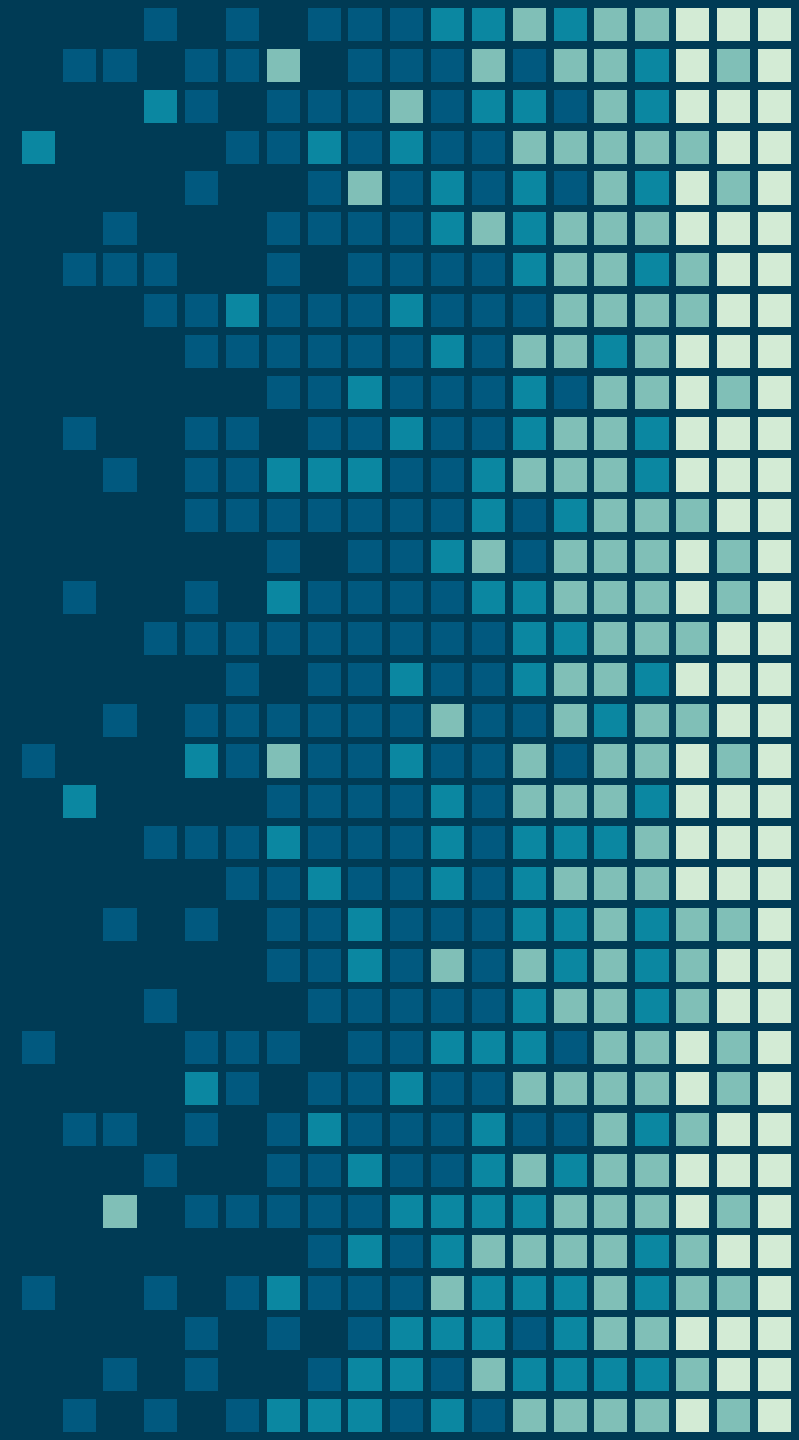


HI-FI BREAD

INCREASING THE FIBRE
CONTENT OF THE GREAT
WHITE BRITISH LOAF

MARCUS TINDALL



Transforming the UK wheat agri-food chain to deliver low cost fibre-rich white bread to consumers

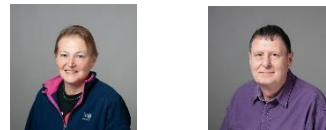
- White bread accounts for 76% of bread sold (~12 million loaves/day) in the UK.
- Only 10% of the UK population are estimated to consume the recommended 30g fibre/day with the average daily adult intake being 18g/day.
- Using high-fibre white flour developed at Rothamsted Research, which is suitable for growing in the UK, we will develop a fibre-rich white loaf, at no extra cost to consumers.
- We will:
 - combine consumer behaviour & food technology studies in collaboration with industry to develop the product; and
 - utilise behavioural economics and predictive mathematical modelling to inform and guide UK wheat chain transformations, accounting for seasonal weather and longer term climate change, land usage, imports and environmental impact.

Product Development



Consumer Behaviour

(Daniele Asioli, Giuseppe Nocella & Vilma Xhakollari, Reading)



Wheat & Flour

(Alison Lovegrove & Peter Shewry, Rothamsted)



Food Technology

(Julia Rodriguez Garcia, Stella Lignou, Victoria Norton & Carol Wagstaff, Reading)



Wheat Chain Behaviour & Modelling



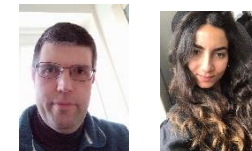
Within Chain Behaviour

(Sophie Clot & Omotuyole Ambali, Reading)



Climate-Crop Modelling

(Andy Challinor & Sachindra Dhanapala Arachchige, Leeds)



Wheat Chain Modelling

(Marcus Tindall & Katerina Christou, Reading)



Land Use & Environmental

Impact Modelling

(John Hammond, Eugene Mohareb, Michelle Felton & Richard Tranter, Reading)



PRODUCT DEVELOPMENT

Consumer Behaviour

- Literature review on consumers' preferences for bread (scientific and market research database).
- Consumers do not want to give up on taste.
- Questionnaire for consumer preferences and willingness to pay for Hi-Fi white bread developed with stakeholder input.
- Qualtrics online questionnaire piloted summer 2023.
- Qualtrics data collection Sept/Oct 2023 (2414 participants with 921 responses).
- Some initial results – Likely UK regional variation in demand for Hi-Fi Bread.
- Publication preparation underway.

PRODUCT DEVELOPMENT

Food Technology



- Selected **10** wheat lines varying in fibre content for baking. Based on initial results identified **five** lines for further analyses.
- Lines look to increase arabinoxylan content – key cell wall polysaccharide, which increases fibre content.
- Breadmaking (via Chorleywood Breadmaking Process)
- Bread properties tested (e.g., shelf-life, texture, cell crumb, water activity, moisture content, etc.).
- Sensory profiling (evaluated 27 attributes) with trained panelists.
- Community focus groups undertaken in collaboration with FoodSEqual Transforming UK Food Systems project.



ROTHAMSTED
RESEARCH



University of
Reading

PRODUCT DEVELOPMENT

Food Technology

- Some initial results – Sensory results promising. One of the fibre-rich lines most preferred by consumers, but more insight needed.
- Publications from sensory profiling and focus groups in preparation.
- Wheat lines for 2024 now harvested.
- Wheat lines for 2025 now planted.

UK WHEAT SUPPLY CHAIN

Within Chain Behaviour

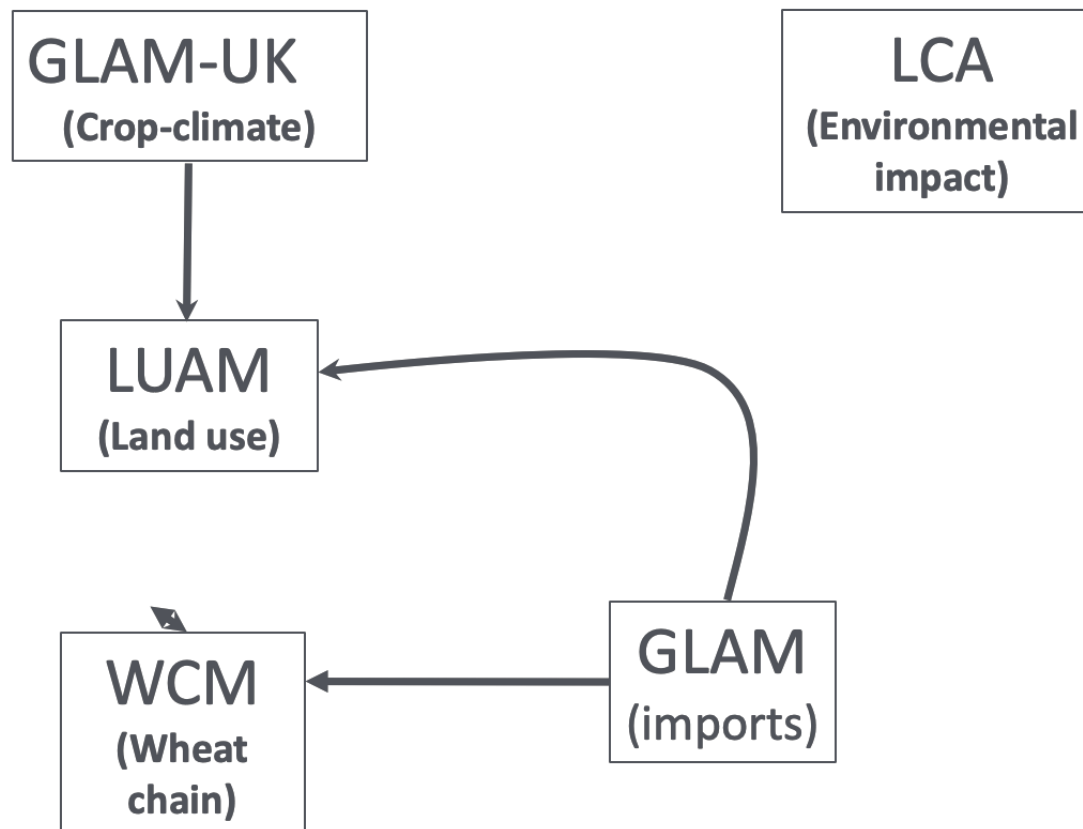
- Choice experiment questionnaire focusing on industry willingness in providing Hi-Fi white bread.
- Questionnaire pretested at University of Reading in March & April 2023.
- Questionnaire started May 2023 in-person.
- Moved online shortly afterwards to support recruitment.
- England Marketing brought on board to support sourcing responses from farmers.
- Data collection completed November 2023.
- Some initial results – Positive view of Hi-Fi bread, with grain attributes and sustainability being two important factors for uptake.
- Publication being drafted.

UK WHEAT SUPPLY CHAIN

Modelling – Systems Approach

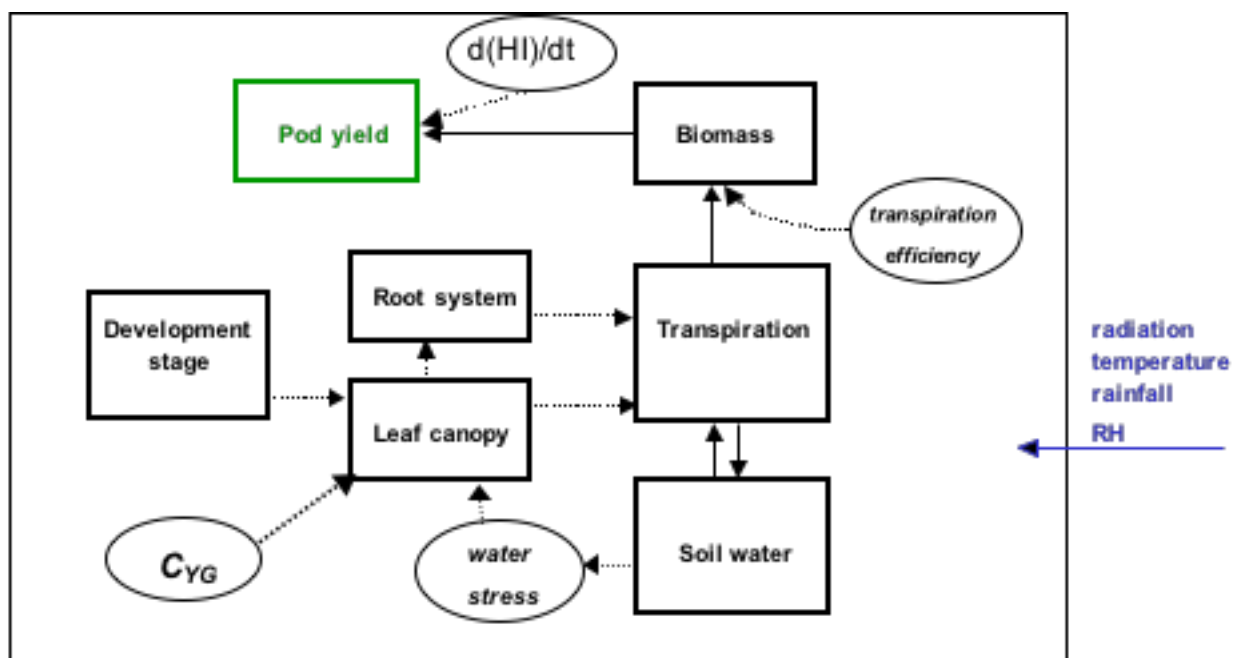
- The modelling aspect of the project looks to provide predictive model simulations to support transformational change.
- Integrated model simulations will account for:
 - Wheat yield in the context of a changing climate (50 yrs);
 - Land use area allocation for growing the high-fibre white wheat in the UK;
 - Balancing demands for (normal) white flour whilst transforming to high-fibre white flour, accounting for domestic needs and production and imports; and
 - Examining the environmental impact of moving to high-fibre white flour production.
- To achieve this we need to integrate three different modelling approaches, utilising a fourth to inform the environmental impact.

UK WHEAT SUPPLY CHAIN



UK WHEAT SUPPLY CHAIN

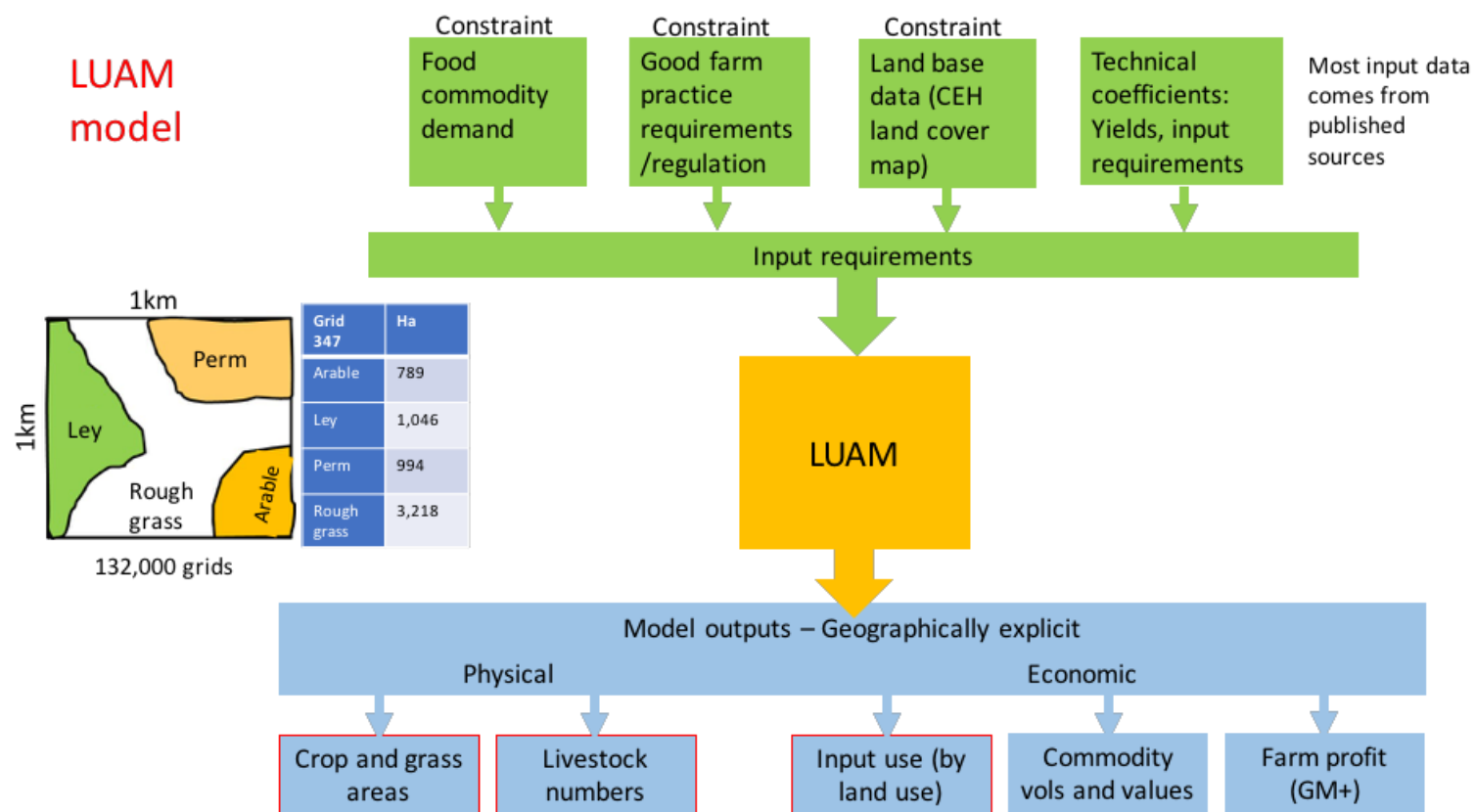
GENERAL LARGE AREA MODEL FOR ANNUAL CROPS (GLAM)



Relatively simple => adaptable to other annual crops or climate change adaptation scenario

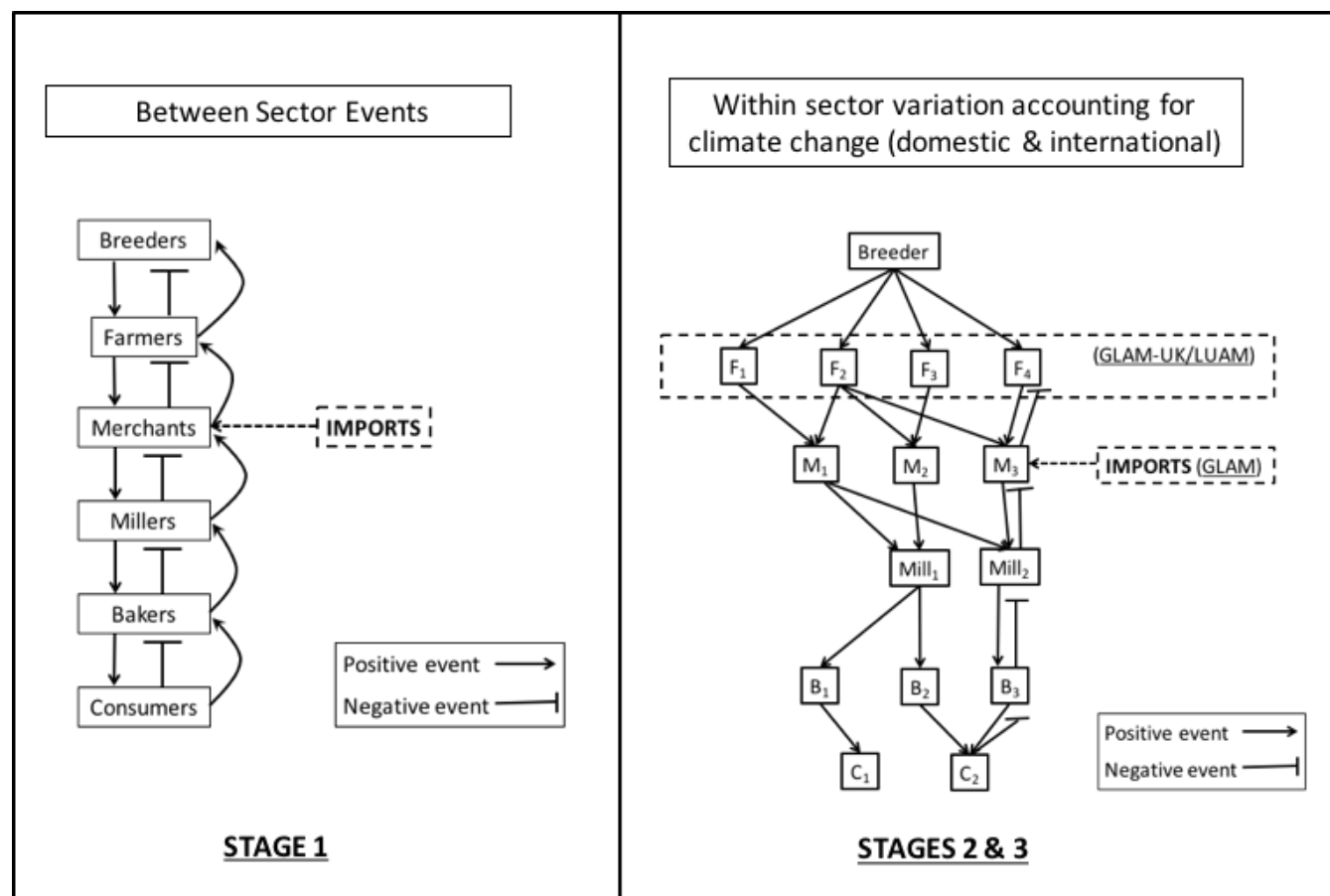
UK WHEAT SUPPLY CHAIN

LAND USE AREA MODEL (LUAM)



UK WHEAT SUPPLY CHAIN

WHEAT CHAIN MODEL (WCM)

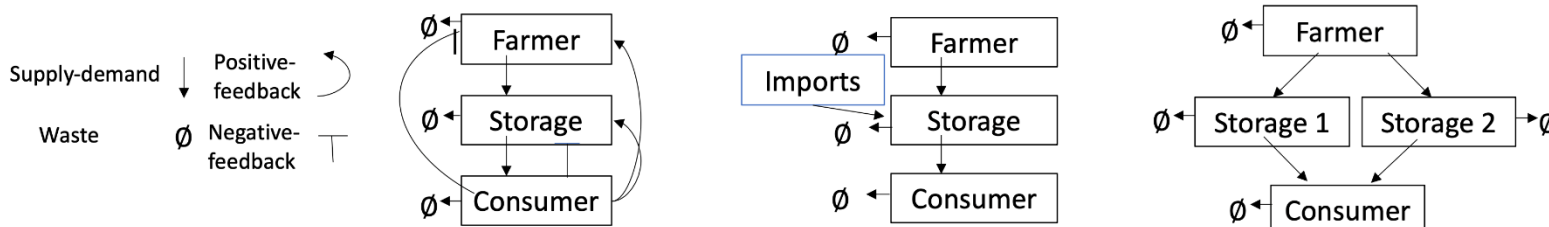


UK WHEAT SUPPLY CHAIN

Climate-crop modelling (GLAM Parti)

- Development of crop climate modelling (General Large Area Model (GLAM) Parti) to predict UK wheat yields under different climate scenarios.
- Combines remote sensing, machine learning and process knowledge for UK wheat yields coupled with climate data.

Wheat Chain Model (WCM)



- Models provide qualitative and quantitative insight into the states of supply each system has, conditions under which certain behaviour (e.g. bullwhip like oscillations occur) and how these can be removed (e.g. through rationing) and the role of seasonality and imports on the system states.



UK WHEAT SUPPLY CHAIN

Environmental (LCA) & Land use area modelling (LUAM).

- LCA data collection and process understanding for UK white bread currently underway in collaboration with stakeholders.
- LUAM working group established at Reading with other TUKFS projects.
- Data collection for parameterising LUAM for various wheat types underway.

Next Steps

- Consumer bread evaluation at Reading and in-store with ASDA of the high-fibre white bread.
- Model scenario development and testing for informing transformation.

Outputs

- Poster presentation on Consumer Behaviour Study at the Italian Association of Agricultural and Applied Economics (AIEEA) conference in June 2023.
- Talk presentation “Hi-Fi Bread – The case for the great white British loaf: Sensory and physical properties insights from year one”, Early Career Researcher Transforming UK Food Systems (TUKFS) conference, October 2023.

Related work

- Food4Years Network (BBSRC & MRC) Pump Priming award with TUKFS Raising the Pulse project on older adult dietary fibre preferences and the role of educational materials.

Norton V, Lovegrove JA, Tindall MJ, Rodriguez Garcia J & Lignou S (2024). Fibre4life: Investigating older adults dietary fibre preferences and the role of targeted educational materials on modulating future dietary fibre intake, *Appetite*, 192, 107109.