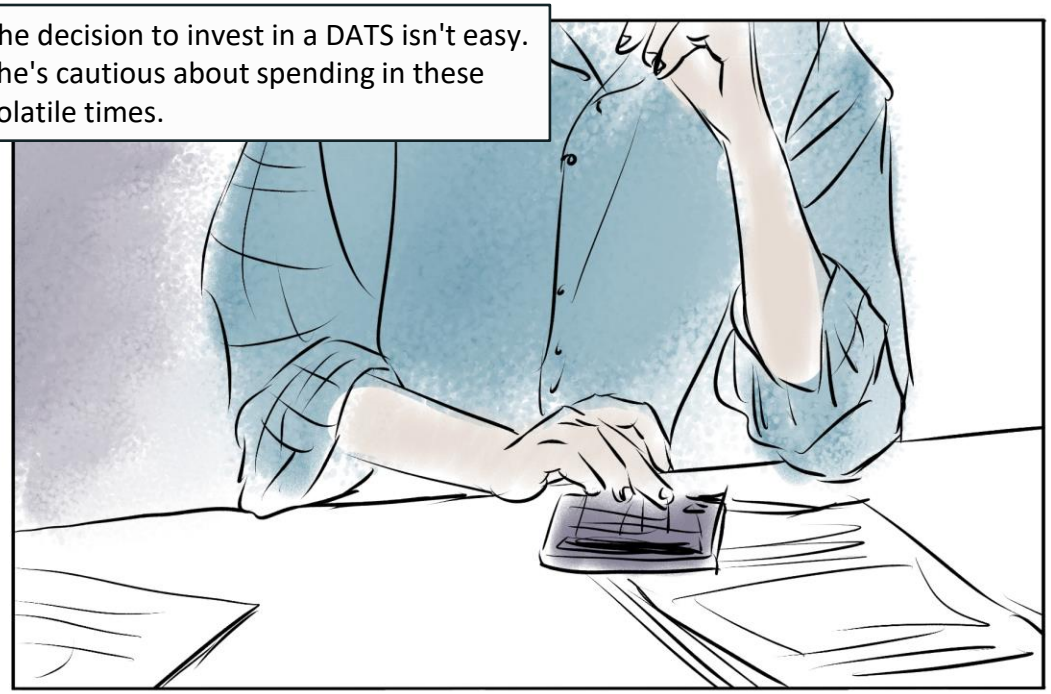
The Organic Farmer

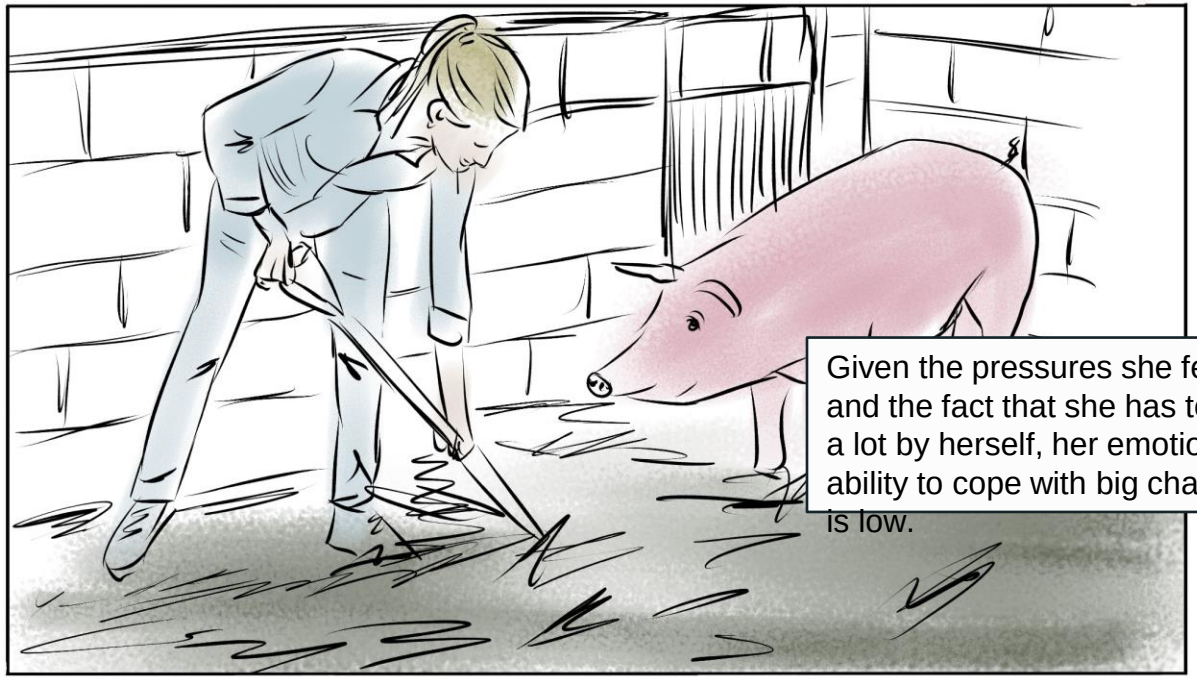
The government pushes for sustainability. She feels however that they are more focused on mending market failures through subsidies, which she does not want to make use of.



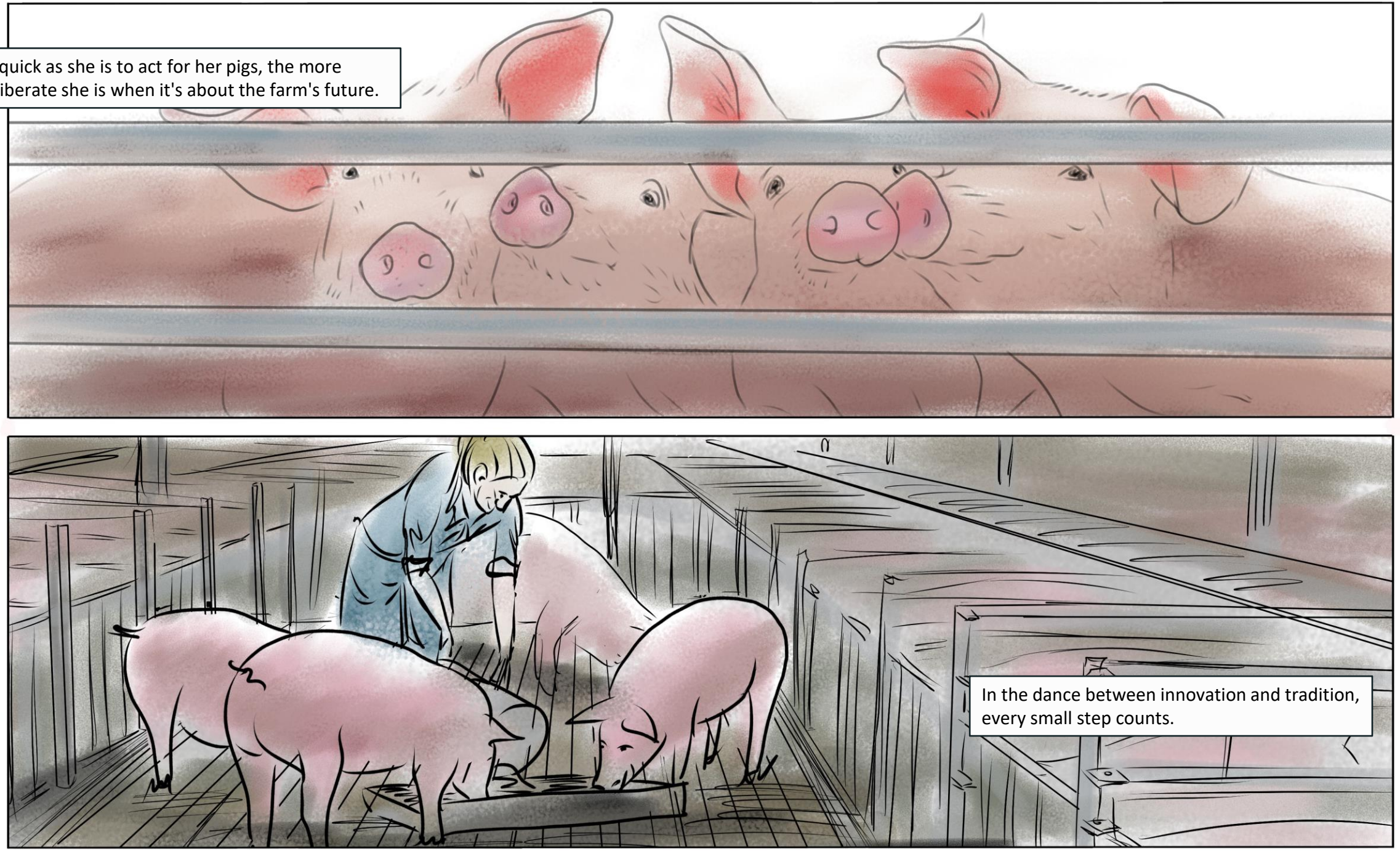
Just a few kilometers away, life seems easier where rules are less tight.

The decision to invest in a DATS isn't easy. She's cautious about spending in these volatile times.





Given the pressures she feels, and the fact that she has to do a lot by herself, her emotional ability to cope with big changes is low.

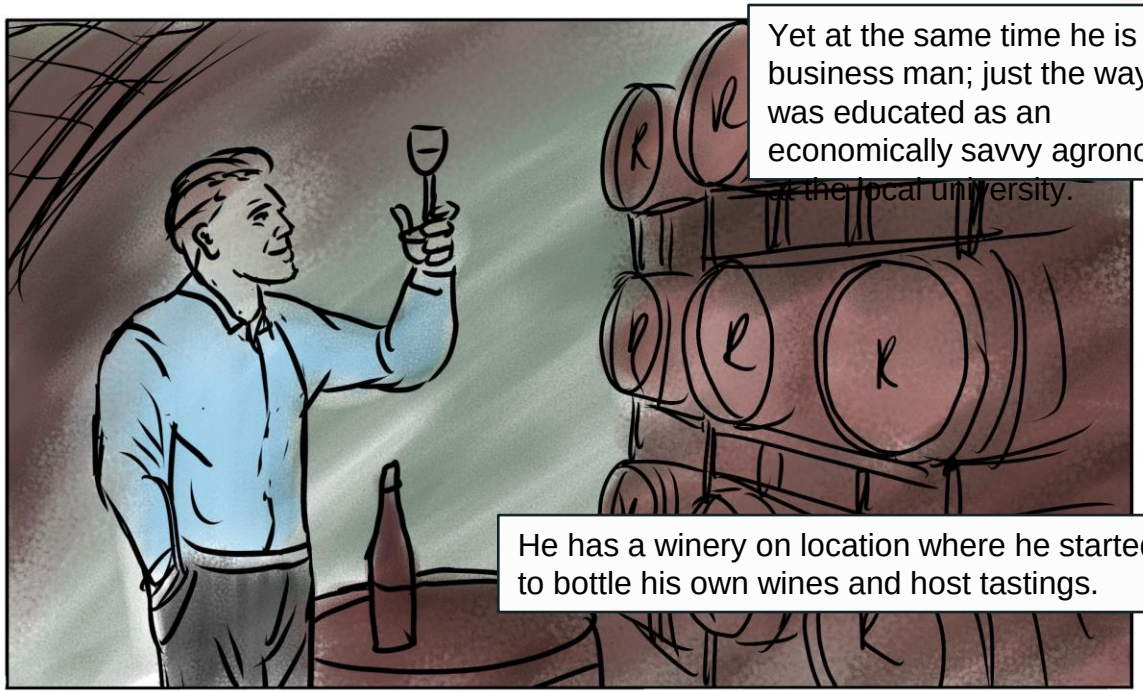

As quick as she is to act for her pigs, the more deliberate she is when it's about the farm's future.
In the dance between innovation and tradition, every small step counts.

FARMER 4

Business mentality

A young entrepreneur, aged 34, farms this land. He bought it a few years ago from a farmer that did not have children to succeed him.

He loves being outside, reaping the fruits of his labour and enjoying the wine from his vines.



Yet at the same time he is a business man; just the way he was educated as an economically savvy agronomer at the local university.

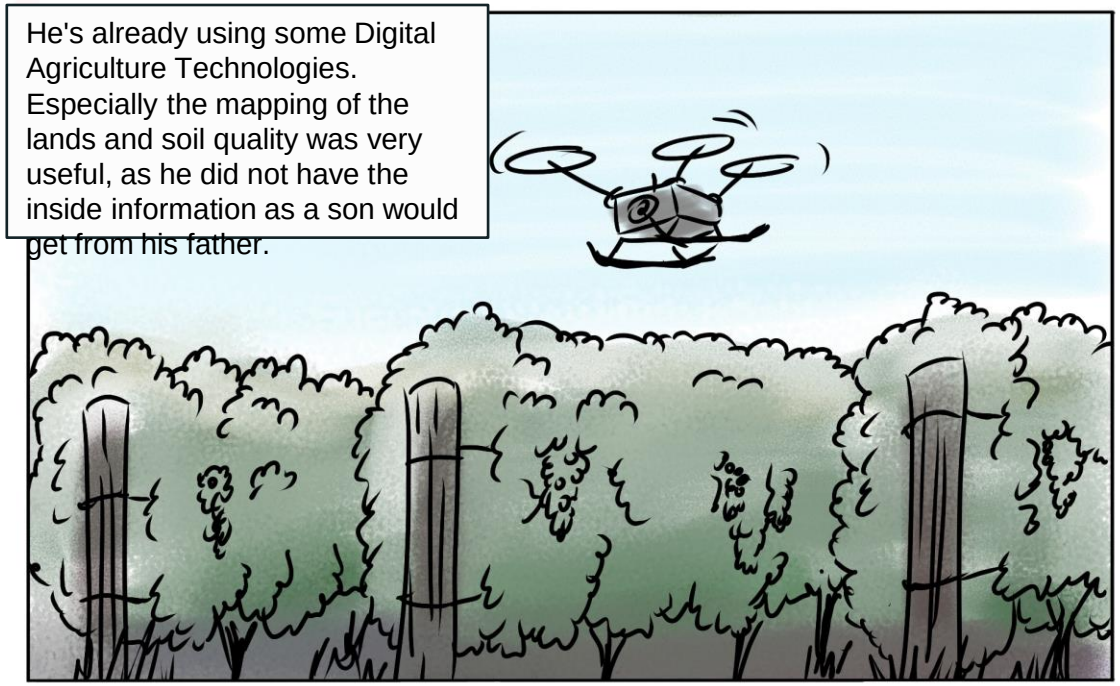
He has a winery on location where he started to bottle his own wines and host tastings.

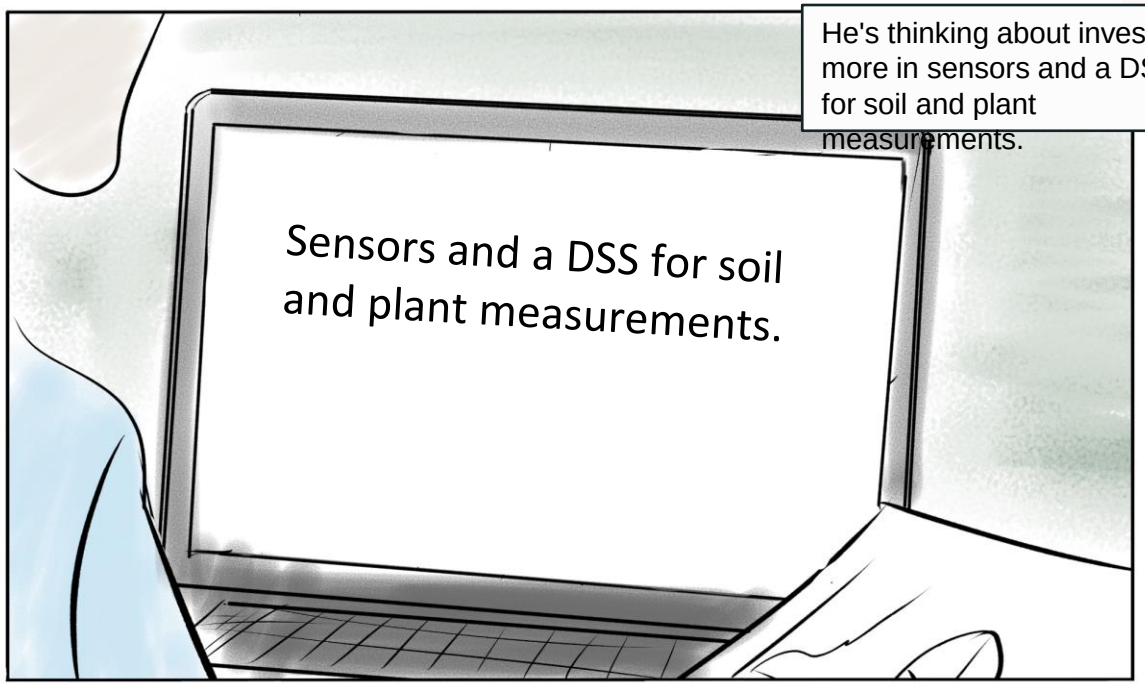
Despite some political instability that sometimes polarises his relatively poor region, he has a strong love for its local heritage.

This results in a desire to preserve the region's nature and local culture. He is convinced DATSs can actually help to do so, for instance by helping to recultivate indigenous types of grapes.

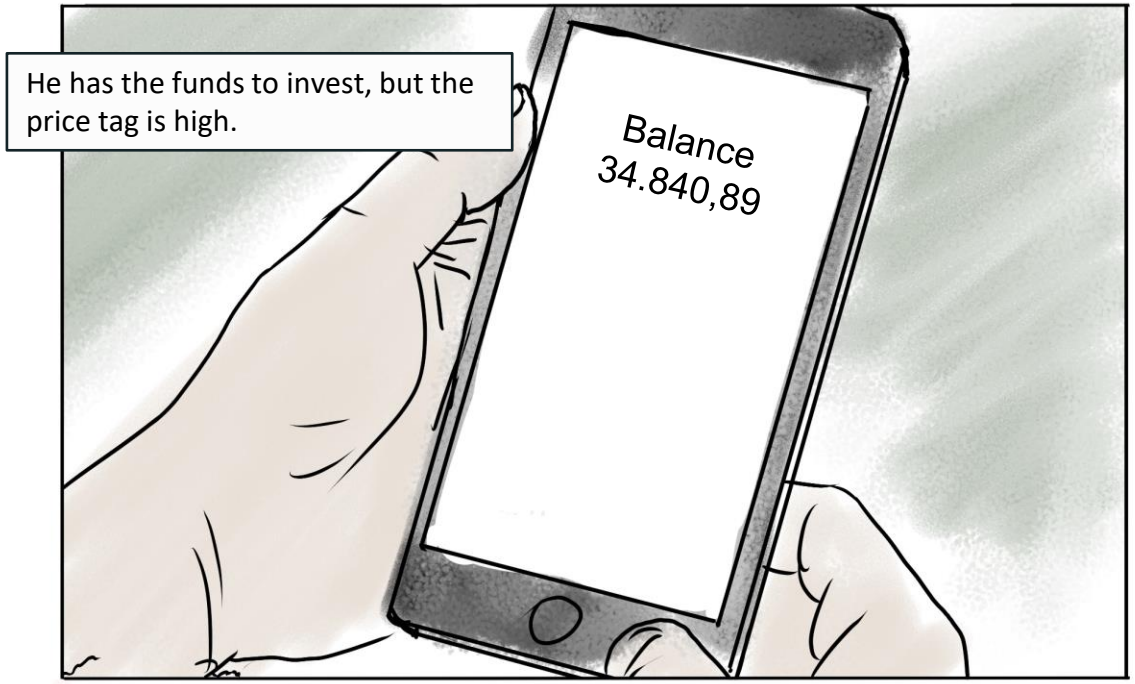
He feels that farmers his age understand him more than the older farmers in the region, who like to keep things as they are.

He's already using some Digital Agriculture Technologies. Especially the mapping of the lands and soil quality was very useful, as he did not have the inside information as a son would get from his father.

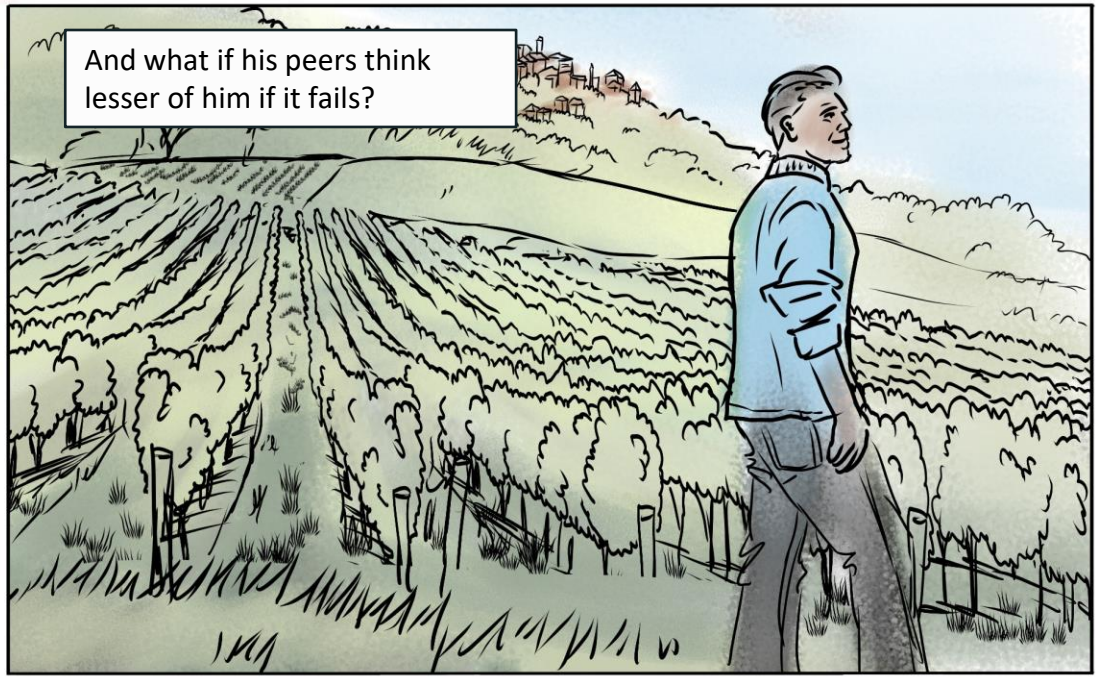


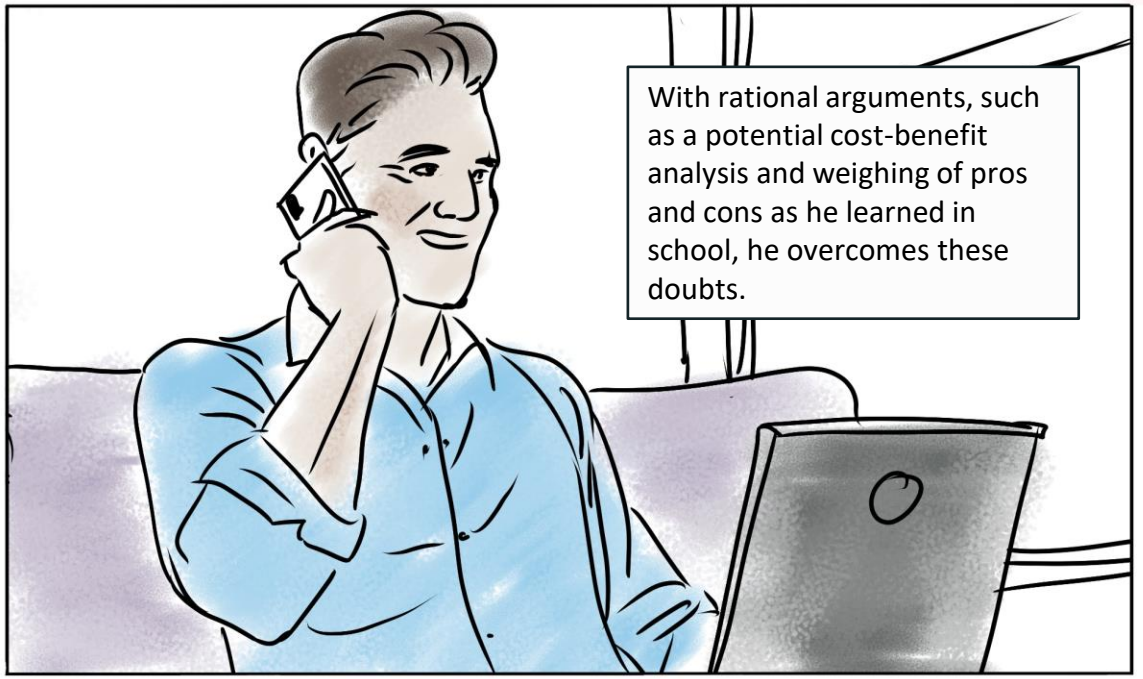


He's thinking about investing more in sensors and a DSS for soil and plant measurements.

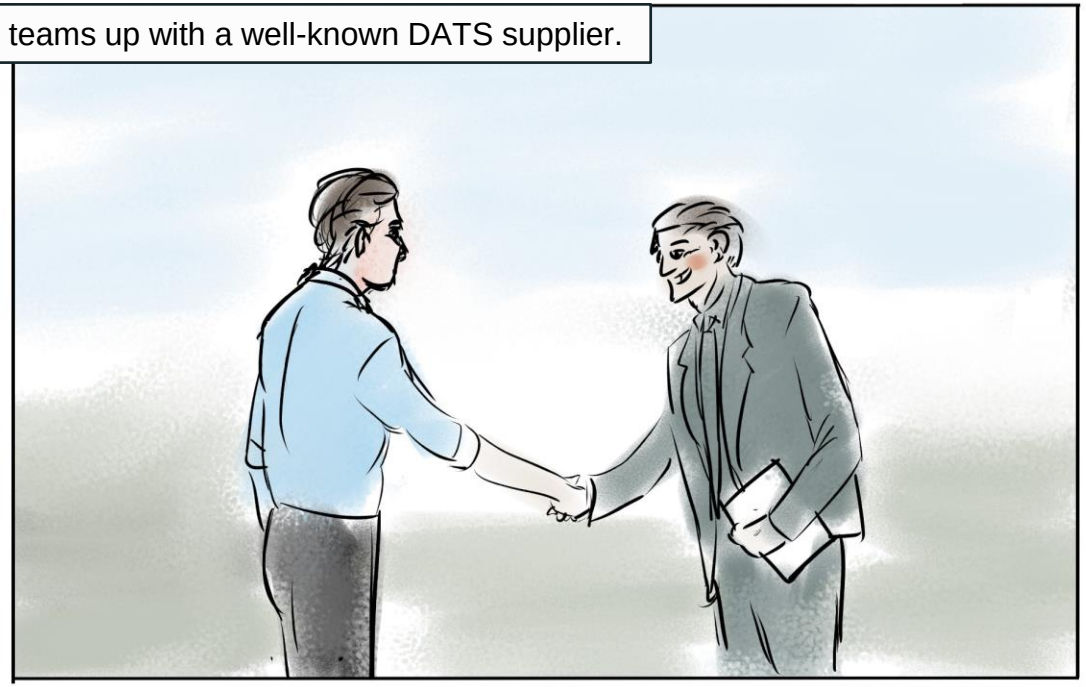

He has the funds to invest, but the price tag is high.
Balance
34.840,89


His partner prefers to wait a while for the DATSs to develop more. What if the technology fails?

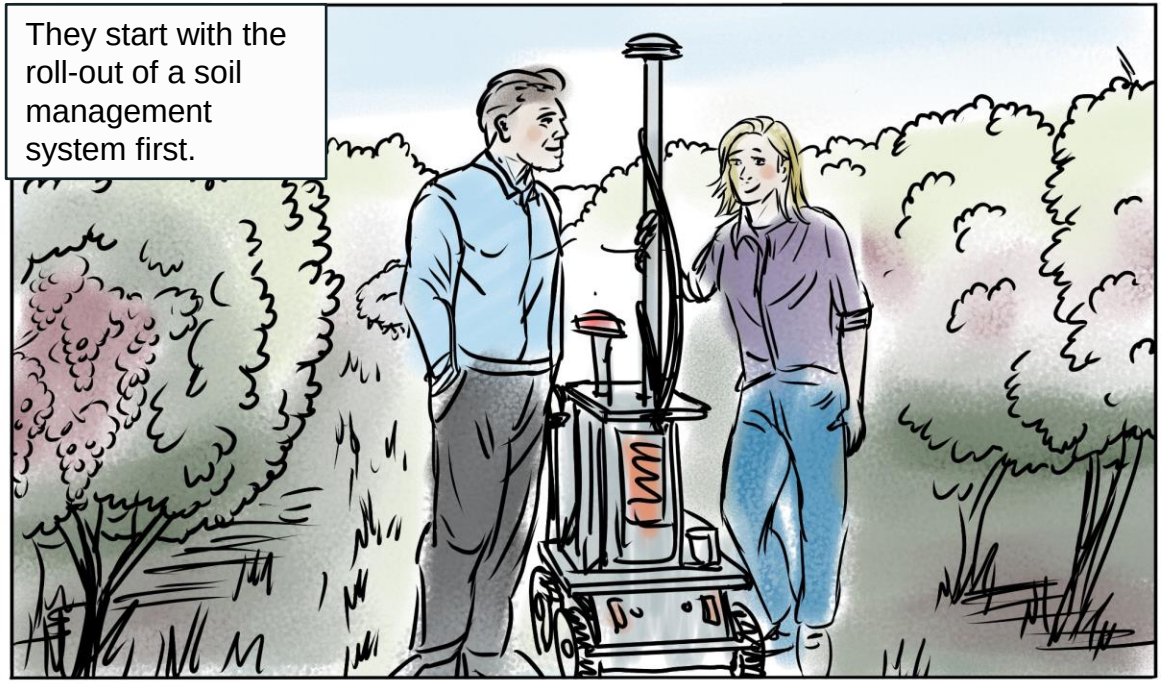

And what if his peers think lesser of him if it fails?


With rational arguments, such as a potential cost-benefit analysis and weighing of pros and cons as he learned in school, he overcomes these doubts.

He teams up with a well-known DATS supplier.



They start with the roll-out of a soil management system first.



Luckily, the farm is not yet entrenched with old habits, so he can easily develop new ones.

He envisions a farm where more and more can be done autonomously in the future, so he can focus on growing his winery and contribute to the wellbeing of his region.

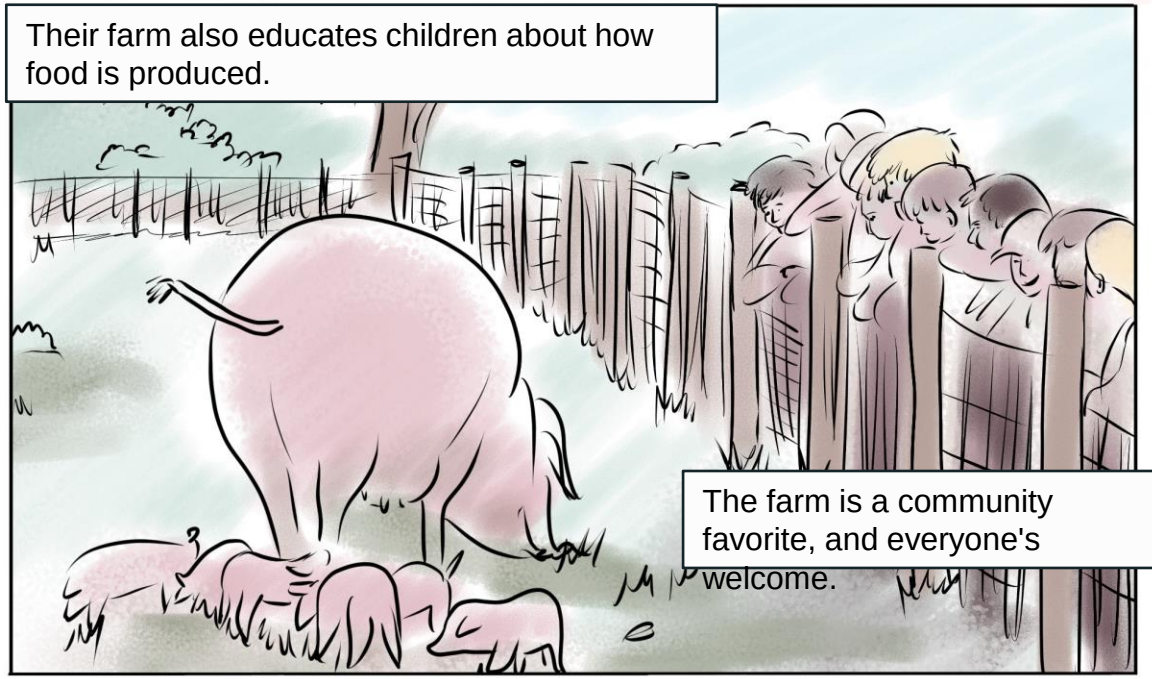
FARMER 5

Non-adopter in doubt

Meet a 43-year-old farmer with a family-owned farm.

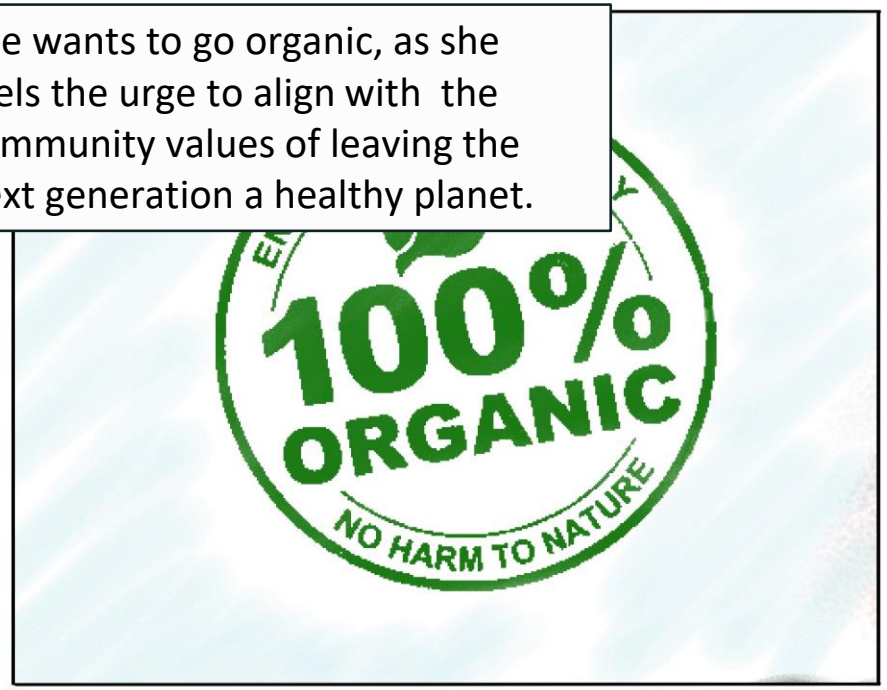
They sell meat to supermarkets and also have a local farm shop.

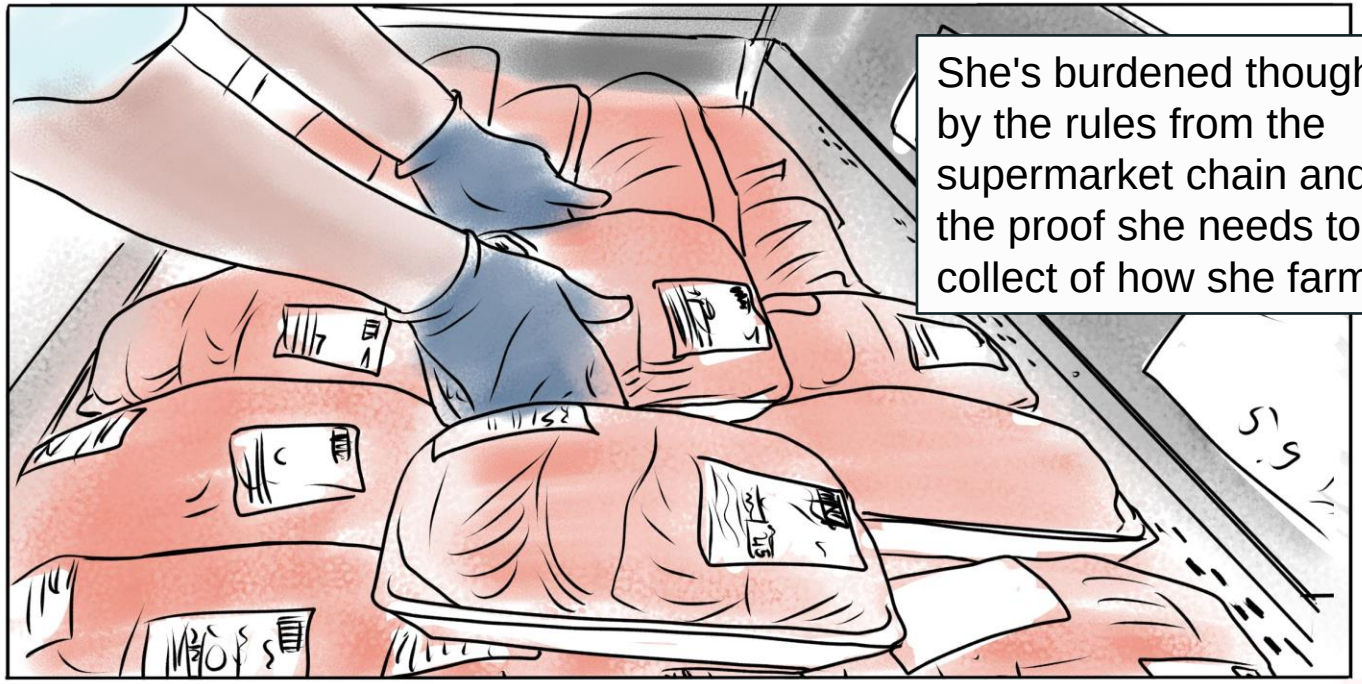
Their farm also educates children about how food is produced.



The farm is a community favorite, and everyone's welcome.

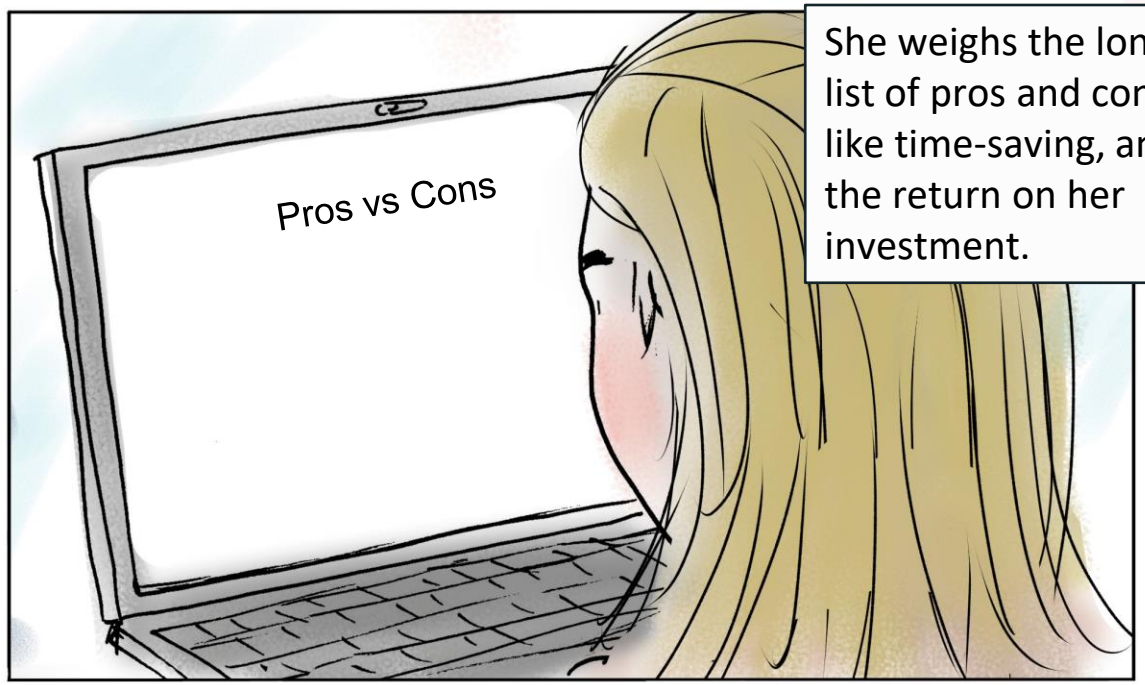
She wants to go organic, as she feels the urge to align with the community values of leaving the next generation a healthy planet.





She's burdened though by the rules from the supermarket chain and the proof she needs to collect of how she farms.

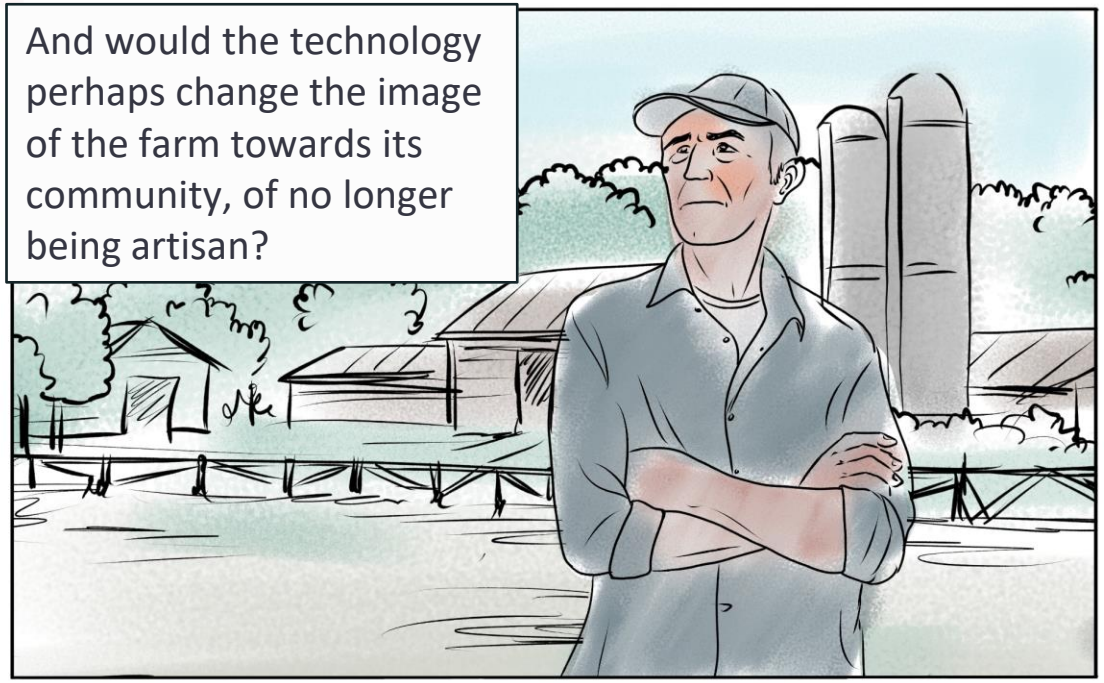
An advisor suggests new technology to help with certification and feeding.



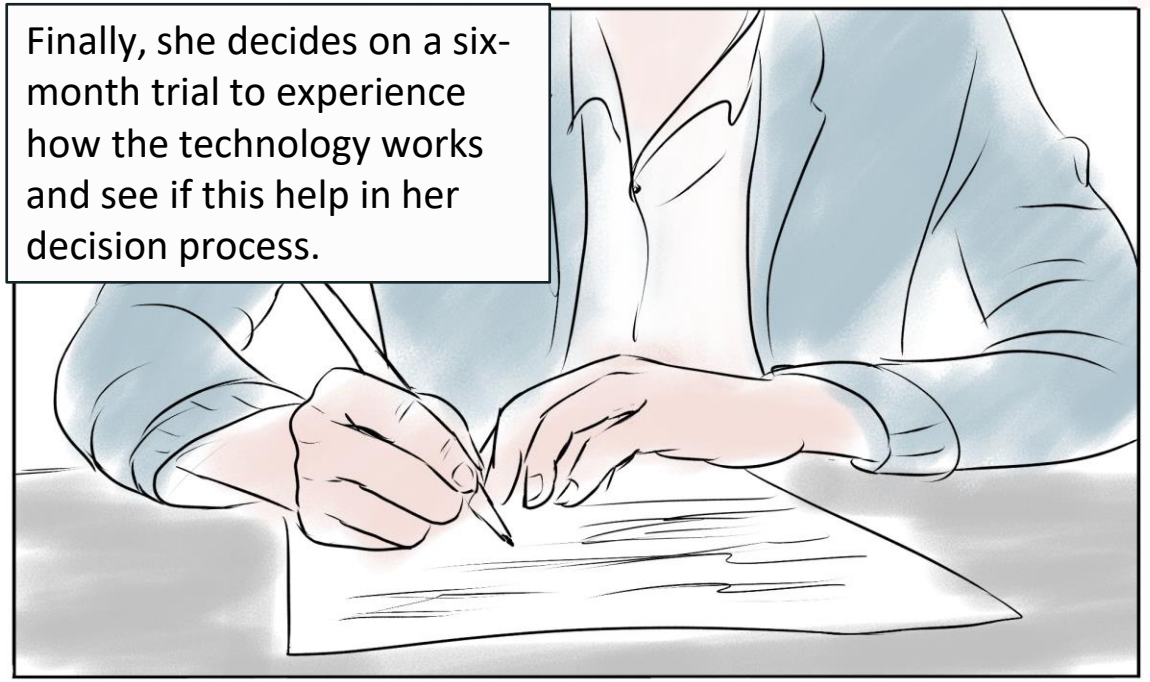
She weighs the long list of pros and cons, like time-saving, and the return on her investment.

Adding to the doubt, she now knows exactly what the animals need, and is afraid to lose that knowledge and insights on the wellbeing of the pigs if a tool replaces this.

And would the technology perhaps change the image of the farm towards its community, of no longer being artisan?



Finally, she decides on a six-month trial to experience how the technology works and see if this help in her decision process.



Further with…

Design part for the Farmer

Design part for the Farm advisor

Design part for the DATS provider

Design part for the Policy maker

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More information?

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