A choice experiment to assess dairy farmers' preferences for pesticide reduction : does work matter?

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Plan

Introduction

1- Litterature review

2- Method

3- Data

4- Results

Conclusion

Introduction

Introduction

Objective:
Pesticide use reduction by 50% in 2025
(MASA, 2022)

Several alternative practices to reduce pesticide use
(Aubertot et al., 2005; Butault et al., 2010; Charbonnier et al., 2015; Jacquet et al., 2022)

Impact on farmer's work
(Delecourt et al., 2019; Dedieu et Servière, 2012)

Livestock farms : a necessary pesticide use reduction to meet the Ecophyto plan objectives
(Tresch & Chartier, 2018)

Productivity increase leading to tensions on work
(Charroin et al., 2012; Depeyrot & Perrot, 2019; Hostiou et al., 2020; Nye, 2018; Peel et al., 2016).

Work : a limiting factor to the implementation of alternative practices to pesticide use?

Introduction

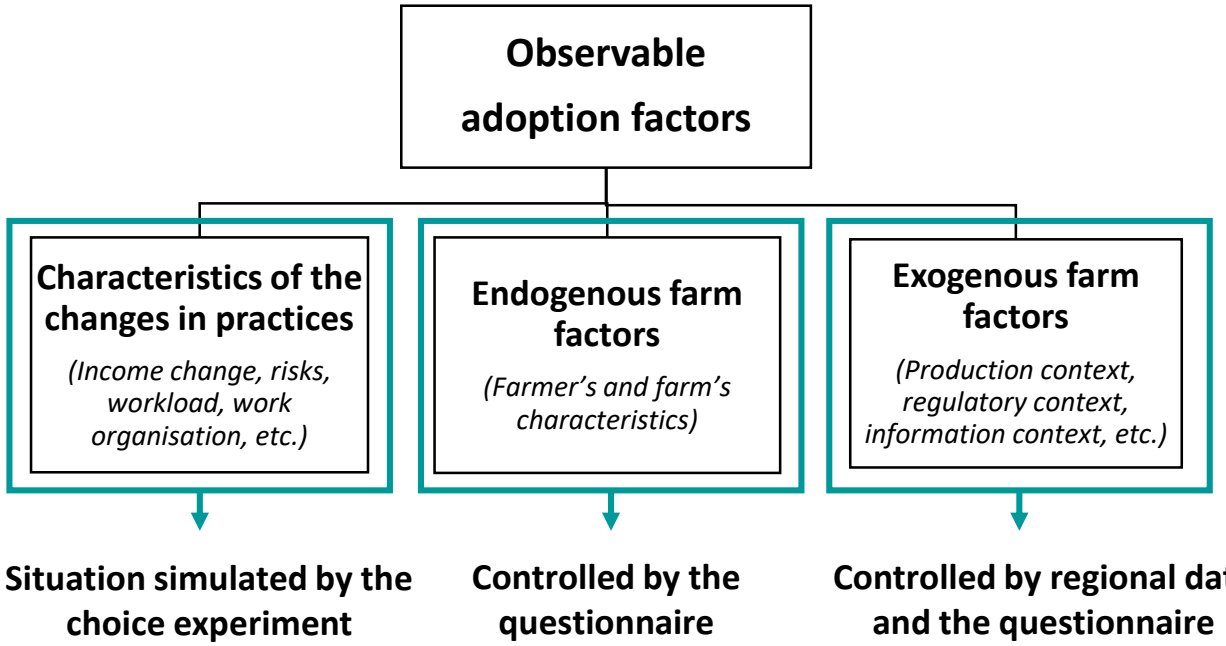
Work dimensions

- Work organization
- Skills and knowledge
- Mental workload

Introduction

To assess farmer's preferences towards pesticide reduction

- Role(s) played by « classical » determinants (profit, risks) ?
- Role(s) played by work dimensions ?



1- Litterature review

1 – Littérature review

❑ 15 papers selected and analysed

Studied attributes	Developed in literature	Implemented in our case
Reduction in pesticide use	• Percentage reduction in pesticide use (3/15) • Number of treatments (2/15) • Authorisation/authorisation under certain conditions/ban (4/15) • Specific alternative practices to pesticides (2/15) • Impact of pesticides on health (3/15)	**Percentage reduction in pesticide use**
Monetary attribute	• Subsidy or tax proposal (6/15) • Variation in the output or input price (6/15) • Change in income/profit/gross margin (3/15)	**Change in Gross Operating Surplus**
Work dimensions	• Skills and knowledge (6/15) • Work organisation **(3/15)** • Mental workload **(0/15)**	**One attribute for each of the three work dimensions**

(Bjørnåvold et al., 2022; Blazy et al., 2011; Chèze et al., 2020; Christensen et al., 2011; Danne et al., 2019; Enthoven & Van den Broeck, 2021; Jaeck & Lifran, 2014; Kuhfuss et al., 2016; Lapierre et al., 2023; Praneetvatakul et al., 2022; Ridier et al., 2021; Sanou et al., 2019; Van den Broeck et al., 2017; Vidogbéna et al., 2015; Zhu et al., 2022)

2- Method

2 – Method

Attributes	Levels	Expected effect on farmer's utility
1.Reduction in pesticide use on the farm	10% 30% 50% 70%	**?**
2.Change in Gross Operating Surplus on the farm	0€/1000l -30€/1000l +30€/1000l +60€/1000l	+
3.Risk of yield loss	0 year out of 10 1 year out of 10 2 years out of 10	–
4.Number of work peaks in the year	No change	**Ref.**
	Decrease in the number of work peaks	+
	Increase in the number of peaks with delegation or salaried employment	–
	Increase in the number of peaks without delegation or salaried employment	–
5.Knowledge/skills	Self-training	**Ref.**
	Individual specialized advice	**?**
	Collective learning in groups of farmers	**?**
6.Mental workload	No change	**Ref.**
	Less mental workload	+
	More mental workload	–

2 – Method

Caracteristics	Situation 1	Situation 2	Situation 3
1.Reduction in pesticide use on the farm	50% 	30% 	Neither of these two situations
2.Change in Gross Operating Surplus on the farm	+0 €/1000l 	+60 €/1000l 	
3.Risk of yield loss	2 years out of 10 	1 year out of 10 	
4.Number of work peaks in the year	No change 	Increase in the number of peaks without delegation or salaried employment 	
5.Knowledge/skills	Group coaching 	Self-training 	
6.Mental workload	No change 	Less mental workload 	

2 – Method

Questionnaire testing phase (N=10) - *December 2022*

Investigation phase – *January 2023 / August 2023*

A 5-part questionnaire

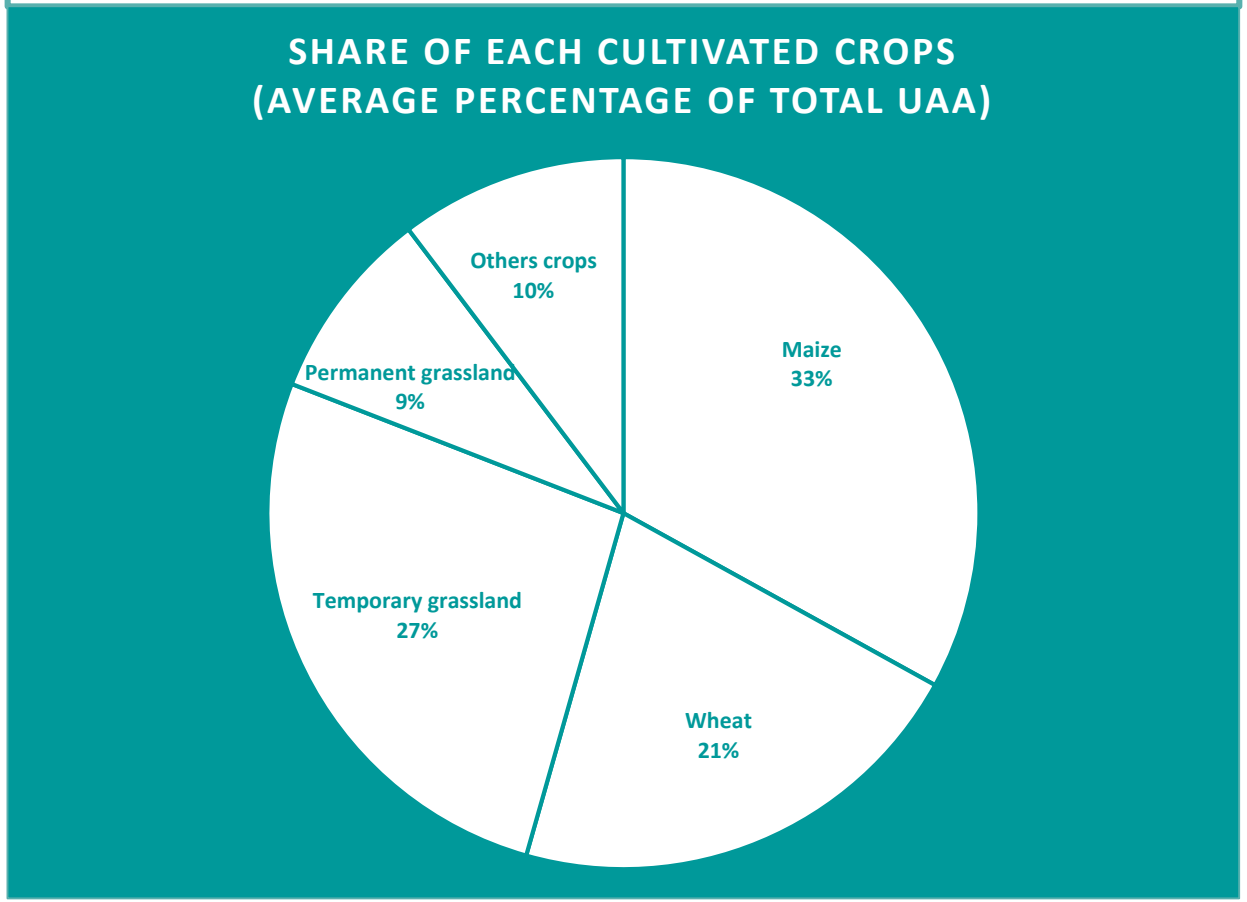
1. **General characteristics of the farm**
2. **Crop protection practices**
3. **Work on the farm**
4. **Discrete Choice Experiment**
5. **The respondent's projections, perceptions and attitudes**

3- Data

3 – Data

On average for our sample (N=94) :

- 125 ha of UAA
- 97 dairy cows
- 9 016 L per dairy cows per year



4- Results

4 – Results

$$U_{ijt} = CSA_{sq} + \alpha_i.PP_{jt} + \beta.\Delta GOS_{jt} + \gamma_i.Risk_{jt} + \delta_{1i}.Peaks1_{jt} + \delta_{2i}.Peaks2_{jt} + \delta_{3i}.Peaks3_{jt} + \eta_{1i}.KS1_{jt} + \eta_{2i}.KS2_{jt} + \mu_{1i}.M1_{jt} + \mu_{2i}.M2_{jt} + \varepsilon_{ijt}$$

t : Set
j : Alternative
i : Farmer

CSA_{sq} : Status quo alternative

PP : **1.Reduction in pesticide use on the farm**

ΔGOS : **2.Change in Gross Operating Surplus on the farm**

$Risk$: **3.Risk of yield loss**

4.Number of work peaks in the year

$Peaks1$: Decrease in the number of work peaks
$Peaks2$: Increase in the number of peaks with delegation or salaried employment
$Peaks3$: Increase in the number of peaks without delegation or salaried employment

5.Knowledge/skills

$KS1$: Individual specialized advice
$KS2$: Collective learning in groups of farmers

6.Mental workload

$M1$: Less mental workload
$M2$: More mental workload

4 – Results

Variables	Mixed logit model	
	Mean	SD
CSA statu quo	**-2,772** *** (0,649)	-
Reduction in pesticide use on the farm	-0,004 (0.008)	**0,0445** ** (0 .014)
Change in Gross Operating Surplus on the farm	**0,051** *** (0,013)	-
Risk of yield loss	**-0,519** ** (0,197)	**0,925** ** (0,355)
Decrease in the number of work peaks	0,061 (0,425)	**-1,639** **(0,591)
No change	Ref.	Ref.
Increase in the number of peaks with delegation or salaried employment	-0,612 (0,408)	**1,997** *** (0,59)
Increase in the number of peaks without delegation or salaried employment	**-2,208** ** (0,718)	**-1,497** * (0,641)
Self-training	Ref.	Ref.
Individual specialized advice	**0,784** + (0,458)	1,113 (0,742)
Collective learning in groups of farmers	**0,689** + (0,371)	**-1,287** ** (0,426)
Less mental workload	0,286 (0,312)	-0,751 (0.565)
No change	Ref.	Ref.
More mental workload	**-2,197** ** (0,690)	**-1,624** ** (0,585)
Log-Likelihood	-409,17	
Ajusted R^2	0,22	
AIC	858,35	
Nb. Of observations	1692	

*Significance levels: *** robust p-value <0,001, ** robust p-value <0,01, * robust p-value <0,05, + robust p-value<0,1*

Robust standard errors in parentheses

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4 – Results

Variables	Latent class model		
	Class 1	Class 2	Class 3
N	21	53	20
CSA statu quo	**-1,456 +** (0,746)	**-2,778 ***** (0,539)	-7,239 (4,468)
Reduction in pesticide use on the farm	-0,014 (0,009)	**0,012 +** (0,006)	**-0,131 *** (0,061)
Change in Gross Operating Surplus on the farm	**0,042 ***** (0,007)	**0,029 ***** (0,005)	**0,181 *** (0,080)
Risk of yield loss	**-1,050 ***** (0,291)	**-0,378 *** (0,158)	0,466 (0,808)
Decrease in the number of work peaks	0,138 (0,619)	-0,473 (0,384)	**4,260 +** (2,250)
No change	Ref	Ref	Ref
Increase in the number of peaks with delegation or salaried employment	-0,179 (0,790)	**-0,619 +** (0,353)	**-3,826 **** (1,457)
Increase in the number of peaks without delegation or salaried employment	**-2,047 *** (0,841)	**-1,155 **** (0,375)	**-7,147 *** (3,481)
Self-training	Ref.	Ref.	Ref.
Individual specialized advice	**-1,281 **** (0,497)	0,272 (0,273)	**10,403 **** (3,738)
Collective learning in groups of farmers	-0,624 (0,459)	0,074 (0,218)	**9,505 *** (4,300)
Less mental workload	0,498 (0,406)	-0,185 (0,230)	**4,317 ***** (1,091)
No change	Ref.	Ref.	Ref.
More mental workload	**-1,757 *** (0,689)	**-0,738 **** (0,246)	**-14,197 +** (7,426)
Delta	0,125 (0,390)	**0,935 *** (0,393)	0 NA (NA)
Log-Likelihood		-392,76	
Ajusted R^2		0,22	
AIC		855,51	
Nb. Of observations		1692	

*Significance levels: *** robust p-value <0.001, ** robust p-value <0.01, * robust p-value <0.05, + robust p-value<0,1*

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4 – Results

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Robust standard errors in parentheses.

Class 1	
• More dairy cows per hectare • More maize in the crop rotation • More people declare to use insecticide on maize • Less sensitive to environmental issues	Than class 2 and class 3

More intensive farms per hectare, with no preference for reducing pesticide use

4 – Results

Variables	Latent class model
	Class 2
N	53
CSA statu quo	**-2,778 *** (0,539)
Reduction in pesticide use on the farm	**0,012 +** (0,006)
Change in Gross Operating Surplus on the farm	**0,029 ***** (0,005)
Risk of yield loss	**-0,378 *** (0,158)
Decrease in the number of work peaks	-0,473 (0,384)
No change	Ref
Increase in the number of peaks with delegation or salaried employment	**-0,619 +** (0,353)
Increase in the number of peaks without delegation or salaried employment	**-1,155 ** ** (0,375)
Self-training	Ref.
Individual specialized advice	0,272 (0,273)
Collective learning in groups of farmers	0,074 (0,218)
Less mental workload	-0,185 (0,230)
No change	Ref.
More mental workload	**-0,738 ** ** (0,246)
Delta	**0,935 *** (0,393)

*Significance levels: *** robust p-value <0.001, ** robust p-value <0.01, * robust p-value <0.05, + robust p-value<0,1*

Robust standard errors in parentheses.

Class 2	
• Larger UAA • More people declare to use herbicide on temporary grassland	Than class 3
• 55% of farmers take part in groups “30,000”.	
• Perceive a reduction of more than 30% in pesticides as less risky	Than class 1

Farms volunteering to reduce their pesticide use

4 – Results

Variables	Latent class model
	Class 3
N	20
CSA statu quo	-7,239 (4,468)
Reduction in pesticide use on the farm	**-0,131 *** (0,061)
Change in Gross Operating Surplus on the farm	**0,181 *** (0,080)
Risk of yield loss	0,466 (0,808)
Decrease in the number of work peaks	**4,260 +** (2,250)
No change	Ref
Increase in the number of peaks with delegation or salaried employment	**-3,826 **** (1,457)
Increase in the number of peaks without delegation or salaried employment	**-7,147 *** (3,481)
Self-training	Ref.
Individual specialized advice	**10,403 **** (3,738)
Collective learning in groups of farmers	**9,505 *** (4,300)
Less mental workload	**4,317 ***** (1,091)
No change	Ref.
More mental workload	**-14,197 +** (7,426)
Delta	0 NA (NA)

*Significance levels: *** robust p-value <0.001, ** robust p-value <0.01, * robust p-value <0.05, + robust p-value<0,1*

Robust standard errors in parentheses.

Class 3	
• Less labelling • Lower wheat yields	Than class 1 and class 2
• Calls for more delegation if pesticides need to be reduced further • More alternative practices implemented • Difference in type of structure: more EARLs for class 3 and more GAECs for class 1	Than class 1

Farms that have already reduced their pesticide use and are finding it difficult to continue

Conclusion

Conclusion

- **The three work dimensions have an effect on the preferences of the farmers surveyed, but differently depending of their characteristics.**

- **2 levels to highlight :**
  - ✓ « Increase in the number of peaks without delegation or salaried employment »
  - ✓ « More mental workload »

A need for public policies to take action

- **Limits of our work**
- **Further work**

Thank you !

Any questions ?

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References

Aubertot, J.-N., Clerjeau, M., David, C., Debaeke, P., Jeuffroy, M.-H., Lucas, P., Monfort, F., Nicot, P., & Sauphanor, B. (2005). Stratégies de protection des cultures. In *Pesticides, agriculture et environnement—ESCO* (INRA, Cemagref, p. 104).

Bjørnåvold, A., David, M., Bohan, D. A., Gibert, C., Rousselle, J.-M., & Van Passel, S. (2022). Why does France not meet its pesticide reduction targets? Farmers' socio-economic trade-offs when adopting agro-ecological practices. *Ecological Economics*, *198*, 107440. https://doi.org/10.1016/j.ecolecon.2022.107440

Blazy, J.-M., Carpentier, A., & Thomas, A. (2011). The willingness to adopt agro-ecological innovations: Application of choice modelling to Caribbean banana planters. *Ecological Economics*, *72*, 140–150. https://doi.org/10.1016/j.ecolecon.2011.09.021

Butault, J.-P., Dedryver, C.-A., Gary, C., Guichard, L., Jacquet, F., Meynard, J. M., Nicot, P. C., Pitrat, M., Reau, R., Sauphanor, B., Savini, I., & Volay, T. (2010). *Écophyto R&D: quelles voies pour réduire l'usage des pesticides? Synthèse du rapport de l'étude* (p. 93) [Rapport technique]. Ministère de l'Ecologie, de l'Energie, du Développement Durable et de la Mer. https://hal.archives-ouvertes.fr/hal-01172967/document

Charbonnier, E., Ronceux, A., Carpentier, A.-S., Soubelet, H., & Barriuso, E. (2015). *Pesticides—Des impacts aux changements de pratiques*. éditions Quae.

Charroin, T., Veysset, P., Devienne, S., Fromont, J. L., Palazon, R., & Ferrand, M. (2012). Productivité du travail et économie en élevages d'herbivores: Définition des concepts, analyse et enjeux. *INRAE Productions Animales*, *25*(2), 193–210. https://doi.org/10.20870/productions-animales.2012.25.2.3208

Chèze, B., David, M., & Martinet, V. (2020). Understanding farmers' reluctance to reduce pesticide use: A choice experiment. *Ecological Economics*, *167*, 106349. https://doi.org/10.1016/j.ecolecon.2019.06.004

Christensen, T., Pedersen, A. B., Nielsen, H. O., Mørkbak, M. R., Hasler, B., & Denver, S. (2011). Determinants of farmers' willingness to participate in subsidy schemes for pesticide-free buffer zones—A choice experiment study. *Ecological Economics*, *70*(8), 1558–1564. https://doi.org/10.1016/j.ecolecon.2011.03.021

Danne, M., Musshoff, O., & Schulte, M. (2019). Analysing the importance of glyphosate as part of agricultural strategies: A discrete choice experiment. *Land Use Policy*, *86*, 189–207. https://doi.org/10.1016/j.landusepol.2019.04.023

Dedieu, B., & Serviere, G. (2012). Vingt ans de recherche-développement sur le travail en élevage: Acquis et perspectives. *INRAE Productions Animales*, *25*(2), 85–100. https://doi.org/10.20870/productions-animales.2012.25.2.3200

Delecourt, E., Joannon, A., & Meynard, J.-M. (2019). Work-related information needed by farmers for changing to sustainable cropping practices. *Agronomy for Sustainable Development*, *39*(2), 28. https://doi.org/10.1007/s13593-019-0571-5

Depeyrot, J.-N., & Perrot, C. (2019). *Actif'Agri chapitre 3—La filière laitière, un concentré des mutations agricoles contemporaines* (La Documentation Française, p. 49). Centre d'études et de prospective, Ministère de l'agriculture et de l'alimentation.

Enthoven, L., & Van den Broeck, G. (2021). Promoting Food Safety in Local Value Chains: The Case of Vegetables in Vietnam. *Sustainability*, *13*, 6902. https://doi.org/10.3390/su13126902

Hostiou, N., Vollet, D., Benoit, M., & Delfosse, C. (2020). Employment and farmers' work in European ruminant livestock farms: A review. *Journal of Rural Studies*, *74*, 223–234. https://doi.org/10.1016/j.jrurstud.2020.01.008

Jacquet, F., Jeuffroy, M.-H., Jouan, J., Le Cadre, E., Litrico, I., Malausa, T., Reboud, X., & Huyghe, C. (2022). Pesticide-free agriculture as a new paradigm for research. *Agronomy for Sustainable Development*, *42*(1), Article 1. https://doi.org/10.1007/s13593-021-00742-8

Jaeck, M., & Lifran, R. (2014). Farmers' Preferences for Production Practices: A Choice Experiment Study in the Rhone River Delta. *Journal of Agricultural Economics*, *65*(1), 112–130. https://doi.org/10.1111/1477-9552.12018

Kuhfuss, L., Préget, R., Thoyer, S., & Hanley, N. (2016). Nudging farmers to enrol land into agri-environmental schemes: The role of a collective bonus. *European Review of Agricultural Economics*, *43*(4), 609–636. https://doi.org/10.1093/erae/jbv031

Lapierre, M., Le Velly, G., Bougherara, D., Préget, R., & Sauquet, A. (2023). Designing agri-environmental schemes to cope with uncertainty. *Ecological Economics*, *203*, 107610. https://doi.org/10.1016/j.ecolecon.2022.107610

MASA. (2022). *Le plan Écophyto, qu'est-ce que c'est ?* [Site ministériel]. Ministère de l'Agriculture et de la Souveraineté alimentaire. https://agriculture.gouv.fr/le-plan-ecophyto-quest-ce-que-cest

Nye, C. (2018). The 'blind spot' of agricultural research: Labour flexibility, composition and worker availability in the South West of England. *Cahiers Agricultures*, *27*(3), 35002. https://doi.org/10.1051/cagri/2018018

Peel, D., Berry, H. L., & Schirmer, J. (2016). Farm exit intention and wellbeing: A study of Australian farmers. *Journal of Rural Studies*, *47*, 41–51.

Praneetvatakul, S., Vijitsrikamol, K., & Schreinemachers, P. (2022). Ecolabeling to Improve Product Quality and Reduce Environmental Impact: A Choice Experiment With Vegetable Farmers in Thailand. *Frontiers in Sustainable Food Systems*, *5*, 704233. https://doi.org/10.3389/fsufs.2021.704233

Ridier, A., Roussy, C., & Chaib, K. (2021). Adoption of crop diversification by specialized grain farmers in south-western France: Evidence from a choice-modelling experiment. *Review of Agricultural, Food and Environmental Studies*. https://doi.org/10.1007/s41130-021-00144-0

Sanou, E. I. R., Tur-Cardona, J., Vitale, J. D., Koulibaly, B., Gheysen, G., & Speelman, S. (2019). Farmers' Preferences for Cotton Cultivation Characteristics: A Discrete Choice Experiment in Burkina Faso. *Agronomy*, *9*, 841. https://doi.org/10.3390/agronomy9120841

Tresch, P., & Chartier, N. (2018). Quels systèmes de polyculture-élevage demain, face aux enjeux de réduction d'usage des produits phytosanitaires? *Fourrages*, *235*, 195–202.

Van den Broeck, G., Vlaeminck, P., Raymaekers, K., Vande Velde, K., Vranken, L., & Maertens, M. (2017). Rice farmers' preferences for fairtrade contracting in Benin: Evidence from a discrete choice experiment. *Journal of Cleaner Production*, *165*, 846–854. https://doi.org/10.1016/j.jclepro.2017.07.128

Vidogbéna, F., Adégbidi, A., Tossou, R., Assogba-Komlan, F., Ngouajio, M., Martin, T., Simon, S., Parrot, L., & Zander, K. K. (2015). Control of vegetable pests in Benin – Farmers' preferences for eco-friendly nets as an alternative to insecticides. *Journal of Environmental Management*, *147*, 95–107. https://doi.org/10.1016/j.jenvman.2014.09.010

Zhu, Z., Chen, Y., Ning, K., & Liu, Z. (2022). Policy setting, heterogeneous scale, and willingness to adopt green production behavior: Field evidence from cooperatives in China. *Environment, Development and Sustainability*. https://doi.org/10.1007/s10668-022-02773-x