

BEYOND THE FIELD: CONSUMER VALUATION OF VERTICALLY FARMED LETTUCE

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THE GLOBAL FOOD SYSTEM CHALLENGE

- ❑ Global population rising to 10.3 billion by mid-2080s (UN, 2024)
- ❑ Agriculture occupies ~1/3 of global land area (FAO, 2022)
- ❑ Conventional agricultural systems face significant limitations:
 - High GHG emissions
 - Environmental degradation
 - Resource inefficiency
 - Climate change
 - ...
- ❑ Also, there is a growing consumer demand for sustainable food systems

VERTICAL FARMING AS A TRANSFORMATIVE SOLUTION

- ❑ Vertical farming (VF) is a type of soilless farming system
- ❑ Controlled, multilayer indoor production system:
- ❑ Key advantages:
 - Higher productivity per land unit
 - Year-round, climate-independent production
 - Use of urban/non-arable spaces
 - Reduced land, water, pesticide use, etc.
- ❑ Drawbacks:
 - High capital investment
 - Relevant operational costs
 - High energy requirements (electricity)
- ❑ Market growth and investments



EUROPEAN & UK POLICY SUPPORT FOR VERTICAL FARMING



POLICY FRAMEWORK

- Circular Economy Action Plan
- Farm to Fork
- Food 2030
- European Green Deal
- UK Food Strategy



FUNDING & EXAMPLES

- Horizon Europe
- Different fundings agencies
- COMPANIES: PlantLab, V-FAST, etc.

**VF can be a strategic technology for sustainable, resilient
and urban food systems**

CRITICAL BOTTLENECK: CONSUMER ACCEPTANCE

- ❑ Early VF producers focused heavily on technological solutions and sustainability, while paying limited attention to consumer acceptance

"We were all so fascinated with the tech – tech, tech, tech – but we forgot the consumer" recalls 80 Acres Farms' Zelkind

- ❑ Small literature (e.g., Gilmour et al., 2019) on consumer preferences of VF:

- Valuation affected by intrinsic and extrinsic product features, socio-demographics, socio-cultural, and psychological factors
- VF perceived as “too artificial”
- VF perception is primarily influenced by prior knowledge of the technology and the importance placed on sustainability
- Few studies have examined consumer willingness to pay (WTP) for VF

AIM & RESEARCH QUESTIONS

- ❑ We investigate consumer WTP of VF lettuce in the United Kingdom, Spain, and Germany using a hypothetical choice experiment

- ❑ Research questions:
 - What is the consumer valuation of VF lettuce?
 - How do lettuce attributes, including production method, nutritional information, environmental labelling, and price, affect consumer WTP?
 - To what extent do consumers exhibit heterogeneous preferences for key lettuce attributes, and how are these preferences influenced by consumer characteristics?

EXPERIMENTAL DESIGN

- ❑ PRODUCT: fresh lettuce
- ❑ 2022: Online choice experiment (850 consumers) using Qualtrics
- ❑ Choice design, OOD: 12 choice sets per respondent

ATTRIBUTES	LEVELS	
Production method (PRODUCTION)	0: 'Conventional' 1: 'Vertical farming in factory buildings' 2: 'Vertical farming in grocery stores'	
Nutritional information (ANTIOX)	0: No information provided 1: 'With more antioxidants'	
Environmental labeling (ECOLABEL)	0: 	1: 
Price (PRICE)	4 price levels	

ECONOMETRIC ANALYSIS

- ❑ Mixed Logit (ML) model in WTP preference space:

$$U_{njt} = ASC + \beta_{1n}FACTORY_{njt} + \beta_{2n}GROCERY_{njt} + \beta_{3n}ANTIOX_{njt} + \\ \beta_{4n}ECOLABEL_{njt} + \beta_{5n}PRICE_{njt} + e_{njt}$$

- ❑ Latent Class Logit (LCL) model:

$$Prob_{jnt|s} = \frac{\exp(\mathbf{x}'_{ntj}\boldsymbol{\beta}_s)}{\sum_{j=1}^{jn} \exp(\mathbf{x}'_{ntj}\boldsymbol{\beta}_s)}$$

- ❑ Stata 19.5

RESULTS: MAIN EFFECTS – ESTIMATED MWTP

ATTRIBUTE	UNITED KINGDOM (N = 279)		SPAIN (N = 288)		GERMANY (N = 283)	
	mWTP (£/100g) (SE)	P-value	mWTP (€/100g) (SE)	P-value	mWTP (€/100g) (SE)	P-value
Factory	-0.19 (0.03)	0.00	-0.49 (0.07)	0.00	-0.70 (0.09)	0.00
Grocery	-0.17 (0.03)	0.00	-0.42 (0.06)	0.00	-0.62 (0.09)	0.00
Antiox	0.03 (0.02)	0.27	0.04 (0.02)	0.11	-0.03 (0.06)	0.59
Ecolabel	-0.18 (0.03)	0.00	-0.34 (0.05)	0.00	-0.89 (0.08)	0.00

Note: SE = standard error.

Note: mWTP = marginal willingness to pay.

RESULTS: LATENT CLASS ANALYSIS – UNITED KINGDOM

ATTRIBUTE	GROUP 1 “Environmentalists, Healthier & Light Traditionalists” (N = 131)		GROUP 2 “Strong Traditionalists & Economical” (N = 114)		GROUP 3 “Extreme Consumers” (N = 31)	
	Coefficient (SE)	P-value	Coefficient (SE)	P-value	Coefficient (SE)	P-value
Factory	-0.22 (0.10)	0.02	-0.73 (0.10)	0.00	-2.92 (0.66)	0.00
Grocery	-0.19 (0.10)	0.05	-0.72 (0.10)	0.00	-1.46 (0.45)	0.00
Antiox	0.33 (0.06)	0.00	-0.12 (0.07)	0.07	-1.24 (0.44)	0.01
Ecolabel	-0.65 (0.07)	0.00	-0.12 (0.07)	0.08	-1.31 (0.38)	0.00
Price	0.14 (0.37)	0.69	-5.96 (0.45)	0.00	-14.43 (1.63)	0.00
Optout	-4.09 (0.16)	0.00	-4.09 (0.16)	0.00	-4.09 (0.16)	0.00
COVARIATES						
Age	-0.06 (0.02)	0.00	-0.04 (0.18)	0.03	Reference group	
Hearing	0.32 (0.54)	0.56	0.27 (0.54)	0.62		
FTNS	-0.86 (0.34)	0.01	-0.68 (0.33)	0.04		
Environment	0.11 (0.19)	0.56	-0.36 (0.18)	0.05		

Note: SE = standard error.

RESULTS: LATENT CLASS ANALYSIS – SPAIN

ATTRIBUTE	GROUP 1 “Light Traditionalists, Healthier, Environmentalists & Economical consumers” (N = 220)		GROUP 2 “Strong Traditionalists, Environmentalists & Economical consumers” (N = 68)	
	Coefficient (SE)	P-value	Coefficient (SE)	P-value
Factory	-0.39 (0.06)	0.00	-3.72 (0.29)	0.00
Grocery	-0.32 (0.06)	0.00	-3.27 (0.24)	0.00
Antiox	0.11 (0.04)	0.01	0.05 (0.16)	0.76
Ecolabel	-0.25 (0.04)	0.00	-0.73 (0.15)	0.00
Price	-1.59 (0.24)	0.00	-5.23 (0.40)	0.00
Optout	-3.41 (0.14)	0.00	-3.41 (0.14)	0.00
COVARIATES				
Age	-0.05 (0.01)	0.00	Reference group	
Hearing	0.05 (0.31)	0.88		
FTNS	-0.71 (0.19)	0.00		
Environment	0.18 (0.11)	0.08		

Note: SE = standard error.

RESULTS: SEGMENTATION ANALYSIS – GERMANY

ATTRIBUTE	GROUP 1 “Strong Traditionalists, Environmentalists & Economical” (N = 55)		GROUP 2 “Traditionalists & Environmentalists” (N = 188)		GROUP 3 “Mild consumers” (N = 40)	
	Coefficient (SE)	P-value	Coefficient (SE)	P-value	Coefficient (SE)	P-value
Factory	-1.55 (0.14)	0.00	-0.87 (0.37)	0.02	-0.31 (0.07)	0.00
Grocery	-1.49 (0.13)	0.00	-0.77 (0.33)	0.02	-0.24 (0.08)	0.00
Antiox	-0.18 (0.10)	0.06	-0.30 (0.33)	0.36	0.04 (0.05)	0.43
Ecolabel	-0.63 (0.11)	0.00	-3.19 (0.41)	0.00	-0.29 (0.07)	0.00
Price	-2.13 (0.10)	0.00	0.47 (0.55)	0.40	-0.74 (0.08)	0.00
Optout	-3.60 (0.14)	0.00	-3.60 (0.14)	0.00	-3.60 (0.14)	0.00
COVARIATES						
Age	0.04 (0.10)	0.00	-0.03 (0.01)	0.05	Reference group	
Hearing	-0.07 (0.30)	0.81	-0.11 (0.39)	0.78		
FTNS	0.29 (0.16)	0.06	0.09 (0.22)	0.66		
Environment	-0.14 (0.10)	0.18	0.34 (0.15)	0.02		

Note: SE = standard error.

DISCUSSION & CONCLUSIONS

- ❑ Consumers, on average, prefer conventional soil-based lettuce labelled with Eco-Score A over VF lettuce
- ❑ Age and fear of new food technologies drive preferences, with effects varying across countries
 - Younger consumers and those who are less concerned about new food technologies are more likely to prefer VF lettuce in the UK and Spain
- ❑ Consumer preferences are diverse and not fully aligned with policy goals
- ❑ Strong heterogeneity in sustainability, environmental, and health preferences also across countries

SOME POLICY IMPLICATIONS

- ❑ VF can have a good potential to support sustainable diets, but stronger consumer engagement is needed, like branding, labeling, etc.
- ❑ Policy makers can support in different ways:
 - R&I policies should support consumer-oriented product development and market launches
 - Financial support needed for equipment, training, and high energy costs
 - Clear labelling regulations needed to help consumers distinguish VF from conventional lettuce similar to the organic labeling

**THANK YOU FOR YOUR
KIND ATTENTION!**

**Any question, suggestion, etc.
is welcome...**