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# MARKETING PATTERNS OF GENETICALLY MODIFIED FOOD IN DUTCH GROCERY STORES

ONAFHANKELIJKE WETENSCHAPPELIJKE ADVISERING EN SIGNALERING VAN DE RIJKSOVERHEID

Research Report

# *Ontwikkelingen rond gg-voedsel in de Nederlandse winkelschappen*

# *Marketing Patterns of Genetically Modified Food in Dutch Grocery Stores*

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**Samenvatting**

De Russische invasie in de Oekraïne zorgde voor ernstige onzekerheden op de mondiale voedselmarkten. Een van de belangrijkste effecten van deze onzekerheden waren de scherpe prijsstijgingen op de wereldmarkt begin 2022. In een dergelijke omgeving zouden supermarkten gestimuleerd kunnen worden om het aandeel voedsel dat genetisch gemodificeerde (gg) ingrediënten bevat te vergroten, aangezien de productiekosten van de onderliggende agrarische grondstoffen lager zijn dan bij conventioneel geproduceerde gewassen. Daarom is voor dit onderzoeksproject data verzameld over marketingpatronen van voedingsproducten die genetisch gemodificeerde ingrediënten bevatten. De data is verzameld door middel van een uitgebreide en regionaal evenwichtige steekproef van twintig supermarkten in Nederland. Deze winkels zijn van november 2022 tot en met juli 2023 vijf keer bezocht om een landelijk representatief beeld te krijgen van de structuur en de veranderingen in de aantallen genetisch gemodificeerde voedingsproducten die aan retailklanten worden aangeboden.

Uit de analyse blijkt dat de mondiale prijzen van agrarische grondstoffen sinds de totstandkoming van de Zwarte Zee Graan Deal in juli 2022 een stabiele neerwaartse trend vertonen. Tegelijkertijd is de inflatie van de voedselprijzen in Nederland versneld en vertoont deze een stabiele opwaartse trend. Noch de voortdurende neerwaartse trend van de mondiale landbouwprijzen, noch de voortdurende opwaartse trend van de nationale voedselprijsinflatie heeft geleid tot substantiële veranderingen in het aantal genetisch gemodificeerde voedselproducten dat in de Nederlandse schappen wordt aangeboden.

Foodretailproducten met genetisch gemodificeerde ingrediënten spelen een marginale rol in de productportfolio's van Nederlandse supermarkten en laten nauwelijks veranderingen zien tussen november 2022 en juli 2023. Voor vier van de zes productcategorieën (meel, mayonaise, margarine en maïs & soja) zijn geen producten met genetisch gemodificeerde ingrediënten gevonden. Voor bakoliën & plantaardige vetten is het aandeel stabiel en lager dan 1% van alle producten die in deze categorie op de markt worden gebracht. Alleen voor snoep, koekjes & chips ligt dit aandeel dicht bij de 1% en vertoonde op korte termijn tijdens de analyseperiode kleine variaties.

Of producten in de supermarkt al dan niet geëtiketteerd zijn met ‘bevat genetisch gemodificeerde ingrediënten’, blijkt op vanuit het perspectief van de supermarkt niet van belang. Supermarktleiders melden dat zij nauwelijks vragen van klanten ontvangen over dit soort voedsel en dat het in hun dagelijkse werkzaamheden nauwelijks een rol speelt. Uit de analyse komen twee groepen supermarkten naar voren: een groep waarvan de leiding er zeker van is dat ze gg-vrij zijn, en een groep die zich grotendeels niet bewust is van de vraag of genetisch gemodificeerd voedsel tot het productportfolio van hun winkel behoort.

**Abstract**

The Russian invasion of Ukraine created severe uncertainties for global food markets. One of the major effects of these uncertainties were steep world market price increases in early 2022. In such an environment, supermarkets might be incentivized to increase the share of food contained genetically modified (GM) ingredients as production costs of the underlying agricultural raw products or commodities are lower than for conventionally produced crops. Hence, this research project collected data on marketing patterns of retail food products containing genetically modified ingredients from a comprehensive and regionally representative sample of 20 supermarkets in The Netherlands. These retail stores have been surveyed five times from November 2022 to July 2023 in order to obtain a nationally representative picture on the structure and the changes in the incidences of genetically modified food products offered in grocery stores to retail customers.

The analysis finds that global agricultural raw product prices have been showing a stable downward trend since the establishment of the Black Sea Grain Deal in July 2022. At the same time, food price inflation within the Netherlands has accelerated and has been showing a stable upward trend. Neither the continuous downward trend of global agricultural prices nor the continuous upward trend of national food retail price inflation led to substantial changes in the incidences of food GM products offered by Dutch supermarkets.

Food retail commodities containing genetically modified ingredients are found to play a marginal role in the product portfolios of Dutch supermarkets and marginally varied between November 2022 and July 2023. For four of the six product categories (i.e. flours, mayonnaises, margarines and corn & soy) no food products with genetically modified ingredients have been found. For baking oils & vegetable fats the share is stable and below 1% of all products marketed in this category. Only for sweets, biscuits & chips this share gets close to 1% and showed minor variations in the short run during the analysis period.

At retail level, food which is labelled to contain genetically modified ingredients appears to be a non-issue from supermarket perspective. Supermarket leaderships report that they barely receive any customer questions about this type of food and that it barely plays any role in their daily activities, suggesting that for customers it is a non-issue as well. The analysis reveals two groups of supermarkets those whose leadership are sure that they are GM-free and those who are largely unaware of whether GM food belongs to the product portfolio of their store.

**Voorwoord**

Het voorliggende onderzoeksrapport van dr. R. Ihle e.a. is tot stand gekomen naar aanleiding van de uitwerking van een onderzoeksoproep van de Commissie Genetische Modificatie (COGEM). In de oproep met als titel “ontwikkelingen gg-voedsel in winkelschappen” is gevraagd om onderzoeksvoorstellen in te dienen gericht op het vaststellen van het voorkomen van gg-voedsel (voedingsmiddelen waarin genetisch gemodificeerde bestanddelen voorkomen) en die aanwezig zijn in de schappen van supermarktketens in Nederland. Daaraan werd de vraag gekoppeld of de extreme prijsstijging van voedingsgrondstoffen na de inval van Rusland in Oekraïne van invloed is op de introductie van gg-voedsel in winkelschappen.

De COGEM beoogde met genoemde onderzoeksoproep een beter inzicht te krijgen in de dynamiek rond het verwerken van gg-voedsel in voedingsproducten in de Nederlandse winkelschappen. Een geactualiseerd inzicht levert de COGEM mogelijk een beter begrip op over de dynamiek in de markt rond gg-voedsel en kan als aanvulling worden gezien op eerdere inventariserende steekproeven die in het verleden zijn uitgevoerd.

Het uitzetten van onderzoek door de COGEM vindt veelvuldig plaats en gaat procedureel samen met het instellen van een begeleidingscommissie vanuit diezelfde COGEM. Niet om inhoudelijk het onderzoek te beïnvloeden –dit is de uitdrukkelijke verantwoordelijkheid van de onderzoeksgroep van in dit geval dr. R. Ihle– maar meer om het algemene belang van de COGEM tijdens het onderzoek te bewaken. De begeleidingscommissie is in totaal 5x fysiek bijeengeweest met de onderzoeksleider. E.e.a. heeft geresulteerd in een helder onderzoeksrapport, dat mogelijkerwijze aanzet tot uitgebreider onderzoek naar de drijfveren achter het introduceren van gg-voedsel in de supermarktketen.

De begeleidingscommissie bestond uit:
- Drs. Hans van den Berg (COGEM lid)
- Dr. Lucien Hanssen (COGEM lid)
- Dr. Ir. Annemarie Breukers (TKI Agri & Food)
- Lotte Bronswijk (VWS)
- Dr. Lisette van der Knaap (COGEM secretariaat)

Drs. H. van den Berg
Voorzitter begeleidingscommissie

**Preface**

The present research report by Dr. R. Ihle et al. was drawn up following the elaboration of a research call from the Committee on Genetic Modification (COGEM). The call entitled “Developments of GM food on store shelves” asked for research proposals to be submitted aimed at determining the occurrence of GM foods (foods containing genetically modified ingredients) that are present on the shelves of supermarket chains in The Netherlands. This was linked to the question of whether the extreme price increase of food raw materials after Russia's invasion of Ukraine will influence the introduction of GM food on store shelves.

With the aforementioned research call, COGEM aimed to gain a better insight into the dynamics surrounding the processing of GM food in food products on Dutch store shelves. An updated insight may provide COGEM with a better understanding of the dynamics in the market surrounding GM food and can be seen as a supplement to previous inventory samples that were carried out in the past.

Research is carried out frequently by COGEM and is procedurally accompanied by the establishment of an advisory board from COGEM. Not to influence the content of the research – this is the explicit responsibility of the research group of, in this case, Dr. R. Ihle – but more to safeguard the general interests of COGEM during the research. The advisory board met physically with the research leader a total of 5 times. The research has resulted in a clear research report, which may encourage more extensive research into the drivers behind the introduction of GM food in Dutch supermarket chains.

The advisory board consisted of:
- Drs. Hans van den Berg (COGEM member)
- Dr. Lucien Hanssen (COGEM member)
- Dr. Ir. Annemarie Breukers (TKI Agri & Food)
- Lotte Bronswijk (VWS)
- Dr. Lisette van der Knaap (COGEM secretariat)

Drs. H. van den Berg
Chairman of the advisory board

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# 1 Background and motivation of the analysis

Farmers have been growing genetically modified (GM, *genetisch gemodificeerde*) crops[1] since the 1990s (U.S. Food & Drug Administration, 2023a; USDA, 2023a). The cultivation, trade and processing of such crops to mostly human food and animal feed has continuously gained importance in the global food system (FAO, 2022b) while "*Non-GMO is one of the fastest growing claims in the U.S. food industry*" (Cargill, 2016). Many countries pursue restrictive policies so that GM crops are allowed to be grown in only a few countries worldwide (GMO Answers, 2023a). Soybeans, maize, cotton, canola and alfalfa are the crops of which sizable quantities of GM varieties are grown at global level (GMO Answers, 2023a; USDA, 2023b; Organic Hawaii, 2019). Consequences of producing GM crops for the environment, farm businesses, food safety etc. are being continuously monitored and reported by, e.g., EFSA (2023), U.S. Food & Drug Administration (2023b), USDA (2023c) as well as critically assessed by scientific analyses such as Chvátalová (2021), Ichim (2020) or Brookes and Barfoot (2012, 2018).

GM crops have been reported to have two major effects for farmers, namely resulting in higher yields and lower production costs (GMO Answers, 2023a; GMO Answers, 2023b; American Council and Science and Health, 2021; EuropaBio, 2017). Anecdotal evidence (GMO Answers, 2023b; American Council and Science and Health, 2021; Alliance for Science, 2020; EuropaBio, 2017) suggests that these lower production costs are being passed through food supply chains to the prices consumers are facing in groceries so that consumers could profit from cheaper prices for food commodities which contain sizable shares of ingredients which have been obtained from GM crops.

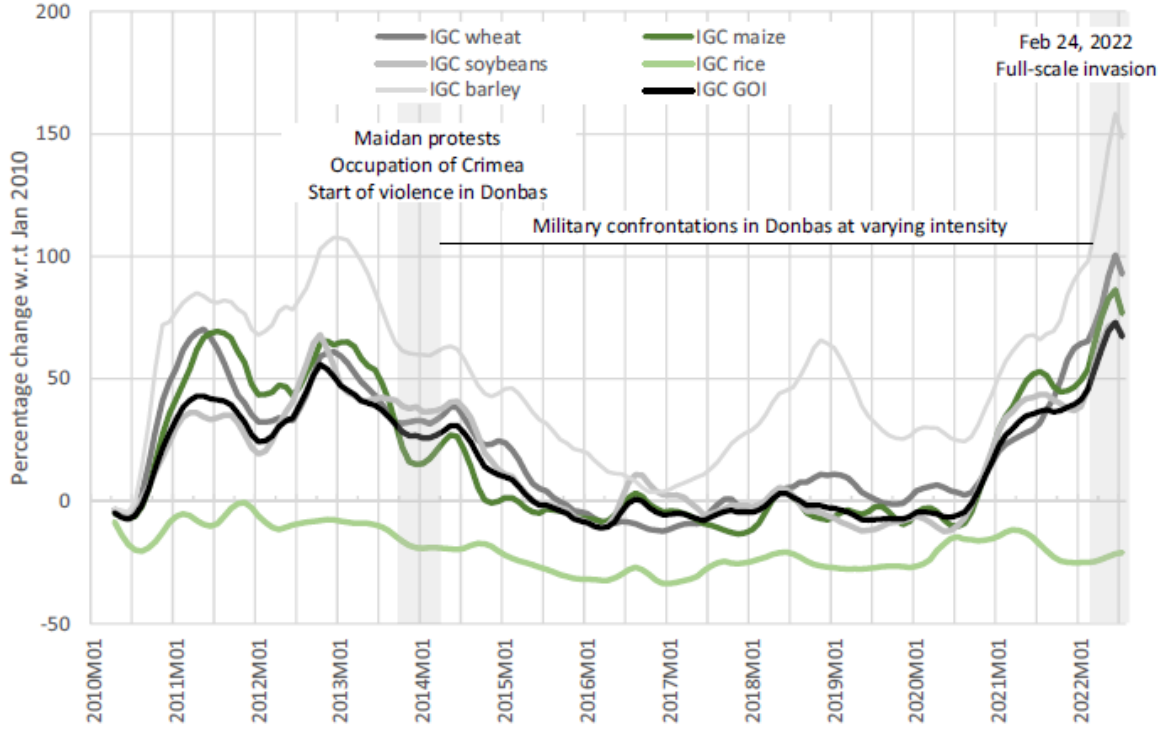
Rigorous scientific analyses proving to what extent this is indeed the case across countries and economic contexts are scarce. Brookes et al. (2010) and GMO Answers (2023c) find that world market prices of corn, soybeans, canola and related cereals and oilseeds would have been 3 to 10% higher in 2007 if no GM varieties would have been grown of these three crops. Analyses at retail price level have been largely focusing on estimating the additional costs consumers need to pay for GM-free brands in comparison to brands which are partly based on GM agricultural raw products. Goodwin et al. (2016) are the first to estimate the effect of the price premium to be paid by consumers in the U.S. for a completely GM-free diet. They find that the higher purchase costs for exclusively non-GM food at retail level would result in an increase of the average annual family food budget of about 28%. Kalaitzandonakes et al. (2018) find that US consumers have been paying price premiums of 10 to 62% for selected GM-free food retail commodities. Some of these expenditure savings might be forgone if companies need to incur additional costs for labelling GM food (Li and Basu, 2020; McCluskey et al., 2018). Fan et al. (2022) find that the introduction of GM-labelled food shifted demand at modest magnitudes from GM to GM-free brands.

At the same time, the massive geopolitical shock taking place in Eastern Europe since early 2022 has been profoundly challenging the affordability of staple food and energy around the globe. The invasion of Ukraine by the Russian Federation which started on 24 February 2022 has created substantial uncertainties and a number of major challenges for global food and

[1] This report refers to GM food products and the respective labelling rules as being applied in the EU (for details see, e.g., European Commission, 2013, 2023a, 2023b, 2023c or Wesseler et al., 2023). Hence, the analysis does not include all food or feed products derived from GM crops but only those beyond the labelling threshold.

non-food commodity markets (FAO, 2022a; Ihle et al., 2022). These unforeseen extreme developments have, among other implications, resulted in global food prices which rose exceptionally sharply and synchronously (Ihle et al., 2022) in the months following this military escalation - as visible in Figure 1 - so that leading international organizations have alerted world leaders and the international community by calling them "*a global commodity shock without parallel*" (World Bank, 2022c) as "*The year-on-year increase in food prices is now at its fastest this century*" (The Economist, 2022). This was because Ukraine and Russia had become major exporters of staple grains, sunflower seeds and oil, sugar beets and canola in recent decades (FAO, 2022a; World Bank, 2022b), that is, major players in global grain, oilseeds and energy markets (World Bank, 2022b).

Figure 1: Effect of the invasion of Ukraine on main global grain price indices




Source: Ihle et al. (2022).
Notes: “IGC” denotes the global price index of the respective commodity as calculated by the International Grains Council (IGC, 2023). The price series are normalized in a way so that their starting values in Jan 2010 are zero. Each line shows, hence, the percentage deviation from the reference price level in that benchmark month (on the y-axis). For example, 50 means that it is 50% higher than in this benchmark month. The x-axis shows the months, e.g., 2014M01 means January 2014.

The unprecedented disruptions of international food supply chains (Ihle et al., 2022) caused by the military escalation had led, especially in the first half of 2022, to much higher prices for agricultural products traded on world markets. World market prices of grains and oilseeds rose within a few weeks to levels which were 70% to 150% higher than in early 2020 (Figure 1). As a consequence, the FAO food price index (FAO, 2023a) reached record levels in early 2022 (UN, 2023a). The high world market prices for grains and vegetable oils have been reported to threaten food security challenges especially in developing countries. However, also the European Council (2023) emphasizes that "*Affordability is a top concern for EU leaders, particularly with regard to low-income and vulnerable groups, which are affected most.*" as food price inflation has continuously risen throughout the EU (Eurostat, 2023a).

Figure 3 shows that the development of food retail price inflation in the Netherlands followed this general pattern.

This unique combination of developments at the global scale in the form of sharply rising world market prices of key agricultural raw commodities and an internationally growing segment of GM-based food - which can offer retail clients some price advantage over GM-free brands (EuropaBio, 2017) - might lead supermarket chains to increase the shares of food brands in their portfolios which contain GM ingredients as consumers adapt their purchasing behaviour (AGF.nl, 2022; Business Insider Nederland 2022; De Nederlandsche Bank, 2022; De Volkskrant, 2022). This raises three questions which are central from the perspective of food consumers. First, to what extent did inflation of retail food prices in the Netherlands follow the trajectories of global agricultural raw commodity prices? Second, have the marketing patterns of processed foods at retail level – which contain more than 0.9% of ingredients derived from GM crop varieties and, thus, need to be labelled inside the EU (European Commission, 2023b) – experienced a substantial change due to that major global food (and energy) affordability crisis? Third, what are the considerations of supermarket managements concerning offering GM-labelled food to customers?

This project hence investigated how prices of agricultural commodities traded on world markets – and being the basic ingredients for producing any kind of (more or less) processed foods[2] (Monteiro et al., 2016) which account for the largest parts of supermarket portfolios – on the one hand and retail food price inflation in the Netherlands on the other have developed since the start of this food affordability crisis in February 2022. Its main focus lay on assessing whether the incidences of GM-labelled food brands offered by Dutch supermarkets to consumers followed the same trends as domestic food price inflation and global agricultural prices did. In particular, this research project gathered and analysed representative and reproducible data for investigating whether the numbers of GM-labelled products in the portfolios of Dutch supermarkets[3] have shown an enduringly increasing trend due to the crisis. Furthermore, the underlying considerations of food retailers in favour of or against offering GM-labelled food to consumers have been surveyed and assessed.

# 2 Research objectives

Based on the developments of global agricultural prices and national retail food prices since the start of the Russian invasion of Ukraine and the potential increased marketing of GM-labelled food in grocery stores has for easing these shocks to food affordability, i.e., to consumers' pockets, econometrically measured by Ihle et al. (2022), this report answers the following research objectives for the period from February 2022 to July 2023:

*Objective O1a* How have the world markets prices of the most important agricultural commodities developed?

*Objective O1b* How have food retail prices in the Netherlands developed?

[2] As GM varieties of fruits and vegetables are currently barely existing nor are they being cultivated (Lobato-Gómez et al., 2021; U.S. Food & Drug Administration, 2022; ISAAA, 2024) and only a single GM crop is approved in the EU (EuropaBio, 2017, p. 47), all fresh fruits and vegetables marketed in the EU are non-GM.

[3] This only covers the changes in a part of the use of GMOs in food production as not all food products containing GM ingredients are required to be labelled such as animal products derived from GM feed (Castellari et al., 2018) as shown in Figure 2.

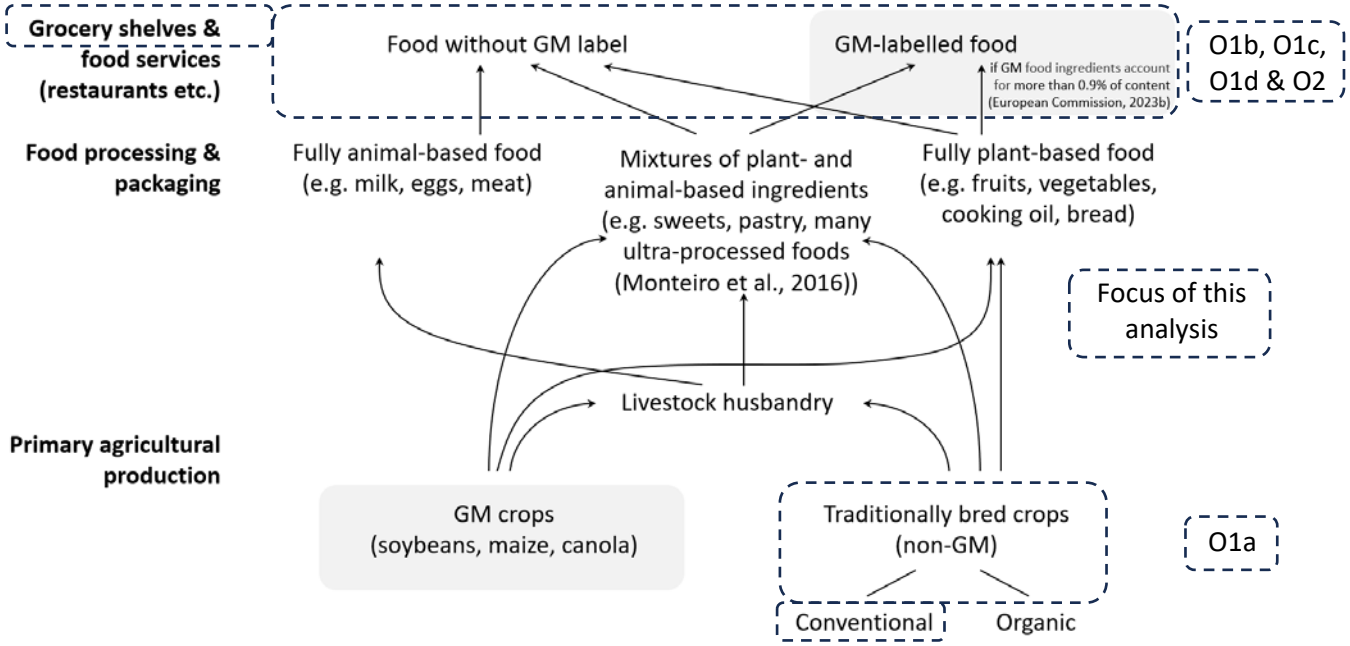
*Objective O1c* How did the number of GM-labelled food products marketed by Dutch supermarkets develop in the short run?

*Objective O1d* Do the developments of the numbers of GM-labelled food in the Netherlands, world market prices and the national food price inflation follow the same trends?

*Objective O2* What are the underlying considerations of Dutch retailers why to offer or not to offer GM-labelled products to consumers?

This report refers to GM food products and the respective labelling rules as being applied in the EU (for details see, e.g., European Commission, 2013, 2023a, 2023b and 2023c or Wesseler et al., 2023). Hence, the analysis does not include all food products derived from GM crops but only those beyond the 0.9% labelling threshold as shown in Figure 2.[4]

Figure 2: Flows of GM-based food ingredients in the EU food system




Source: Authors.

Notes: The arrows denote actual product flows as the production outputs of upstream food supply chain stages (visible in the lower part of the graph) serve as production inputs for downstream food supply chain activities until the processed and packaged food products reach the supermarket shelves or food services. International prices of GM commodities were not available for the analysis, therefore only prices of conventionally produced agricultural commodities were considered for answering objective O1a. For details on the importance of GM crops as feed for the EU livestock sector, see, e.g., CropLife Europe (2022), ISAAA (2020) or EuropaBio (2017, pp. 25 to 27).

[4] In the EU, all raw or processed versions of human food and animal feed which contain more than 0.9% approved GM crops need to be labelled (European Commission, 2023b). In some EU countries a market for non-GM labelled food products has emerged in response to the EU labelling rules (Venus et al., 2018). Food partly or fully based on ingredients derived from animals fed with GM feed does not need to be labelled in the EU. Hence, the feed sector and the human food derived from it are not considered in this analysis - although GM crops are largely used for animal feed - as it is not visible for consumers in supermarket shelves which ingredients of this food have been produced using GM feed.

A transparent description of the data gathering approach as well as of the details of the statistical analysis which ensure the reproducibility of this analysis are contained in appendices A.1 and A.2. The questionnaire used for analysing research objective O2 can be found in appendix A3.

# 3 Research results

In this section the answers obtained for each of the research objectives – as obtained based on the sampling design and data gathering (detailed in section A.1 of the appendix) and the chosen research approaches (detailed in section A.2 of the appendix) – will be summarized and discussed.

## 3.1 Answers to research objectives O1a and O1b

**O1A How have the world markets prices of the most important agricultural commodities developed?**
**O1b How have food retail prices in the Netherlands developed?**

**Core results:** World market prices of the most important grain and oilseed commodities (wheat, barley, maize, soybeans, rapeseeds, sunflower seeds) stayed at very high and unprecedented levels for about only 6 months after the start of the Russian invasion of Ukraine. They had continuously increased following a steady upward trend until June 2022. The Black Sea Grain Deal agreed upon in July 2022[5] had a huge lasting effect on global grain and oilseed prices as it turned the stable upward trend into a stable continuous downward trend of about the same magnitude. However, the development of national retail food price inflation did not follow these world market price developments, but even accelerated fivefold after the Black Sea Grain Deal and has been continuously growing at this high rate since July 2022. In late summer 2023, average national retail food price inflation exceeded global price increases of rapeseed and sunflower oil, maize as well as sugar with respect to price levels in January 2020.

**Detailed explanation and analysis:**
Both the world market prices as well as the national food price inflation rates have been transformed to a common scale in order to make their percentage changes directly comparable to each other. Hence, each variable takes the value zero in January 2020 and its values in all other months shown in Figure 3 tell by how many percent each variable has changed in relation to this reference month.

The world market prices $p_{c,m}$ of the most important agricultural commodities $c$ are published each month $m$ by the World Bank (2023). For this analysis, we consider the international prices of soybean, rapeseed oil, sunflower oil, maize, wheat and sugar. As these prices are at differing levels, they are brought all to one scale by transforming them into price indices $p_{c,m}^{ind}$ via Equation (E1):

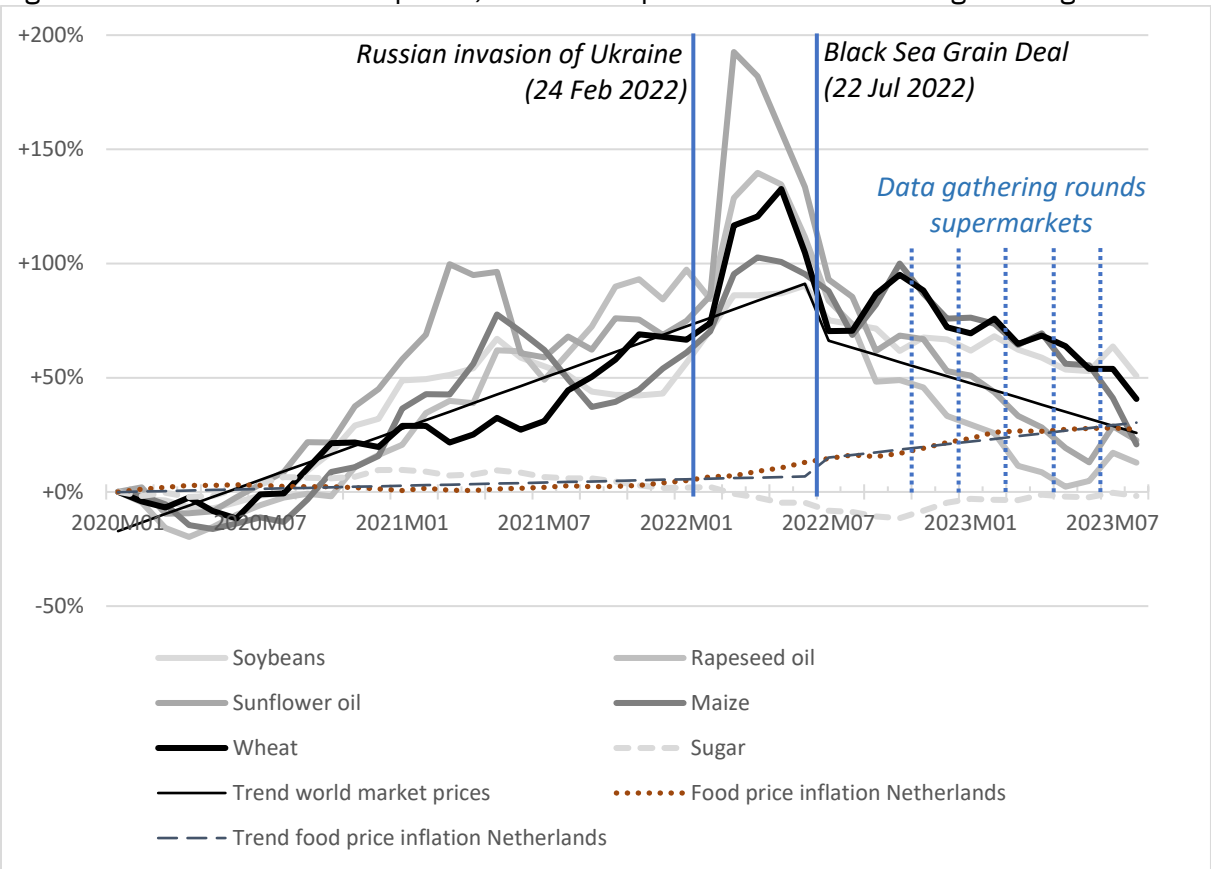
$$p_{c,m}^{ind} = \left(\frac{p_{c,m}}{p_{c,1}} - 1\right) * 100. \qquad \text{(E1)}$$

[5] This initiative was suggested and monitored by the United Nations to resume Ukrainian grain exports via the Black Sea in order to curb the intense inflationary pressure on global grain prices (UN, 2023a) caused by the Russian invasion (Ihle et al., 2022).

Hence, the prices $p_{c,m}$ are normalized so that the resulting indices $p_{c,m}^{ind}$ of each commodity $c$ start with 0 in January 2020. For all subsequent months, the indices $p_{c,m}^{ind}$ then show the percentage differences of the price of commodity $c$ in month $c$ in comparison to January 2020.[6]

Figure 3 shows the development of each of the prices of these most important agricultural raw products on world markets as well as the Harmonised Index of Consumer Prices (HICP) for all food in the Netherlands from January 2020, one month before Covid-19 became a global pandemic, until August 2023. It also shows the start of the Russian invasion of Ukraine and the joint price trend of agricultural raw products at global level as well as the trend in national food price inflation in the Netherlands before and after the Black Sea Grain Deal.[7] In addition, the timings of the five data gathering rounds for counting the numbers of GM-labelled food products in Dutch supermarkets are highlighted (see also Table A.3).

Figure 3: Global commodities prices, Dutch food price inflation and data gathering




Source: Authors based on World Bank (2023) and Eurostat (2023b).
Notes: All time series are normalized in a way so that their value is zero in Jan 2020. The following months - shown on the x-axis, e.g., 2022M07 means July 2022 - show the percentage deviation in price/ inflation levels from their respective values in this benchmark month of January 2020 (on the y-axis). For example, +50% means that it is 50% higher.

[6] The exactly same approach has been followed to also normalize food price inflation at the retail level in the Netherlands. The data obtained from Eurostat (2023b) have been transformed as specified in Equation (E1) so that food price inflation is zero in January 2020.
[7] Detailed estimation results are available in Table A.10 and Table A.11 in the appendix.

Figure 3 shows that the prices of major grain and oilseed commodities have experienced very similar developments on world markets since early 2020. Global grain and oilseed prices have developed largely in parallel showing a constant and statistically significant upward trend until June 2022 – i.e., one month before the Black Sea Grain Deal – officially known as the Black Sea Grain Initiative (UN, 2023b) had been established to relax the upward prices pressures on global commodity markets (UN, 2023). Ihle et al. (2022) have verified that this co-movement between the prices of several raw commodities has substantially intensified since the invasion started. The sugar price did, however, develop independently being largely stable during these 44 months.

The Black Sea Grain Deal had a strong and lasting (and statistically significant) effect on global grain and oilseed price developments. This means it induced a structural change in world market price dynamics as it terminated the stable upward trend and turned it into a stable continuous downward trend. This downward trend since July 2022 has been about 20% less steep than the initial upward trend and still continued to exist in autumn 2023. Hence, global grain and oilseed prices stayed at very high and unprecedented levels (World Bank, 2022c) only for about 6 months and have been steadily decreasing since then.

The inflation of Dutch food retail prices took a completely different trajectory than global prices. Although global prices of the six agricultural raw commodities considered exceeded their levels from January 2020 in June 2022 by about 90%, Dutch retail food prices rose much more slowly, namely by only 13% over the same 29 months. While global raw product prices kept on continuously decreasing after the Black Sea Grain Deal, food price inflation at retail level in the Netherlands (as in all over Europe and most countries worldwide) actually accelerated (five times) instead of slowing down. Despite that global prices of rapeseed and sunflower oil, maize as well as sugar almost returned to their low levels of early 2020, Dutch food retail price inflation kept on constantly growing. The inflation continuously rose to almost 30% (with respect to January 2020) from July 2022 to August 2023 (i.e. 14 months).

## 3.2 Answers to research objective O1c

**How did the numbers of GM-labelled food products marketed by Dutch supermarkets develop in the short run?**

**Core results:** Currently, the shares of GM-labelled food products play a minimal (stable) role in the shelves of Dutch retail stores. For four of the six commodity groups[8] not a single GM-labelled brand has been found between November 2022 and July 2023. Only for the category sweets, biscuits & chips and the category baking oils & vegetable fats a low two-digit number of retail food products have been found which contain at least one labelled GM ingredient. The incidence counts of sweets, biscuits & chips vary slightly at negligible levels. For cooking oils & vegetable fats the incidence counts did not change during the five sampling rounds.

The number of GM-labelled food products found show in the short-run, i.e., during the 9 months of the data gathering, a modest upward-pointing trend with high variability. As the observed incidences of GM-labelled food per sampling round range in the magnitude of one to two dozens, GM-labelled food is expected to continue to have a niche role in the supermarket product portfolios independently of how this observed short-run trend might

[8] The six commodity groups considered are sweets, biscuits & chips; baking oils & vegetable fats; flours; mayonnaises; margarines and corn & soy. See Table A.1 for further details.

develop in the next years, i.e., independently of the trajectory according to which this short run trend will transform into a long-run trend (in the statistically most likely scenarios).

If this short-run trend stabilizes into a stable long-run trend, about 4% of all sweets, biscuits & chips offered by Dutch supermarkets are expected to contain GM ingredients by July 2033. If the long-run trend which will develop in the coming years will be weaker than the observed short-run trend, this share will be lower than 4%. The observed GM food incidence patterns do not suggest that this short-run trend might accelerate over the years to come (which would result in a share of GM food in July 2033 being substantially more than 4%). As any short-run trend can easily change within 3 to 5 years (or earlier), a follow-up assessment needs to be conducted to obtain robust evidence about the long-run trend in the marketing of GM-labelled food in the Netherlands.

**Detailed explanation and analysis:**
In total more than 22,000 retail food products have been checked in the 20 supermarkets sampled (Table 1).[9] That is, in each of the five sampling rounds about 4,500 products have been checked whether they were labelled to contain at least one GM ingredient. About 40% of the products checked belonged to the category sweets, biscuits & chips and 27% were cooking oils and fats accounting together for two thirds of all products whose ingredients lists have been assessed.

Table 1: Number of food products checked per food category and data gathering round

| Data gathering round | sweets, biscuits & chips | baking oils & vegetable fats | flours | mayonnaises | margarines | corn & soy | Total |
|---|---|---|---|---|---|---|---|
| round1 (Nov 22) | 1,876 | 1,115 | 744 | 352 | 199 | 118 | **4,404** |
| round2 (Jan 23) | 1,913 | 1,192 | 798 | 397 | 207 | 65 | **4,572** |
| round3 (Mar 23) | 1,826 | 1,235 | 853 | 439 | 201 | 51 | **4,605** |
| round4 (May 23) | 1,772 | 1,247 | 854 | 419 | 214 | 63 | **4,569** |
| round5 (Jul 23) | 1,653 | 1,237 | 850 | 376 | 196 | 68 | **4,380** |
| **Total per category** | **9,040** | **6,026** | **4,099** | **1,983** | **1,017** | **365** | **22,530** |
| | | | | | | | |
| **Average per category** | 1,808 | 1,205 | 820 | 397 | 203 | 73 | **4,506** |

Source: Authors.
Notes: For the correspondence of English and Dutch food category names, see Table A.1 in the appendix. For further details on the sampling see Table A.3 and the rest of appendix A.1.

The shares of GM-labelled food products play a minimal and mostly stable role in the shelves of Dutch retail stores as emphasized by Table 2. Across all six product categories only 0.5% of the number of food products offered in Dutch supermarkets are labelled to contain at least one ingredient derived from GM crops. The analysis identifies three groups among all food products checked. Most of the categories, namely flour and maize, mayonnaises, margarines and soy product (varieties), belong to the ***GM-free retail food product group*** for which no GM-ingredients during all product checks between November 2022 and July 2023 have been found. Baking oils & vegetable fats form the second category of ***foods with constant GM shares***. Their share in the total number of products marketed in this category did not change during the nine months of data gathering (Table 2). The third category is formed by ***foods with varying GM shares***. This group is formed by the category of sweets, biscuits & chips which contains the highest share of the number of retail food products with GM ingredients of almost 1%. The 106 retail food commodities found in all five data gathering rounds (Table

[9] For details on the sampling design see appendix A.1. For an explanation of the choice of these six categories, see Table A.1 and the notes thereunder.

A.8) which were labelled containing at least one GM ingredient contain many products which have been counted several times as the product portfolios of supermarkets stayed largely constant across the sampling period of nine months. For example, a single brand of cooking oil was found in all supermarkets of a specific chain which were sampled in every round leading to counting this single brand of cooking oil thirty times throughout the entire sampling.

Table 2: Shares of GM-labelled brands in food products checked

| Data gathering round | sweets, biscuits & chips | baking oils & vegetable fats | flours | mayonnaises | margarines | corn & soy | Average per round |
|---|---|---|---|---|---|---|---|
| **round1 (Nov 22)** | 0.7% | 0.5% | 0.0% | 0.0% | 0.0% | 0.0% | **0.4%** |
| **round2 (Jan 23)** | 0.5% | 0.5% | 0.0% | 0.0% | 0.0% | 0.0% | **0.3%** |
| **round3 (Mar 23)** | 0.8% | 0.5% | 0.0% | 0.0% | 0.0% | 0.0% | **0.4%** |
| **round4 (May 23)** | 1.3% | 0.5% | 0.0% | 0.0% | 0.0% | 0.0% | **0.6%** |
| **round5 (Jul 23)** | 1.0% | 0.5% | 0.0% | 0.0% | 0.0% | 0.0% | **0.5%** |
| **Average across rounds** | **0.8%** | **0.5%** | **0.0%** | **0.0%** | **0.0%** | **0.0%** | **0.5%** |

Source: Authors.

Notes: The total counts these shares are based upon are reported in Table A.8 in the appendix. For the correspondence of English and Dutch food category names, see Table A.1 in the appendix.

When taking the numbers of sweets, biscuits & chips and of cooking oils & fats found in round 1 of the data gathering in November 2022 containing GM ingredients as reference points (13 and 6, respectively, as shown in Table A.8 in the appendix), the changes of these numbers of GM-labelled food products during the four subsequent sampling rounds until July 2023 can be assessed in comparison to this benchmark (see Table A.3 for details on the sampling rounds). For achieving that, the numbers $n_s^{GMO}$ of GM-labelled brands belonging to food category $f$ found in sampling rounds $s = 1, 2, 3, 4, 5$ have been transformed into indices $n_{f,s}^{ind}$ in the following way, Equation (E2):

$$n_{f,s}^{ind} = \left(\frac{n_{f,s}^{GMO}}{n_{f,1}^{GMO}} - 1\right) * 100. \qquad \text{(E2)}$$

This transformation results in the indices shown in Table 3 and Figure 4. The numbers of cooking oil and fat products containing at least one GM ingredient does not change from November 2023 (round1) until July 2023 (round5). The counts in the pre-last column show the counts which would be expected[10] based on the point estimates reported in the regression results shown in Table A.9. The last column contains the differences between these expected counts and the observed ones in order to show how close or how far the these count expectations are from the ones observed in reality.

[10] These expected incidence counts are the numbers of sweets, biscuits & chips predicted to be observed in each round by the statistical model shown in Table A.9 which assumes that these counts are a function of a linear time trend. This statistical model quantifies the expected (i.e., the average) relationship between the incidence counts and the linear time trend (called variable 'round' in Table A.9 which increases by one unit for every sampling round and beyond the sampling rounds by 1 every two months) based on the incidence counts observed and recorded across all five sampling rounds.

Table 3: Numbers of GM-labelled food products found during the five sampling rounds

| | Observed counts per round | | Corresponding change | | | Expected counts | Difference expected vs. observed |
|---|---|---|---|---|---|---|---|
| Data gathering round | sweets, biscuits & chips | baking oils & vegetable fats | sweets, biscuits & chips | baking oils & vegetable fats | | sweets, biscuits & chips | sweets, biscuits & chips |
| round1 (Nov 22) | 13 | 6 | benchmark | benchmark | | 13 | 0.00 |
| round2 (Jan 23) | 10 | 6 | -23.1% | +0.0% | | 13.9 | +3.9 |
| round3 (Mar 23) | 14 | 6 | +7.7% | +0.0% | | 14.9 | +0.9 |
| round4 (May 23) | 23 | 6 | +76.9% | +0.0% | | 15.8 | -7.2 |
| round5 (Jul 23) | 16 | 6 | +23.1% | +0.0% | | 16.8 | +0.8 |
| **Total for all/ average across rounds** | **76** | **30** | **n.a.** | **n.a.** | | **n.a.** | **n.a.** |

Source: Authors.

Notes: The changes in columns 4 and 5 are calculated according to Equation (E2). Each of them denotes the percentage change of the count of this round relatively to the count in round 1. For example, the 10 sweets, biscuits & chips products found in round 2 correspond to a percentage decrease of 23.1% in comparison to the 13 products found in this category in round 1. For the correspondence of English and Dutch food category names, see Table A.1 in the appendix.

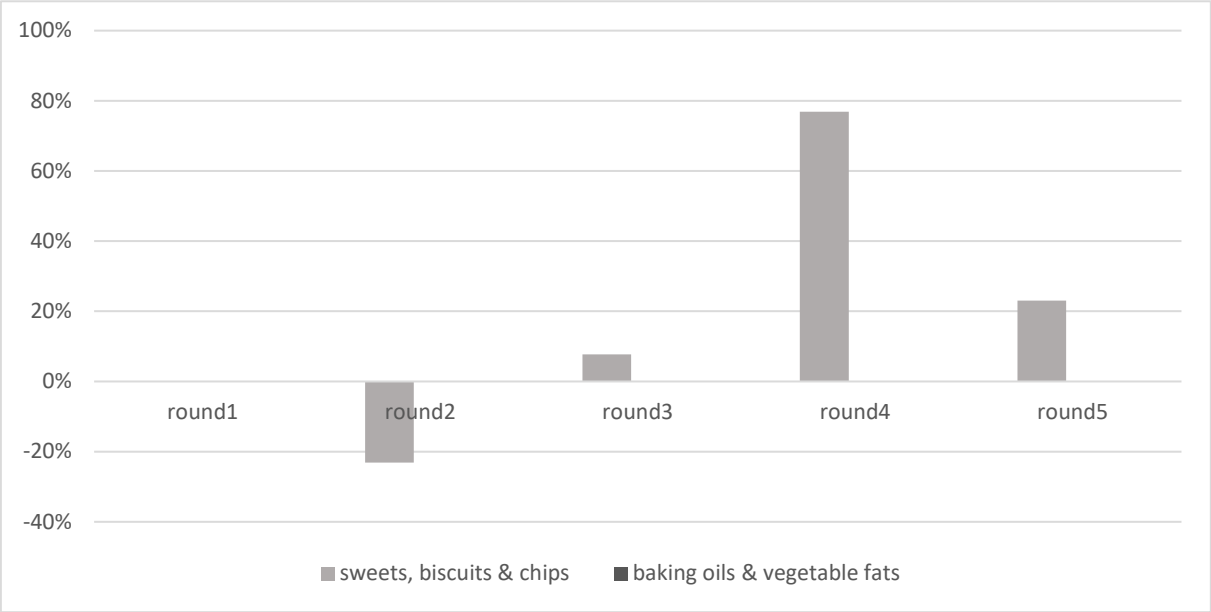
The numbers of GM-labelled sweets, biscuits & chips found show considerable variation from sampling round to sampling round. Figure 4 visualizes these percentage changes which are also shown in column four of Table 3. The average tendency of the percentage changes shown in the fourth column of Table 3 amounts to a raise by 7.3 percentage points from sampling round to sampling round relative to the 13 observations in round 1 (econometric results in Table A.9 in appendix). This means that on average in every new data gathering round, i.e., every two months, about one additional GM-labelled food product has been found.[11] The variation in Figure 4 does, however, not follow a structurally increasing trend which is statistically detectable.[12] Hence, the numbers shown in Table 3 need to be considered as slight upward trend which is not structural in the statistical sense. This means for the observation period of 9 months that these five observations appear as random variations around the stable average number of about 15 brands of sweets, biscuits & chips being GM-labelled per sampling round.[13]

[11] This number results from $13 \cdot 0.0725 = 0.946 \approx 1$.

[12] The term "not structurally increasing trend" means that the effect is not significant at the 5% level (see Table A.9 for details). This finding is mainly due to the fact that the dataset only contains five repeated measurements for each supermarket. Hence, these few observations are not sufficient evidence to decide on objective statistical grounds whether this tendency represents a stable long-run development (i.e., indeed continuing with this average growth in a structural way for many more months after the end of the data gathering in July 2023) or whether it does only seem like a stable tendency based on the four observations from data gathering rounds 2 to 5. The latter case would mean that it is not a systemic tendency and hence to be interpreted as a random sequence of growth rates existing only in the short run during very few months. The only way to obtain sufficient evidence for making this decision about the two potential patterns with certainty is repeating the data gathering as explained blow.

[13] However, the analysis of additional data gathered after several months or years might suggest long-run evidence which contradicts this short-run evaluation which is limited to November 2022 to July 2023. It is possible that there exists indeed a stable long-run tendency which shows that this average growth continues in a stable way for many more months after July 2023.

Figure 4: Development and variation of GM-labelled product counts during the sampling




Source: Authors.

Notes: All observations have been normalized in a way so that their value is zero in November 2022 (data gathering round 1). The y-axis and the bars for each of the following rounds show, hence, the percentage deviation from the numbers of GM-labelled products counted that first data gathering round, i.e., column four of Table 3. For example, -20 means that the number of GM-labelled products found in some data gathering round was 20% smaller than in the first round. For the category baking oils & vegetables fats no bars are visible because the GM product incidence count observed in November 2022 did not change.

The described short-run fluctuations reported in Table 3 have been observed at very low levels with high uncertainty are, hence, fairly likely not the result of pronounced deliberate strategy (changes). Most likely they are the result of common temporal fluctuations in product availability due to common delivery or assortment fluctuations. It happens that single brands are out of sale for a couple of days or other (short-run) supply chain fluctuations or even disruptions, e.g., strikes of supermarket distribution centres (e.g. in April/May 2023) might cause the observed variations.

However, if there would be any deliberate strategy existing to extend the GM food portfolio substantially that would mean that a strong and consistent upward trend or at least one single upwards shift should have been observable during these nine months. As none of such patterns has been observed, the observed incidence counts do not support the claim that (all/ most) supermarkets have changed to a deliberate strategy to extend the GM food portfolio substantially between November 2022 to July 2023. The observed pattern suggests merely that (on average) about one additional GM-labelled sweets, biscuits & chips product is offered by any of the Dutch supermarket chains every two months which is a conclusion subject to fairly high statistical uncertainty.

***Short-run patterns vs. long-run stability – analysis of potential future development scenarios of the incidence counts of GM food***

For the short-run observation period of 9 months from November 2022 until July 2023, the five GM-labelled brand counts of the foods with varying GM shares (column 2 of Table 3) show a too high variability around very modest count numbers without any substantial or stable

count changes (see Table 5). This observed pattern is therefore not stable enough to allow to determine with certainty whether these five counts of GM-labelled food products across the 20 supermarkets resulted from a stable long-run trend or whether they represent only a short-run random deviation from a constant value which does not grow.

The incidence count of GM-labelled sweets, biscuits & chips products observed in November 2022 – representing also the starting value of the growth rate calculations in the fourth column of Table 3 – has been only 13. In combination with the estimated bi-monthly tendency of an increase of 7.3 percentage points, this pattern yields a marginal increase in the numbers of GM-labelled brands. This observed pattern, hence, suggests that there has been only one additional GM-labelled food product on average been added to the marketing portfolio of all Dutch supermarkets every two months between November 2022 and July 2023. This increase will be especially marginal if this short-run pattern is only short-lived, e.g., if it ceases to continue in autumn or winter 2023.

Hence, the main question of whether this observed short-run pattern stabilizes into a stable long-run trajectory – which would continue to show the same characteristics over the coming years – or whether it will not cannot be answered due to the short-run observation period of only 9 months. For finding with certainty an answer to that question, a follow-up assessment needs to be conducted to obtain robust evidence about the long-run trend in the marketing of GM-labelled food in the Netherlands.

In order to provide an intuitive understanding of the real-world implications of such abstract statistical patterns which might realize subject to larger or lesser uncertainty, a limited number of relevant scenarios is assessed. Table 4 summarizes four long-run scenarios which are most relevant from a real world perspective given the incidence counts observed during the sampling period. Figure 5 visualizes examples of potential predicted observation patterns of the numbers of GM-labelled sweets, biscuits & chips which might be observed if the data gathering would continue in the regular two months setup until July 2033.

Scenario (A) refers to the case that the short-run trend observed between November 2022 and July 2023 (Figure 4) will stably continue, but the very high variation around that trend observed (Figure 4) is minimized by assuming it would be zero. As the variation of socio-economics processed – due to the immense complexity of the socio-economic reality – is never zero, this scenario can for sure never be observed in any future sampling. Scenario (B) assumes that the observed short-run trend and variation around it will transform into a long-run trend and a long-run variation both of which will be stable for the coming 10 years. Scenario (C) assumes that the observed short-run trend will cease to exist after July 2023, i.e. it assumes that the five incidence counts of sweets, biscuits & chips observed until this month are random variations around the starting count of 13 made for November 2022. Each of these scenarios is somewhat likely as the observed short-run patterns might plausibly continue for the next years, however they are not very likely because they will most probably be (several times) impacted by changes in the preferences of supermarkets about GM food marketing, technological innovations, etc. over the simulation horizon until July 2023. Finally, scenario (D) assumes the observed short-run variation to continue in the long-run while the observed short-run trend is assumed to iteratively increase by 0.25% each two months what would mean that the growth of the numbers of sweets, biscuits & chips products marketed in the Netherland increasingly accelerates. As this acceleration is assumed to happen in a stable way until July 2033, it is extremely unlikely that this will indeed happen in reality.

Table 4: Relevant hypothetical long-run scenarios about GM food development

| **Scenario** | **(A) Identical long-run trend without variation** | **(B) Identical long-run trend with identical variation** | **(C) Identical variation without any trend** | **(D) Constantly increasing long-run trend with identical variation** |
|---|---|---|---|---|
| **Assumed trend** | +7.3% increase every two months in relation to incidence count of Nov 22 | +7.3% increase every two months in relation to incidence count of Nov 22 | zero | Until Sep 23 same trend as scenario (A) From Nov 23 iteratively increasing by 0.25% every two months |
| **Assumed variation/ uncertainty** | Zero | Same variation as for the observations* | Same variation as for the observations* | Same variation as for the observations* |
| **Likelihood of occurrence** | Impossible | Somewhat likely | Somewhat likely | Extremely unlikely |

Source: Authors.

Notes: *The observations of the GM-labelled sweets, biscuits & chips found during the sampling period are shown Table 3 and Figure 4. Those variations are modelled as repeated draws from the integers between -4 and 10 (i.e., the maximum deviations observed from the starting count of 13 in Nov 22).

The last two rows of Table 5 extrapolate the pattern observed during the sampling period of nine months (Scenario (B)). If this trend would stably continue until July 2025, i.e. after two additional years, the share of GM-products in the category of foods with varying GM shares is expected to rise to 1.6% and until July 2033, i.e. after 8 additional years after that, to 4.1% of the entire portfolio offered within this category. Obviously, this would still constitute a minor niche in the national food retail market.

Table 5: Observed vs. expected GM-labelled food and 2 & 10 years forecasts (scenario (B))

| | **Counts per round** | | | **Index** | | **Shares in total** | |
|---|---|---|---|---|---|---|---|
| **Data gathering round** | **observed** | **expected** | **obs.-exp.** | **observed** | **expected** | **observed** | **expected** |
| **round1 (Nov 22)** | 13 | 13 | 0 | 0 | 0 | 0.7% | 0.7% |
| **round2 (Jan 23)** | 10 | 14 | -4 | -23.1% | +7.3% | 0.5% | 0.7% |
| **round3 (Mar 23)** | 14 | 15 | -1 | +7.7% | +14.6% | 0.8% | 0.8% |
| **round4 (May 23)** | 23 | 16 | 7 | +76.9% | +21.8% | 1.3% | 0.9% |
| **round5 (Jul 23)** | 16 | 17 | -1 | +23.1% | +29.1% | 1.0% | 1.0% |
| **Total** | **76** | **74** | **2** | **n.a.** | **n.a.** | **0.8%** | **0.8%** |
| | | | | | | | |
| **After 2 additional years** | unknown | 29 | unknown | unknown | +123.7% | unknown | 1.6% |
| **After 8 additional years** | unknown | 74 | unknown | unknown | +472.9% | unknown | 4.1% |

Source: Authors.

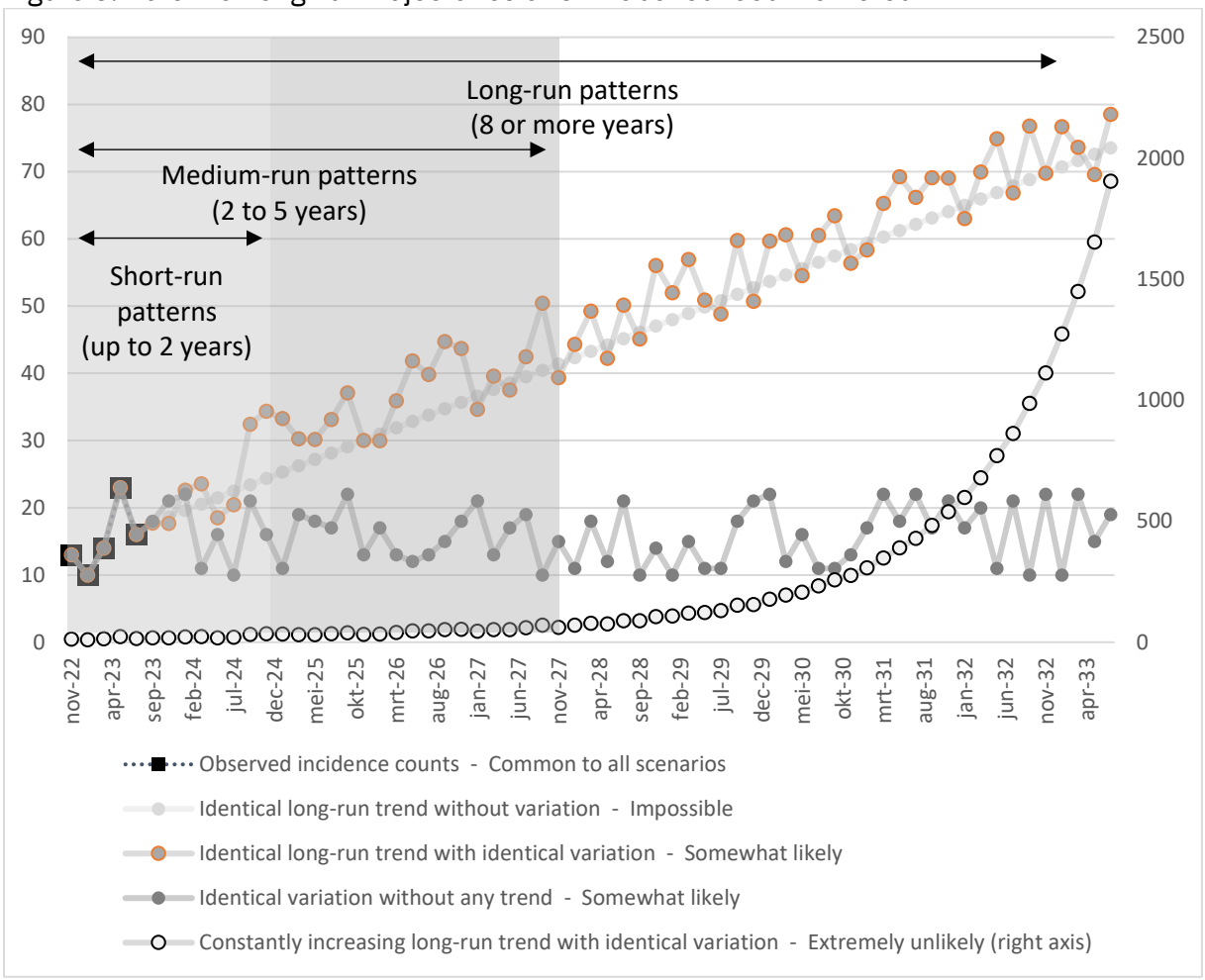
Notes: The extrapolated shares of GM brands in the total number of sweets, biscuits & chips have been calculated assuming a stable total portfolio of 1808 products (Table 1) and the stable continuation of the short-run pattern found in Table A.9 for the next 10 years.

If the observed patterns for the foods with constant GM shares and the GM-free retail foods continue (scenario (B)), then the incidence counts of GM brands for baking oils & vegetable

fats, flours, mayonnaises, margarines, and corn & soy would not differ from their negligible/ absent numbers found between November 2022 and July 2023.

Figure 5 visualizes examples of predicted observation patterns of the numbers of GM-labelled sweets, biscuits & chips which might be counted (in hypothetical sampling rounds) until July 2033 if each of the assumed scenarios (A) to (D) characterized in Table 4 would indeed happen in reality. That such socio-economic patterns are stable over ten years or more is highly unlikely, therefore, these are hypothetical patterns which will with fairly high likelihood not be observed like that in reality. It is more probable that some or a mixture of these the patterns (A) to (D) will be observed in reality in the medium term for about 2 to 4 years before the pattern changes (again).

Figure 5: Potential long-run trajectories of GM-labelled food marketed




Source: Authors.

Notes: Each line shows one simulation representing one of the relevant hypothetical trajectories for the total number of GM-labelled sweets, biscuits & chips products offered by supermarkets as characterized in Table 4. The two y-axes show how many GM-labelled sweets, biscuits & chips products are (expected to be) observed in each of the months shown on the x-axis assuming that each of the four simulated patterns would be stable between November 2022 and July 2033. The expected counts of scenarios (A) to (C) are shown on the left y-axis, while (D) is shown on the right y-axis. The maximum number of sweets, biscuits & chips products counted in the 20 supermarkets in any of the sampling rounds was 1,913.

Each of these four long-run patterns is equally consistent with the five short-run incidence counts shown in the second column of Table 5. Inference about which long pattern is causing the observed short-run pattern, i.e., conclusions about the stability and duration of the observed short-run pattern can only be drawn with certainty if the incidence counts of GM-labelled products are (continued to be) regularly monitored over a longer period as indicated in Figure 5. Conclusions about the long-run stability of this trend over a period of more than 5 years can only be drawn if a follow-up product count will be collected after 5 or 10 years (July 2028/ July 2033).

## 3.3 Answers to research objective O1d

**Do the developments of the numbers of GM-labelled food in The Netherlands, world market price as well as the national food price inflation follow the same trends?**

**Core results:** Between November 2022 and July 2023 only the numbers of GM-labelled sweets, biscuits & chips marketed in Dutch supermarkets showed in the short run a slightly increasing tendency at the magnitude of small two-digit numbers. In contrast, world market prices - which had skyrocketed after Russia's invasion of Ukraine during the first half of 2022 - have been showing a continuous and stable decline since the data gathering started in November 2022 while national retail price inflation has continuously risen at stable substantial rates. Therefore, there is no robust evidence that the changes in numbers of GM-labelled sweets, biscuits & chips offered in Dutch retail shelves follow the same trends as agricultural raw commodity prices at world market level and general retail price inflation at national level. This finding applies to category of foods with varying GM shares. The other five categories did not show any variation as either no GM-labelled brands have been discovered in supermarket shelves (GM-free retail foods) or the very low number of GM products marketed did not show any change (foods with constant GM shares) during the duration of the data gathering.

**Detailed explanation and analysis:**
In order to answer this research objective, the pattern discovered in the indices of the numbers of GM food products $n^{ind}_{snoepEtAl,s}$ offered by Dutch supermarkets in the category sweets, biscuits & chips (Equation (E2) and Table 3) is compared to the trends in global agricultural price indices $p^{ind}_{c,m}$ (Equation (E1)) and in the national food retail price inflation indices $i^{retp}_{m}$ between November 2022 and July 2023 during which the GM product counts have been gathered (see Figure 3 and Table A.3).

The analysis of research objective O1a found that the world market prices for the main crop commodities have been showing a constant declining trend between November 2022 and July 2023. In contrast to that, national food price inflation at retail level has experienced a consistent upward trend as shown in Figure 3. Both trends appear to have been fairly stable during these nine months of data gathering. Each of them is statistically detectable and they therefore represent stable structural developments of diverging directions which have been continuing since the establishment of the Black Sea Grain Deal in July 2022.

During the same period, the numbers of GM-labelled retail food products found in the categories of foods with constant GM shares and those which have appeared to be GM-free did not change. Only the numbers of GM-labelled sweets, biscuits & chips marketed in Dutch supermarkets showed a slightly increasing short-run tendency starting at very low levels. The high variation these product counts show does not allow to draw a robust conclusion about

whether this is a structural trend or a stable pattern around a constant value. For determining which pattern applies beyond the data gathering period of nine months follow-up measurements after two or more years are necessary.

Any of these two potential patterns of the GM product count among sweets, biscuits & chips offered in Dutch retail shelves, however, structurally differs from the world market price trend in terms of direction, stability as well as in terms of magnitude of the pattern and from the trend of retail food price inflation in the Netherlands in any case in terms of growth magnitude and pattern stability. Only follow-up measurements can determine with high certainty whether the slight increases at negligible levels will indeed transform in a stable tendency with a upward direction as the domestic food retail price inflation has shown since summer 2022, but its growth rate is likely to be much smaller than that of inflation.

## 3.4 Answers to research objective O2

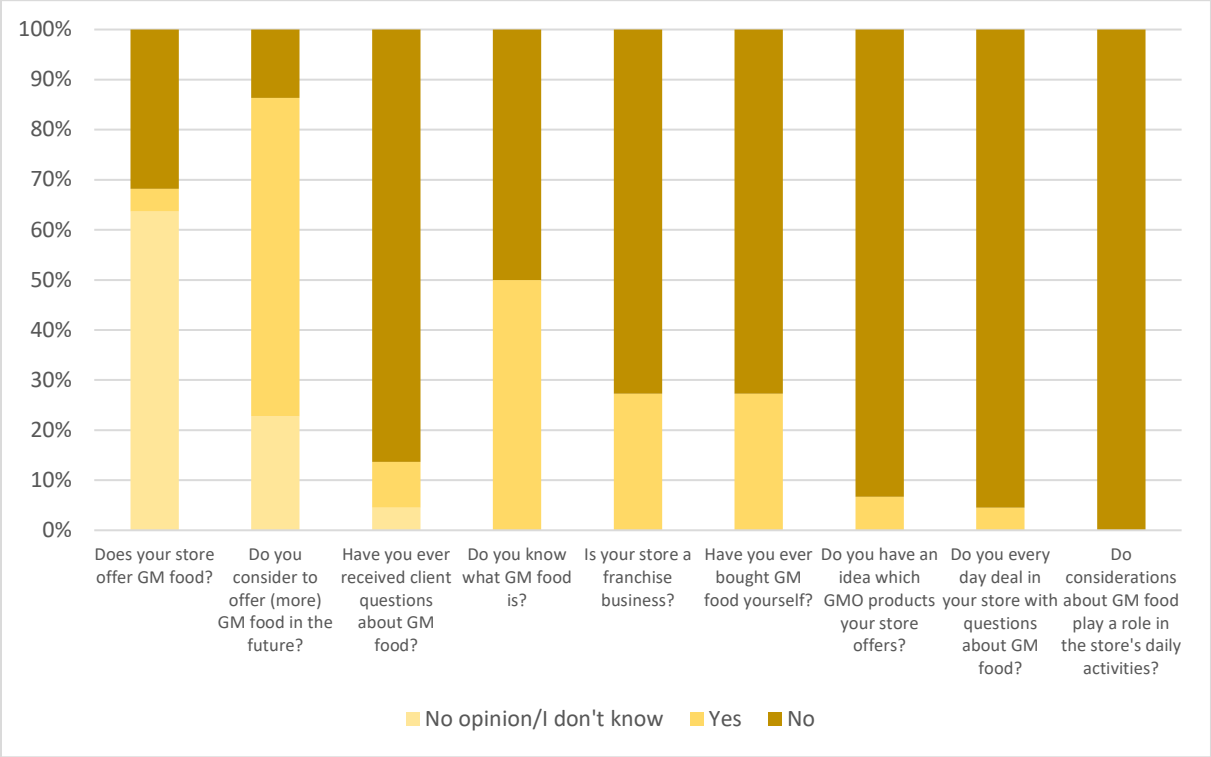
**What are the underlying considerations of Dutch retailers why to offer nor not to offer GM-labelled products to consumers?**

**Core results:** Considerations concerning GM-labelled food products appear to be a non-issue both for supermarket managements as well as for clients. The analysis identified two groups namely supermarket leadership staff who are sure that GM food is not marketed in their store (GM-free supermarkets) and the larger group of supermarket leadership staff who is unaware of whether or not GM food forms part of their product portfolio (GM-unaware supermarkets). Both groups differ in several aspects from each other. The former group mostly belongs to small retail organizations. Several supermarket managements expect that the importance of GM food will grow in the future. Client requests concerning GM food have been reported to be completely absent for most supermarkets, only a few retailers rarely get a few questions which are mainly about whether GM ingredients are absent in the food commodities sold. Supermarkets deliberately not selling GM food appeared to have more varying attitudes and considerations why not marketing GM food while those being largely unaware of the topic of GM food appear to share larger consensus. There is no consensus among supermarket managements on that GM food helps to cushion adverse retail food price inflation effects or on moral considerations regarding whether or not to offer GM-labelled food to customers.

**Detailed explanation and analysis:**
The questionnaire about the underlying considerations of Dutch retailers why to offer or not to offer GM-labelled products to consumers contained 106 questions, two thirds of which Likert-scale questions, accompanied by 19 open, 9 yes/no, 7 ranking, and one enumerating question (see Table A.12 for details). The 70 Likert scale questions contained 35 statements in favour of offering labelled GM food to clients (presented to all interviewees who reported that the own branch is currently offering GM food and to those who did not know for sure) in the own branch and 35 against (presented to all interviewees who reported that the own branch is currently not offering any labelled GM food). 25 supermarkets have been approached for filling in this questionnaire in a face-to-face interview of which 22 agreed and completely filled in all questions (25% of those where a franchise branch, see Figure 6) which corresponds to a response rate of 88%. Repeated efforts to contact managers in the supermarket chain headquarters responsible for the chain's product portfolios (*inkoop-managers*) have not been successful.

Figure 6 summarizes all answers to the nine yes/no questions which characterize which role considerations about labelled GM food play in the daily work routines of the interviewees[14] as well as their experiences with labelled GM food in their private lives and the type of supermarket branch. Each of these questions contained the option "I don't know/ I do not have an opinion (about that)". Figure 6 shows these questions sorted according to decreasing share of answers of this option and a decreasing share of yes-answers.

Figure 6: Personal experience with GM food and role in daily work routine




Source: Authors.

Notes: The term "GM food" refers to retail food products with at least one genetically modified (GM) ingredient required to be labelled according to EU regulation. See Figure A.1 as well as Table A.15 for the Dutch version of this figure. The y-axis shows the share of interviewees who chose each of the answer options.

Figure 6 suggests three central insights. First, labelled GM food does virtually not play any role in the daily work routines of any of the supermarket staff with leadership functions. All interviewees report that considerations about labelled GM food do not play any role in their daily work routines. In line with this observation, about two thirds of all interviewees do not know whether labelled GM food is part of the product portfolio of their store, and almost all of them do not know which specific GM-labelled brands are offered. Second, 86% report that they have never encountered any interest or question from clients about this type of food.[15] The two only supermarkets which reported such questions belong to small & regional chains, the one belonging to a chain with emphasis on organic products receives such questions about once per month, the other one about once per year.

[14] Table A.14 shows that 16 of the 22 interviewees, i.e., about 75%, had a leading professional function in the supermarket.

[15] This is consistent also with the experience of the Voedingscentrum (as documented in the notes of Table A.1) which also basically never gets questions about GM-labelled food from consumers.

Only half of the interviewed supermarket leadership staff report to know what GM food is, but only one quarter reported to have purchased it in their private lives as food retail client. The interviewees reported five core considerations concerning the importance of GM food (see Table A.14 for details):

- Little awareness in public/ among clients,
- Barely known phenomenon with many uncertainties,
- Little/ absent personal awareness of the interviewee,
- Missing involvement for including GM food into shop portfolio as reason of missing awareness,
- Clear expectations about increasing importance in future.

This virtually completely lacking awareness of the topic *GM food* is consistent with the negligible shares of labelled GM food encountered in the comprehensive food retail product check to answering research objective O1c (see Table 2). However, two thirds of the interviewees report that they are open to consider to deliberately offer (more) food with labelled GM ingredients in the future. This indicates that supermarket leaderships are aware of that although GM food does currently barely have any attention at retail level neither from the marketing nor from the demand side, this attention might grow in the near future and they are open to embrace any opportunities which might appear in this direction.

Third, the analysis reveals two distinct groups of supermarkets: 7 supermarkets whose leading employee was sure that GM food does not belong to the marketing portfolio in the own branch and, on the other side, 1 supermarket whose employee knew for sure that GM food is part of the product portfolio as well as 14 markets whose employees where not sure about that. These two groups of supermarkets differ from each other in several respects as summarized in Table 6. Interviewees who were sure about that their branch is GM-food-free worked in supermarkets which mainly belonged to small chains (i.e., having less than 5% market share). Supermarkets belonging to the second group mainly belong to large chains.

Table 6: GM food-related experiences of both groups of supermarket managements

| | All supermarkets | | | Supermarkets without GM food | | | Supermarkets (not sure whether) with GM food | | |
|---|---|---|---|---|---|---|---|---|---|
| Question | No opinion/ I don't know | Yes | No | No opinion/ I don't know | Yes | No | No opinion/ I don't know | Yes | No |
| Is your business a franchise business? | 0% | 0% | 0% | 0% | 14% | 86% | 0% | 33% | 67% |
| Do you know what GM food is? | 0% | 0% | 0% | 0% | 57% | 43% | 0% | 47% | 53% |
| Does your branch offer GM food? | 0% | 0% | 0% | 0% | 0% | 100% | 93% | 7% | 0% |
| Do you know which GM food your branch offers? | 0% | 0% | 0% | na | na | na | 0% | 7% | 93% |
| Are you considering offering (more) GM food in the future? | 0% | 0% | 0% | 29% | 57% | 14% | 20% | 67% | 13% |
| Do you deal with GM food on a daily basis in your branch? | 0% | 0% | 0% | 0% | 14% | 86% | 0% | 0% | 100% |
| Do considerations about GGD play a role in daily activities? | 840% | 0% | 0% | 0% | 0% | 100% | 0% | 0% | 100% |
| Have you ever received questions from customers about GM food? | 0% | 0% | 0% | 14% | 29% | 57% | 0% | 0% | 100% |
| Have you ever bought GM food yourself? | 0% | 0% | 0% | 0% | 29% | 71% | 0% | 27% | 73% |

Source: Authors.
Notes: Cells marked in grey emphasize pronounced differences in the GM food-related experiences in both groups.

Table 6 also highlights that the leading employees of these two groups of supermarkets differ in their daily work experiences relating to GM food. Supermarkets whose employees are sure that they do not offer GM food, are less frequently franchise enterprises and are more frequently busy with GM-related questions (although at very low levels). They also receive client requests about GM food much more often (again at very low levels) than the leadership of the second group of markets who appear to be largely unaware about the topic of GM-labelled food.

The analysis of the underlying considerations of Dutch retailers about marketing GM-labelled food will be conducted separately for both supermarket groups. The first group will be referred to as ***GM-free*** and the second as ***GM-unaware*** supermarkets. Table A.17 highlights to what extent the approval rates to the 35 statements about their considerations of why or why not to offer GM-labelled food to their consumers differ between these two groups of supermarkets. About one third of the leaderships of GM-unaware supermarkets show broad consensus and the remaining two thirds strong approval of these statements. The opinions towards marketing GM-food of the leaderships of GM-free supermarkets are much more diverse: only half of the statements earn broad consensus or strong approval while the remaining statements found only weak approval, a balanced opinion or even strong rejection. This is also visible in the fact that the coefficient of variation of all answers of the GM-unaware supermarkets is 1.09 (Table A.19) while that of the GM-free supermarkets is 2.37 (Table A.18), i.e., more than twice as large which indicated a much wider heterogeneity in answers to the 25 statements.

***Attitudes and considerations of GM-free supermarkets***

Table 7 summarizes the considerations and attitudes of GM-free supermarkets concerning not marketing GM-labelled food. Broadest consensus exists among the seven supermarket leaderships about the role of corporate identity of the supermarket chain in refraining from offering GM food to clients as well as concerning the decisions of suppliers about whether adding or banning GM food to/ from the portfolio. As these stores mostly belong to small chains, e.g., EkoPlaza, having less than 5% share in the overall Netherlands market, this finding hints to the fact that the corresponding retail chains deliberately choose a niche-position with respect to GM food marketing by running a GM-free policy in order to differentiate their portfolios from the large market players. For the GM-unaware supermarkets, the argument that offering GM food corresponds to the corporate identity of the company received an approval score of only 0.71 (Table 8). Risks believed to be associated with GM food production and marketing and a presumed lower food quality receive broad consensus among the GM-free supermarkets.

Demand-related reasons for why not offering GM food (mainly due to limited client interest) receive mostly strong approval while two of these statements are seen as mostly neutral. Statements relating to the public opinion of GM food, its absent food system benefits as well as its marketing aspects receive only weak approval or balanced opinions among these seven supermarket leaderships.[16] All six statements which receive a broad consensus have also largest consensus among the leaderships of GM-free supermarkets. The weaker the approval or the more balanced all seven answers are (indicated in the last column), the less consensus they receive which is visible in the large standard deviations in the lower part of Table 7.

[16] That can be seen from the wide variability of opinions for those statements in column 3 of Table 7.

Table 7: Considerations of GM-free supermarkets against marketing GM food

| | Approval score | | |
|---|---|---|---|
| Statement | Average | Standard deviation | General opinion |
| Not offering GM food is in line with the identity of my retail organization | **1.00** | **0.93** | |
| Sales of GM food increase the risk of damage claims in the short or longer term | **1.00** | **0.49** | |
| The retail organization to which this branch belongs has decided so (overarching policy) | **0.86** | **0.35** | broad consensus |
| The supplier of this branch has decided so | **0.86** | **0.35** | |
| Consuming GM food creates dangers for public health | **0.86** | **0.35** | |
| GM food has a lower quality than non-GM food | **0.80** | **0.40** | |
| Complicated marketing that causes higher costs | **0.71** | **0.70** | |
| GM food is less safe for the customer than non-GM food | 0.67 | 0.75 | |
| Few consumers are interested in GM food | 0.57 | 0.73 | |
| GM food creates a bad image of my store | 0.57 | 1.05 | |
| The average consumer shows little interest in GM food | 0.57 | 0.73 | |
| There is little demand for GM food | 0.57 | 0.73 | predominant strong |
| GM food is not accepted by customers | 0.57 | 0.73 | approval |
| GM food does not contribute to making the food system more sustainable | 0.57 | 0.90 | |
| Sales of GM food increase the risk of damage claims in the short or longer term | **0.57** | **0.49** | |
| GM food is more expensive for customers | 0.43 | 0.90 | |
| There are major public concerns about GM food | 0.43 | 0.73 | |
| GM food has poorer continuity in supply (poor availability) | 0.33 | 0.94 | |
| I fear boycotts will occur at this branch by offering GM food | 0.29 | 1.16 | |
| I fear anti-GM food protests will arise | 0.29 | 1.16 | |
| GM food has a shorter shelf life for customers | 0.29 | 0.88 | predominant weak |
| GM food has a lower nutritional value for customers | 0.17 | 0.90 | approval |
| There is policy uncertainty about GM food | 0.17 | 0.90 | |
| GM food does not have an important role in the future global food supply | 0.17 | 0.90 | |
| Selling GM food lowers the profit of my branch | 0.14 | 0.99 | |
| The long-term effects of GM food production are uncertain | 0.14 | 0.99 | |
| Fewer and fewer people want to buy GM food | 0.14 | 0.83 | |
| GM food has poorer price stability under varying market conditions | 0.00 | 1.00 | |
| My store's turnover will decrease by offering GM food | 0.00 | 0.82 | largely balanced |
| Offering GM food will lead to fewer customers | 0.00 | 0.93 | opinion |
| GM food does not contribute to combating climate change | 0.00 | 1.29 | |
| GM food does not help to limit inflation | 0.00 | 0.82 | |
| GM products give my store a worse reputation | -0.14 | 0.99 | |
| Too few customers are curious to taste GM food | -0.14 | 0.99 | |
| It is morally wrong to sell GM food | -0.33 | 0.47 | predominant strong rejection |
| | | | |
| **All answers** | **0.38** | **0.90** | |

Source: Authors.

Notes: The term “GM food” refers to retail food products with at least one genetically modified (GM) ingredient required to be labelled according to EU regulation. All average answers shown in bold show that all respondents tended to have more or less the same opinion on that question a (i.e. the standard deviation of the answers was smaller than their average). If the average and standard deviation are not bold, this indicates high diversity of opinions to that question (standard deviation larger than average). See Table A.18 for further statistical details.

***Attitudes and considerations of GM-unaware supermarkets***

Table 8 provides the comparable overview of considerations and attitudes of the leaderships of GM-unaware supermarkets concerning the marketing of GM-labelled food. In general, consensus among them is larger than among the GM-free supermarkets. The approval scores for the 35 considerations range only from 1 to 0.4 (Table 8) while they range from 1 to -0.33 for the latter (Table 7). The standard deviation of all answers only amounts to 0.74 while it is 0.9 for the GM-free supermarkets. Hence, attitudes and considerations concerning GM food among those supermarkets which are aware of not marketing such food in their branches are more diverse than among those supermarket leaderships which are largely unaware of GM food.

Table 8: Considerations of GM-unaware supermarkets in favour of marketing GM food

| | Approval score | | |
|---|---|---|---|
| **Statement** | **Average** | **Standard deviation** | **General opinion** |
| Eating GM food has no risk to customers' health | **1.00** | **0.00** | |
| GM food is safer for the customer than the original product | **0.93** | **0.57** | |
| GM food has a longer shelf life for customers | **0.93** | **0.57** | |
| Many consumers are interested in GM food | **0.87** | **0.50** | |
| GM food ensures a good image of my branch | **0.87** | **0.50** | |
| There are no dangers to public health from consuming GM food | **0.87** | **0.62** | broad consensus |
| GM food ensures a better reputation for my store | **0.87** | **0.62** | |
| GM food helps differentiating of my product portfolio | **0.87** | **0.50** | |
| There is sufficient policy certainty about GM food | **0.86** | **0.52** | |
| GM food has better continuity in delivery (better availability) | **0.86** | **0.74** | |
| The sale of GM food helps to attract new customers | **0.80** | **0.54** | |
| GM food provides price benefits for customers | **0.79** | **0.56** | |
| Many customers are curious to taste GM food | **0.79** | **0.56** | |
| GM food is accepted by customers | **0.73** | **0.44** | |
| GM food has a higher quality than the original product | **0.73** | **0.57** | |
| Offering GM food fits in with the identity of my retail organization | **0.71** | **0.70** | |
| There is a high demand for GM food | 0.67 | 0.94 | |
| The retail organization to which this branch falls has decided so (overarching policy) | 0.67 | 0.87 | |
| More and more people want to buy GM food | 0.67 | 0.87 | |
| An easier form of marketing ensures lower costs | 0.64 | 0.81 | |
| GM food contributes to sustainability in the food supply | 0.64 | 0.72 | |
| GM food has better price stability under varying market conditions | 0.60 | 0.71 | |
| There is a lot of public interest in GM food | 0.60 | 0.71 | predominant strong |
| GM food plays an important role in the future of global food supply | 0.60 | 0.80 | approval |
| The long-term effects of GM food production are well known | 0.57 | 0.90 | |
| GM food creates new market segments that my branch can be part of | 0.57 | 0.73 | |
| GM food increases the turnover of this branch | 0.53 | 0.88 | |
| The supplier of this branch has decided so | 0.53 | 0.96 | |
| GM food ensures a higher yield for my branch | 0.47 | 0.88 | |
| The average consumer shows a lot of interest in GM food | 0.47 | 0.96 | |
| GM food helps limiting inflation | 0.47 | 0.96 | |
| GM food has a higher nutritional value for customers | 0.43 | 0.82 | |
| It is morally right to offer GM food | 0.43 | 0.73 | |
| GM food contributes to combating climate change | 0.43 | 0.82 | |
| Offering GM food is in line with my focus on offering innovative food | 0.40 | 0.80 | |
| | | | |
| **All answers** | **0.68** | **0.74** | |

Source: Authors.

Notes: The term "GM food" refers to retail food products with at least one genetically modified (GM) ingredient required to be labelled according to EU regulation. All average answers shown in bold show that all respondents tended to have more or less the same opinion on that question a (i.e. the standard deviation of the answers was smaller than their average). If the average and standard deviation are not bold, this indicates high diversity of opinions to that question (standard deviation larger than average). See Table A.19 for further statistical details.

In contrast to the GM-free group of retail stores, considerations concerning the absence of risks receive highest consensus scores among the 15 supermarkets which answered. The remaining considerations which receive highest consensus are related to food quality, demand interest, public opinion aspects of GM marketing as well as supply chain aspects. The 16 statements ranked the highest in Table 8 also show highest consensus in the sense that the variation of answers is smallest for those statements.

Affordability benefits of GM food for clients receive approval scores of 0.79, 0.60 and 0.47 while GM-free supermarkets show much less consensus to affordability aspects having approval scores of 0.42 and twice zero. There appears to be no consensus[17] on whether GM food helps to cushion adverse retail food price inflation effects (shown in Figure 3) for consumers. Moral considerations of why or why not to offer GM food to consumers as well as links of GM food production with climate change receive also very little support by both groups of supermarket leaderships.

# 4 Summary, discussion and outlook

This report assessed whether the massive and unprecedented economic shocks resulting from the Russian invasion of Ukraine led to behavioural change in food retail marketing patterns within the Netherlands. Neither the steep increase in global agricultural prices during the first months of the Russian invasion of Ukraine (Ihle et al., 2022) nor the constantly rising domestic food retail price inflation have been found to have resulted in a substantial increase in GM-labelled food products offered in Dutch retail shelves. While global agricultural prices have constantly been declining since the establishment of the Black Sea Grain Deal in July 2022 while national retail food price inflation has fiercely and continuously been rising, the number of retail products containing GM ingredients has barely risen until summer 2023.

This analysis has found that the number of GM-labelled food products marketed by a representative sample of Dutch retail store shelves is extremely limited. About one to two dozen brands are currently being marketed. The share of GM-labelled brands in all retail food products marketed hence stagnated in the first half of 2023 at very low levels reaching a share of about 1% for only one of the six food categories considered. Four of the six food categories (see Table A.1) appeared to be GM-free as no GM-labelled brands have been detected in them. The category of cooking oils & vegetable fats showed a constant share of GM-labelled brands, while the highest number of GM-labelled brands marketed in Dutch supermarkets belongs to the category of sweets, biscuits & chips. This was the only of the six food categories which showed (limited) variation in the share of GM food in the short run, i.e., from November 2022 to July 2023. Almost all of the GM-labelled brands of this category are produced in the Unites States and imported to the Netherlands.

Only a few retail chains offer GM-labelled food in the Netherlands. The analysis discovered two categories of supermarket management staff. The first group is sure that GM food is not marketed by their branch. The larger group was formed by those managers who are unaware of whether or not GM food forms part of their store's product portfolio. GM-labelled food appears hence to be a non-issue not only in in supermarket shelves, but also for supermarket managements as well as for customers. Client requests concerning GM food have been reported to be completely absent for most supermarkets, only very few retailers are rarely being asked mainly about whether GM ingredients are absent in the food sold[18]. Supermarkets deliberately not selling GM food appear to have more diverging attitudes and considerations why not marketing GM food while those being unaware of the topic of GM food appear to share fairly similar views.

[17] The standard deviations of the answer to both questions (indicated by the black frames in Table 7 and Table 8) are very high. This indicates that approximately the same number of interviewees agreed and did not agree with these two statements.

[18] Also the Voedingscentrum reported to rarely receive questions about GM food.

The core result that the "*global commodity shock without parallel*" (World Bank, 2022c) has not changed GM food marketing patterns in the Netherlands suggests that Dutch retail marketing structures are largely resilient to such massive and unprecedented global shocks. This is remarkable as world market prices of agricultural commodities appeared indeed to be very susceptible to this unexpected event which partially or completely disrupted several global food supply chains (Ihle et al., 2022). Also, national retail food price inflation appeared to be impacted at, however, somewhat lower magnitude and in a more stable, i.e., predictable manner.

Despite the growth GM crop acreage has been experiencing in recent years at global level (GMO Answers, 2023a), the resulting large quantities of GM crops are virtually not ending up in GM-labelled (and often highly processed) retail food brands in Dutch supermarkets (Figure 2). Additionally, there was no consensus among supermarket managements that GM food would help customers to cushion adverse effects of high retail food price inflation. Although most of the GM crops imported to the EU are used for animal feed (EuropaBio, 2017), processed foods containing animal-based ingredients such as meat, eggs or dairy which were produced using animal feed containing GM crops are not considered in this analysis. As such food does not (need to) get labelled in the EU it is not possible to distinguish them from competing brands whose animal-based ingredients have been produced with GM-free feed.

This analysis is to the best of our knowledge the worldwide first structured and repeated data gathering effort for measuring the incidence of GM-labelled food products at retail level for a nationally representative set of supermarket shelves. This analysis is based on a representative sample of Dutch food retailing stores from a wide portfolio of the most relevant chains in all regions of the country. It creates a unique panel dataset for 20 supermarkets with five repeated observations for each supermarket every two months. This innovative dataset allows the first quantitative analysis of the temporal dynamics of GM food retail marketing during the major recent global crisis of energy and food affordability worldwide. This is complemented by a - to the best of our knowledge - unique comprehensive analysis effort for clarifying considerations of retailers in favour of or against marketing GM-labelled food.

Although this data gathering and analysis effort is to the best of our knowledge unique, it is subject to a number of methodological limitations. Most importantly, data have been gathered in only five rounds every two months between November 2022 (i.e., 9 months after the start of the Russian invasion) until July 2023 so that the first months of the invasion and the global commodity market turmoil are not covered. However, as the analysis finds that the incidences of GM-labelled food in retail stores do not change substantially, one can plausibly assume that this pattern also held for the first half of 2022.

Hence, the size of the panel is fairly limited especially in time dimension as it covers only five repeated measures for each of the 20 supermarkets during a relatively short time window during sampling period of only 9 subsequent months. This limits the potential of the statistical analysis as well as the generalizability of the analysis results with respect to long-run development patterns. Hence, this analysis of the incidence counts of GM food and the patterns isolated from it are a measurement in the short term. It may plausibly be assumed that these patterns stay stable for one or two years, however, they might change during longer time scopes of 3 to 5 years.

This implies for future research that a long-term perspective needs to be taken by repeating the incidence measurement and augmenting the analysis in about 2 to 5 years. Ideally that would be followed by another follow-up in 8 to 10 years so that not only evidence on medium-term, but also long-term patterns can be obtained. Without such follow-up assessments in the long-run, no robust conclusions about the long-run trend in the marketing pattern of GM-labelled food in the Netherlands can be obtained. Such an extension of the incidence measurement in the temporal domain might go along with an extension to countries other than the Netherlands. Relevant candidates would be countries in which substantial quantities of GM crops are grown such as the Unites States, Brazil or Argentina as well as countries which pursue policies which try to limit the use of GM food or feed like France and Germany.

The very small numbers of food products with labelled GM ingredients found in Dutch grocery shelves render the potential of statistical analysis to be limited as they imply various analysis limitations caused by the scarcity of the measurements collected. The high variability across the bi-monthly observations results in time trend estimates of small growth rates and large statistical uncertainty. The corresponding effect size of a single additional GM food product to be on average newly discovered among the ca. 4500 products checked in the next sampling round – i.e. every two months – tend to be of negligible magnitude as it barely makes a difference from a practical perspective.

As the data gathering effort focused on counting the incidences of GM-labelled food and the topic appears to be a non-issue for most supermarket leaderships, it is barely possible to deduce with certainty the determinants of the observed slight fluctuations in GM food incidences. Hence it remains uncertain whether they are the result of deliberate strategy changes of the supermarket (chains) or are observed due to other reasons. Such reasons could be common temporal fluctuations in product availability, being out of sale in the short run, common delivery or assortment fluctuations, other (short-run) supply chain fluctuations or even disruptions such as strikes of supermarket distribution centres.

However, deliberate strategy changes appear to be very unlikely as that would mean that a steady and consistent upward trend or a substantial upward shift had been observable which was not the case. However, that such a change has not happened during the data gathering phase does not exclude the possibility that it might happen at some point in the future. To detect such major changes concerning GM food marketing continuous grocery monitoring would be necessary which is effort- and cost-intensive. A feasible option in terms of effort and costs could be to monitor this development at lower frequencies, e.g., every 6 months, which would yield two observations per year.

Contact requests to interviewees at the holding level were not successful supposedly because they have very limited priority to invest time into this issue because the topic of GM food is a non-issue for most retail companies (see PBL, 2012, p. 23 for the structure of the Dutch food chain). In contrast, small supermarket chains which provide a GM-free assortment nevertheless are interested in the topic mainly due to differentiation reasons of the own brand vis-a-vis the big players in the national market.

This data gathering effort and the subsequent analysis have created original value added. Future follow-up research might tackle answering various additional questions of relevance. Data gathering should be extended with providing more comprehensive and more detailed public data because evidence-based policy making crucially depends on transparent and sufficiently detailed measurements of the socio-economic reality. The national perspective

taken in this analysis should be extended by clarifying which products at global scale contain GM ingredients or are produced using gene engineering techniques. A global inventory of which food producing companies are using which GM ingredients would enable many additional analyses especially if large GM crop growing countries such as the US, Argentina or Brazil are covered as much as possible. It would be worthwhile to clarify what drives the decisions of retail food producers to consciously choose for or to abstain from GM ingredients. Lastly, a structured comparative cross-national analysis of the indirect effects of the use of GM ingredients on food retail prices would shed light on the question to what extent GM food can ease inflationary pressure to food prices.

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# Appendix

## A.1 Sampling design and data gathering

To analyse the development of the numbers of GM-labelled food products offered by Dutch supermarkets (research objectives O1c and O1d), a regionally balanced sample of 20 supermarkets has been randomly selected. The distribution of the randomly selected supermarkets (see appendix Table A.4) represents the distribution of the supermarket turnover share in the entire Dutch market in 2021 as quantified by NielsenIQ (Food en Retail, 2022) in order to closely resemble the aggregated importance of each chain for the Dutch retail market. Altogether, the eight chains sampled account for 88.5% of the total supermarket food retail turnover.

Moreover, the number of supermarkets has been sampled according to the population shares of the different parts of The Netherlands (the so-called *landsdelen*: East, North, West, South, see Table A.5) as defined by CBS (2022, expressed as share in the total number of 20 supermarkets sampled). In this way, the supermarket distribution corresponds to the distribution of the Dutch population across these four regions in order to account for potential differences in GMO marketing across these four regions. Last, the supermarkets sampled also correspond to the distribution of Dutch population across municipality sizes (see Table A.6). Hence, 30% of the 20 supermarkets sampled were located either in middle-sized towns (between 40,000 until 90,000 inhabitants) or in rural areas (less than 40,000 inhabitants) and 40% in located in big cities (municipalities of more than 90,000 inhabitants).

For analyzing research objective O2, the set of twenty supermarket chains which have been visited five times for repeatedly counting the numbers of GM food[19] products offered (see Table A.2) has been extended by five supermarket chains. Each of these chains account only for a niche share of less than 2% of the Dutch food retail market (Table A.7). Nevertheless, this ensured that also the considerations of small supermarket chains about whether or not offering GM food to customers deserve sufficient attention for analyzing O2. Hence, the analysis of research objective O2 covers 13 supermarket chains active in the Dutch food retailing market.

Table A.1: Correspondence of Dutch and English food category names

| Dutch name | English name |
|---|---|
| snoep, koek, chips | sweets, biscuits and chips |
| olie & vetten | baking oils & vegetable fats |
| meel & bloem | flours |
| mayonaises | mayonnaises |
| margarines | margarines |
| mais & soja | corn & soy |

Source: Authors.

[19] The term GM food refers in the following to retail food products with at least one genetically modified (GM) ingredient corresponding to the terms “ggv” or “genetisch gemotificeerde voedselproducten” in Dutch.

These six categories have been deduced from a dataset of anonymized retail products containing at least one GM ingredient extracted from the Levensmiddelendatabank (LEDA) and kindly made available by Wieke van der Vossen-Wijmenga, projectmanager of the LEDA at Voedingscentrum (The Netherlands Nutrition Center). LEDA is a branded food database which lists the names, nutritional values, ingredients & additional data of 140.000 food retail products which corresponds to about 75% of all retail food products sold in The Netherlands. The database is managed together with RIVM and not publicly accessible. Sharing ingredient data of the food products marketed with LEDA is done on voluntary basis. This implies that it does not contain all data of all food producers/ retailers (e.g. Aldi and Lidl did not contribute at the time this research was conducted). Hence, data quality and data completeness/ representativeness is a point of attention. The Voedingscentrum itself is almost never asked any questions about GM-labelled food.

Table A.2: Supermarket characteristics (location and chain)

| **Supermarkets for product counting and questionnaire** | | | | |
|---|---|---|---|---|
| **Supermarket ID** | **Area** | **Region** | **Chain** | **Chain size** |
| 1 | Rural area | East | Albert Heijn | large |
| 2 | Rural area | East | Lidl | large |
| 3 | Rural area | North | Plus (Superunie) | large |
| 4 | Rural area | North | Aldi | large |
| 5 | Rural area | West | Jumbo | large |
| 6 | Rural area | West | Albert Heijn | large |
| | | | | |
| 7 | Middle-sized town | South | Coop (Superunie) | small |
| 8 | Middle-sized town | South | Jumbo | large |
| 9 | Middle-sized town | East | Hoogvliet (Superunie) | small |
| 10 | Middle-sized town | East | Albert Heijn | large |
| 11 | Middle-sized town | West | Jumbo | large |
| 12 | Middle-sized town | West | Lidl | large |
| | | | | |
| | | | | |
| 13 | Big city | West | Albert Heijn | large |
| 14 | Big city | West | Plus (Superunie) | large |
| 15 | Big city | West | Jumbo | large |
| 16 | Big city | West | Dirk van de Broek (Superunie) | small |
| 17 | Big city | West | Albert Heijn | large |
| 18 | Big city | West | Aldi | large |
| 19 | Big city | South | Coop (Superunie) | large |
| 20 | Big city | South | Albert Heijn | large |
| | | | | |
| **Supermarkets for questionnaire only** | | | | |
| 21 | Rural area | South | Jan Linders (Superunie) | small |
| 22 | Rural area | East | Spar (Superunie) | small |
| 23 | Big city | North | Odin | small |
| 24 | Big city | West | Ekoplaza | small |
| 25 | Middle-sized town | East | Dekamarkt (Superunie) | small |

Source: Authors.
Notes: A supermarket chain is categorized as small if it had a share in the total Dutch retail food market of less than 5% in 2021 as published by Food en Retail (2022).

Table A.3: Supermarkets sampled per sampling round

| Data gathering round | Month/ year | Number supermarkets sampled | Comments |
|---|---|---|---|
| round1 | Nov22 | 20 | |
| round2 | Jan23 | 20 | |
| round3 | Mar23 | 20 | |
| round4 | May23 | 20 | |
| round5 | Jul23 | 19 | survey for answering O2 also conducted; one of the sampled supermarktets permanently closed on 30-06-23 |
| | | | |
| | **total** | **99** | |

Source: Authors.

Table A.4: Supermarkets sampled vs. supermarket market share in 2022

| | Share in 2021 | Supermarkets sampled | |
|---|---|---|---|
| **Supermarket chain** | in NL market | number | share |
| Albert Heijn | 35.0% | 6 | 30.0% |
| Jumbo | 21.8% | 4 | 20.0% |
| Lidl | 10.7% | 2 | 10.0% |
| Plus (Superunie) | 6.5% | 2 | 10.0% |
| Aldi | 5.2% | 2 | 10.0% |
| Coop (Superunie) | 3.9% | 2 | 10.0% |
| Dirk van de Broek (Superunie) | 3.4% | 1 | 5.0% |
| Hoogvliet (Superunie) | 2.0% | 1 | 5.0% |
| | | | |
| Total | 88.5% | 20 | 100.0% |

Source: Authors.
Notes: Market shares for 2021 as published in Food en Retail (2022).

Table A.5: Supermarkets sampled per country part (*landsdeel*)

| | Population 2022 | | Supermarkets sampled | |
|---|---|---|---|---|
| **Region (landsdeel)** | number | share | number | share |
| Noord-Nederland | 1,741,932 | 9.9% | 2 | 10.0% |
| Oost-Nederland | 3,717,153 | 21.1% | 4 | 20.0% |
| West-Nederland | 8,420,411 | 47.9% | 10 | 50.0% |
| Zuid-Nederland | 3,711,176 | 21.1% | 4 | 20.0% |
| | | | | |
| Total | 17,590,672 | 100% | 20 | 100% |

Source: Authors based on CBS (2022).
Notes: *landsdelen* correspond to the NUTS-1 regions of The Netherlands. They link to the twelve provinces (representing the NUTS-2 division) in the following way:
Noord-Nederland (NL1)
NL11 Groningen
NL12 Friesland
NL13 Drenthe

Oost-Nederland (NL2)
NL21 Overijssel
NL22 Gelderland
NL23 Flevoland

West-Nederland (NL3)
NL31 Utrecht
NL32 Noord-Holland
NL33 Zuid-Holland
NL34 Zeeland

Zuid-Nederland (NL4)
NL41 Noord-Brabant
NL42 Limburg

Table A.6: Supermarkets sampled per municipality size category

| | Population 2022 | | Supermarkets sampled | |
|---|---|---|---|---|
| **Municipality size** | number | share | number | share |
| Big cities | 7,372,916 | 41.9% | 8 | 40.0% |
| Middle-sized towns | 5,246,634 | 29.8% | 6 | 30.0% |
| Rural areas | 4,971,122 | 28.3% | 6 | 30.0% |
| | | | | |
| Total | 17,590,672 | 100% | 20 | 100% |

Source: Authors.
Notes: Big cities are defined as municipalities of more than 90,000 inhabitants. Middle-sized towns are defined as municipalities which have between 40,000 and 90,000 inhabitants. Rural municipalities are defined to have less than 40,000 inhabitants.

Table A.7: Additional supermarkets interviewed for answering research objective O2

| Supermarket ID | Area | Region | Chain | NL market share |
|---|---|---|---|---|
| 21 | Rural area | South | Jan Linders (Superunie) | 1.1% |
| 22 | Rural area | East | Spar (Superunie) | 1.2% |
| 23 | Big city | North | Odin | n.a. |
| 24 | Big city | West | Ekoplaza | n.a. |
| 25 | Middle-sized town | East | Dekamarkt (Superunie) | 1.7% |

Source: Authors.
Notes: Market shares for 2021 as published by Food en Retail (2022).

## A.2 Detailed results tables

Table A.8: Counts of GM-labelled food per category and data gathering round

| Data gathering round | snoep, koek, chips | olie & vetten | meel & bloem | mayo-naises | marga-rines | mais & soja | Total products per round |
|---|---|---|---|---|---|---|---|
| **round1** | 13 | 6 | 0 | 0 | 0 | 0 | 19 |
| **round2** | 10 | 6 | 0 | 0 | 0 | 0 | 16 |
| **round3** | 14 | 6 | 0 | 0 | 0 | 0 | 20 |
| **round4** | 23 | 6 | 0 | 0 | 0 | 0 | 29 |
| **round5** | 16 | 6 | 0 | 0 | 0 | 0 | 22 |
| **Total products per category** | 76 | 30 | 0 | 0 | 0 | 0 | 106 |

Source: Authors.

Table A.9: Regression output for a potential trend in the GM food product numbers

```
> round <- 1:5
> cbind(snoepEtAl_PerRound, round)
     snoepEtAl_PerRound round
[1,]         0.00000000     1
[2,]        -0.23076923     2
[3,]         0.07692308     3
[4,]         0.76923077     4
[5,]         0.23100000     5
> reg <- lm(snoepEtAl_PerRound~round-1)
> summary(reg)

Call:
lm(formula = snoepEtAl_PerRound ~ round - 1)

Residuals:
       1        2        3        4        5
-0.07275 -0.37627 -0.14132  0.47824 -0.13274

Coefficients:
      Estimate   Std. Error t value  Pr(>|t|)
round  0.07275    0.04334   1.679    0.169

Residual standard error: 0.3214 on 4 degrees of freedom
Multiple R-squared:  0.4133,    Adjusted R-squared:  0.2666
F-statistic: 2.818 on 1 and 4 DF,  p-value: 0.1685
```

Source: Authors.
Notes: This regression output has been obtained using the statistical software R.

Table A.10: Joint trend estimation in world market prices shown in Figure 3

```
> head(pw)
    Index D_soy D_rap D_sun D_mai D_whe D_sug Trend D_GrainDeal
1  0.0000     1     0     0     0     0     0     1           0
2 -0.0300     1     0     0     0     0     0     2           0
3 -0.0378     1     0     0     0     0     0     3           0
4 -0.0671     1     0     0     0     0     0     4           0
5 -0.0725     1     0     0     0     0     0     5           0
6 -0.0456     1     0     0     0     0     0     6           0
> D_GDxt <- D_GrainDeal*Trend
>
> reg_pw <- lm(Index ~ D_GrainDeal + Trend + D_GDxt)
> summary(reg_pw)

Call:
lm(formula = Index ~ D_GrainDeal + Trend + D_GDxt)

Residuals:
     Min       1Q   Median       3Q      Max
-0.95930 -0.13003  0.01564  0.17156  1.12664

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) -0.208905   0.043877  -4.761 3.20e-06 ***
D_GrainDeal  1.834154   0.296256   6.191 2.32e-09 ***
Trend        0.037347   0.002472  15.111  < 2e-16 ***
D_GDxt      -0.068421   0.008152  -8.393 3.07e-15 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.287 on 260 degrees of freedom
Multiple R-squared:  0.4902,    Adjusted R-squared:  0.4843
F-statistic: 83.32 on 3 and 260 DF,  p-value: < 2.2e-16
```

Source: Authors.

Notes: This regression output has been obtained using the statistical software R. The model estimated is

$$\begin{bmatrix} p_{1,1}^{ind} \\ \dots \\ p_{6,44}^{ind} \end{bmatrix} = \alpha_0 + \beta_0 t + D_{GrainDeal}(\alpha_0 + \beta_0 t) + e_t \quad (3a)$$

$$= \alpha_0 + \alpha_0 D_{GrainDeal} + \beta_0 t + \beta_0 D_{GrainDeal} t + e_t \quad (3b)$$

Table A.11: Trend estimation of Dutch food price inflation shown in Figure 3

```
> head(inf)
  HICP_food_NL Trend D_GrainDeal
1   0.00000000     1           0
2   0.01232751     2           0
3   0.02079117     3           0
4   0.02824287     4           0
5   0.02842686     5           0
6   0.03118675     6           0
> D_GDxt <- D_GrainDeal*Trend
> reg_inf <- lm(HICP_food_NL ~ D_GrainDeal + Trend + D_GDxt)
>
> summary(reg_inf)

Call:
lm(formula = HICP_food_NL ~ D_GrainDeal + Trend + D_GDxt)

Residuals:
      Min        1Q    Median        3Q       Max
-0.029384 -0.017561 -0.001257  0.011748  0.061978

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) -0.0033032  0.0079062  -0.418 0.678329
D_GrainDeal -0.2130550  0.0533826  -3.991 0.000273 ***
Trend        0.0023496  0.0004453   5.276 4.90e-06 ***
D_GDxt       0.0094619  0.0014689   6.441 1.13e-07 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.02111 on 40 degrees of freedom
Multiple R-squared:  0.9575,    Adjusted R-squared:  0.9543
F-statistic: 300.2 on 3 and 40 DF,  p-value: < 2.2e-16
```

Source: Authors.

Notes: This regression output has been obtained using the statistical software R. The model estimated is equation (3b) with the difference in comparison with Table A.10 that the dependent variable is the transformed Dutch food price inflation index which takes the value zero in January 2020.

Table A.12: Questions types answering research objective O2

| Question type | Number questions | Share | Focus |
|---|---|---|---|
| Likert scale | 70 | 66% | GMO considerations |
| open | 19 | 18% | GMO marketing in own shop |
| yes/no | 9 | 8% | GMO in daily work routine<br>Personal experience with GMO |
| ranking | 7 | 7% | GMO decision making |
| enumerating | 1 | 1% | GMO decision making |
| | | | |
| **total number questions** | **106** | **100%** | |

Source: Authors.

Table A.13: Professional roles of interviewees

| Function in supermarket | Number |
|---|---|
| supermarket manager | 5 |
| team leader | 4 |
| deputy supermarket manager | 4 |
| assistant supermarket manager | 3 |
| shift leader | 2 |
| service manager | 2 |
| sales employee | 1 |
| allround employee | 1 |
| | |
| **total** | **22** |

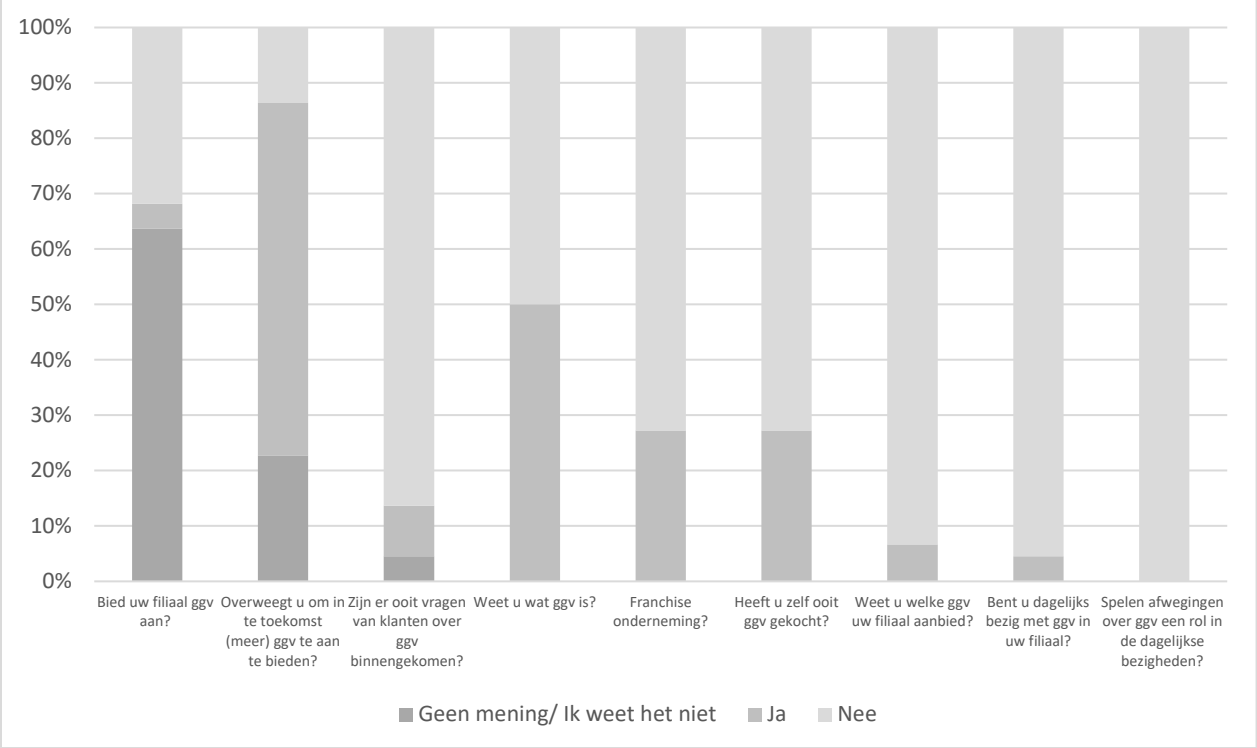
Source: Authors.

Table A.14: Interviewees' answers to open questions

| | |
|---|---|
| **hoeveel klantenvragen kommen er binnen?** | |
| | Ongeveer 1x per maand, of het product misschien genetisch gemodificeerd is |
| | 1x per jaar maximaal |
| | |
| **nog opmerkingen over het onderwerp gg voedsel?** | |
| **little awareness in public/ among clients** | Weinig bekendheid |
| | Weinig over bekend/gehoord |
| | Weinig over bekend |
| | Nog weinig over bekend. Toekomst van deze producten hangt van veel factoren af. |
| | |
| **barely known phenomenon with many uncertainties** | Interessant en onzeker fenomeen. Maar het speelt totaal niet op de winkelvloer en in de organisatie |
| | |
| **little/ absent personal awareness of the interviewee** | Weet er weinig van |
| | Nooit echt van gehoord |
| | Nooit bewust bij stil gestaan, wij zijn puur bezig met het runnen van de winkel |
| | |
| **missing involvement for including GM food into shop portfolio as reason of missing awareness** | Het hoofdkantoor beslist vrijwel alles rondom deze producten |
| | Nooit eerder over gehoord, hangt allemaal van het hoofdkantoor af |
| | |
| | |
| **clear expectations about increasing importance in future** | Zal een grotere rol gaan spelen in de toekomst |
| | Ben benieuwd hoe het in de toekomst gaat |
| | Heel erg afhankelijk van de situatie of we ze in de toekomst gaan verkopen. Ligt vooral heel erg aan de prijs. |

Source: Authors.

Figure A.1: Rol van ggv in de dagelijkse werkroutine en persoonlijke ervaring met ggv




Source: Authors.

Notes: The abbreviation “ggv” means “genetisch gemodificeerde voedselproducten”, i.e., retail food products with at least one genetically modified (GM) ingredient required to be labelled according to EU regulation. See

Table A.15 for the Dutch-English correspondence of questions.

Table A.15: Correspondence of English and Dutch questions of Figure 6 and Figure A.1

| English question | Dutch question |
|---|---|
| Does your store offer GM food? | Bied uw filiaal ggv aan? |
| Do you consider to offer (more) GM food in the future? | Overweegt u om in te toekomst (meer) ggv te aan te bieden? |
| Have you ever received client questions about GM food? | Zijn er ooit vragen van klanten over ggv binnengekomen? |
| Do you know what GM food is? | Weet u wat ggv is? |
| Is your store a franchise business? | Franchise onderneming? |
| Have you ever bought GM food yourself? | Heeft u zelf ooit ggv gekocht? |
| Do you have an idea which GMO products your store offers? | Weet u welke ggv uw filiaal aanbied? |
| Do you every day deal in your store with questions about GM food? | Bent u dagelijks bezig met ggv in uw filiaal? |
| Do considerations about GM food play a role in the store's daily activities? | Spelen afwegingen over ggv een rol in de dagelijkse bezigheden? |

Source: Authors.

Table A.16: GM food-related experiences by group of supermarket management (Dutch)

| | Alle supermarkten | | | Supermarketen, die zeker geen ggv aanbieden | | | Supermarkten (niet zeker of) ggv aanbieden | | |
|---|---|---|---|---|---|---|---|---|---|
| Question | Geen mening/ Ik weet het niet | Ja | Nee | Geen mening/ Ik weet het niet | Ja | Nee | Geen mening/ Ik weet het niet | Ja | Nee |
| Franchise onderneming? | 0% | 27% | 73% | 0% | 14% | 86% | 0% | 33% | 67% |
| Weet u wat ggv is? | 0% | 50% | 50% | 0% | 57% | 43% | 0% | 47% | 53% |
| Bied uw filiaal ggv aan? | 64% | 5% | 32% | 0% | 0% | 100% | 93% | 7% | 0% |
| Weet u welke ggv uw filiaal aanbied? | 0% | 7% | 93% | na | na | na | 0% | 7% | 93% |
| Overweegt u om in te toekomst (meer) ggv te aan te bieden? | 23% | 64% | 14% | 29% | 57% | 14% | 20% | 67% | 13% |
| Bent u dagelijks bezig met ggv in uw filiaal? | 0% | 5% | 95% | 0% | 14% | 86% | 0% | 0% | 100% |
| Spelen afwegingen over ggv een rol in de dagelijkse bezigheden? | 0% | 0% | 100% | 0% | 0% | 100% | 0% | 0% | 100% |
| Zijn er ooit vragen van klanten over ggv binnengekomen? | 5% | 9% | 86% | 14% | 29% | 57% | 0% | 0% | 100% |
| Heeft u zelf ooit ggv gekocht? | 0% | 27% | 73% | 0% | 29% | 71% | 0% | 27% | 73% |

Source: Authors.

Notes: Cells marked in grey emphasize pronounced differences in the GM-related experiences in both groups of supermarkets. The abbreviation “ggv” means “genetisch gemodificeerde voedselproducten”, i.e., retail food products with at least one genetically modified (GM) ingredient required to be labelled according to EU regulation.

Table A.17: Approval of GM related statements by GM-free vs. GM-unaware markets

| | Approval score | | Frequency | |
|---|---|---|---|---|
| General opinion | larger than | smaller or equal than | GM-free | GM-unaware |
| broad consensus | 0.80 | 2.00 | 17% | 31% |
| predominant strong approval | 0.33 | 0.80 | 34% | 69% |
| predominant weak approval | 0.15 | 0.33 | 17% | 0% |
| largely balanced opinion | -0.15 | 0.15 | 29% | 0% |
| predominant weak rejection | -0.33 | -0.15 | 0% | 0% |
| predominant strong rejection | -0.80 | -0.33 | 3% | 0% |
| broad rejection | -2.00 | -0.80 | 0% | 0% |
| | | Sum | 100% | 100% |

Source: Authors.

Notes: “Approval score” refers to the average approval score for a statement by all interviewees who answered it on a Likert scale between -2 (helemaal niet mee eens) and 2 (helemaal mee eens).

Table A.18: Coefficients of variation of approval scores of GM-free supermarkets

| | Approval score | | | |
|---|---|---|---|---|
| **Statement** | **Average** | **Standard deviation** | **Coefficient of variation** | **General opinion** |
| Niet aanbieden van ggv sluit aan bij de identiteit van mijn retailorganisatie | **1.00** | **0.93** | **0.93** | |
| Verkoop van ggv verhoogt het risico op schadeclaims op korte of langere termijn | **1.00** | **0.49** | **0.49** | |
| De retailorganisatie waar dit filiaal onder valt heeft het besloten (overkoepelend beleid) | **0.86** | **0.35** | **0.41** | broad consensus |
| De toeleverancier van dit filiaal heeft het besloten | **0.86** | **0.35** | **0.41** | |
| Gevaren voor de volksgezondheid bij consumptie van ggv | **0.86** | **0.35** | **0.41** | |
| ggv hebben een lagere kwaliteit dan het oorspronkelijke product | **0.80** | **0.40** | **0.50** | |
| Ingewikkelde marketing dat zorgt voor hogere kosten | **0.71** | **0.70** | **0.98** | |
| ggv zijn onveiliger voor de klant dan het originele product | 0.67 | 0.75 | 1.12 | |
| Weinig consumenten zijn geïnteresseerd in ggv | 0.57 | 0.73 | 1.27 | |
| ggv zorgen voor een slecht imago van mijn winkel | 0.57 | 1.05 | 1.84 | |
| De gemiddelde consument toont weinig interesse in ggv | 0.57 | 0.73 | 1.27 | |
| Er is geringe vraag naar ggv | 0.57 | 0.73 | 1.27 | predominant strong |
| ggv worden door de klant niet geaccepteerd | 0.57 | 0.73 | 1.27 | approval |
| ggv dragen niet bij aan een verduurzaming van het voedselsysteem | 0.57 | 0.90 | 1.58 | |
| Verkoop van ggv verhoogt het risico op schadeclaims op korte of langere termijn | **0.57** | **0.49** | **0.87** | |
| ggv zijn duurder voor de klant | 0.43 | 0.90 | 2.11 | |
| Er bestaan grote publieke zorgen over ggv | 0.43 | 0.73 | 1.70 | |
| ggv hebben een slechtere continuïteit in de aanlevering (slechte verkrijgbaarheid) | 0.33 | 0.94 | 2.83 | |
| Ik vrees boycots die bij dit filiaal zullen komen door het aanbieden van ggv | 0.29 | 1.16 | 4.06 | |
| Ik vrees anti-ggv protesten zullen ontstaan | 0.29 | 1.16 | 4.06 | |
| ggv hebben een kortere houdbaarheid voor de klant | 0.29 | 0.88 | 3.08 | predominant weak |
| ggv hebben een lagere voedingswaarde voor de klant | 0.17 | 0.90 | 5.39 | approval |
| Er heerst beleidsonzekerheid over ggv | 0.17 | 0.90 | 5.39 | |
| ggv hebben geen belangrijke rol in de toekomstige wereldwijde voedselvoorziening | 0.17 | 0.90 | 5.39 | |
| ggv zorgen voor een lagere opbrengst in mijn filiaal | 0.14 | 0.99 | 6.93 | |
| De lange termijneffecten van ggv productie zijn onzeker | 0.14 | 0.99 | 6.93 | |
| Minder en minder mensen willen ggv kopen | 0.14 | 0.83 | 5.83 | |
| ggv hebben een slechtere prijsstabiliteit onder wisselende marktomstandigheden | 0.00 | 1.00 | not a number | |
| De omzet van mijn winkel zal dalen door het aanbieden van ggv | 0.00 | 0.82 | not a number | largely balanced |
| Het aanbieden van ggv zal leiden tot minder klanten | 0.00 | 0.93 | not a number | opinion |
| ggv dragen niet bij aan het tegengaan van klimaatverandering | 0.00 | 1.29 | not a number | |
| ggv helpen niet om de inflatie te beperken | 0.00 | 0.82 | not a number | |
| gg-producten zorgen voor een slechtere reputatie voor mijn winkel | -0.14 | 0.99 | -6.93 | |
| Te weinig klanten zijn nieuwsgierig om ggv te proeven | -0.14 | 0.99 | -6.93 | |
| Het is moreel onjuist om ggv te verkopen | -0.33 | 0.47 | -1.41 | predominant strong rejection |
| | | | | |
| **All answers** | **0.38** | **0.90** | **2.37** | |

Source: Authors.

Notes: The abbreviation “ggv” means “genetisch gemodificeerde voedselproducten”, i.e., retail food products with at least one genetically modified (GM) ingredient required to be labelled according to EU regulation. In bold all answers with a coefficient of variation larger than 1 in absolute terms indicating a high diversity of opinions to that question. When the coefficient of variation in absolute terms is smaller than 1, this indicates that all respondents tended to have more or less the same opinion.

Table A.19: Coefficients of variation of approval scores of GM-unaware supermarkets

| | Approval score | | | |
|---|---|---|---|---|
| Statement | Average | Standard deviation | Coefficient of variation | General opinion |
| Het eten van ggv heeft geen risico voor de gezondheid van de klant | **1.00** | **0.00** | **0.00** | |
| ggv zijn veiliger voor de klant dan het originele product | **0.93** | **0.57** | **0.61** | |
| ggv hebben een langere houdbaarheid voor de klant | **0.93** | **0.57** | **0.61** | |
| Vele consumenten zijn geïnteresseerd in ggv | **0.87** | **0.50** | **0.58** | |
| ggv zorgen voor een goed imago van mijn filiaal | **0.87** | **0.50** | **0.58** | |
| Er bestaan geen gevaren voor de volksgezondheid bij consumptie ggv | **0.87** | **0.62** | **0.71** | broad consensus |
| ggv zorgen voor een betere reputatie voor mijn winkel | **0.87** | **0.62** | **0.71** | |
| ggv helpen met de differentiatie van mijn aanbod | **0.87** | **0.50** | **0.58** | |
| Er heerst voldoende beleidszekerheid over ggv | **0.86** | **0.52** | **0.60** | |
| ggv hebben een betere continuïteit in de aanlevering (betere verkrijgbaarheid) | **0.86** | **0.74** | **0.87** | |
| De verkoop van ggv helpt om nieuwe klanten aan te trekken | **0.80** | **0.54** | **0.68** | |
| ggv leveren prijsvoordeel op voor de klant | **0.79** | **0.56** | **0.71** | |
| Vele klanten zijn nieuwsgierig om ggv te proeven | **0.79** | **0.56** | **0.71** | |
| ggv worden door de klant geaccepteerd | **0.73** | **0.44** | **0.60** | |
| ggv hebben een hogere kwaliteit dan het oorspronkelijke product | **0.73** | **0.57** | **0.78** | |
| Aanbieden van ggv sluit aan bij de identiteit van mijn retailorganisatie | **0.71** | **0.70** | **0.98** | |
| Er is grote vraag naar ggv | 0.67 | 0.94 | 1.41 | |
| De retail organisatie waar dit filiaal onder valt heeft het besloten (overkoepelend beleid) | 0.67 | 0.87 | 1.30 | |
| Meer en meer mensen willen gg voedsel kopen | 0.67 | 0.87 | 1.30 | |
| Een gemakkelijkere vorm van marketing zorgt voor lagere kosten | 0.64 | 0.81 | 1.26 | |
| ggv dragen bij aan verduurzaming in de voedselvoorziening | 0.64 | 0.72 | 1.12 | |
| ggv hebben een betere prijsstabiliteit onder wisselende marktomstandig-heden | 0.60 | 0.71 | 1.19 | |
| Er bestaat veel publieke interesse in ggv | 0.60 | 0.71 | 1.19 | predominant strong |
| ggv speelt een belangrijke rol in de toekomst van de wereldwijde voedselvoorziening | 0.60 | 0.80 | 1.33 | approval |
| De lange termijn effecten van ggv productie zijn voldoende bekend | 0.57 | 0.90 | 1.58 | |
| Nieuwe marktsegmenten waar mijn filiaal onderdeel van kan zijn | 0.57 | 0.73 | 1.27 | |
| ggv verhogen de omzet van dit filiaal | 0.53 | 0.88 | 1.66 | |
| De toeleverancier van dit filiaal heeft het besloten | 0.53 | 0.96 | 1.79 | |
| ggv zorgen voor een hogere opbrengst van mijn filiaal | 0.47 | 0.88 | 1.90 | |
| De gemiddelde consument toont veel interesse in ggv | 0.47 | 0.96 | 2.05 | |
| ggv helpt de inflatie te beperken | 0.47 | 0.96 | 2.05 | |
| ggv hebben een hogere voedingswaarde voor de klant | 0.43 | 0.82 | 1.91 | |
| Het is moreel juist om ggv aan te bieden | 0.43 | 0.73 | 1.70 | |
| ggv dragen bij aan het tegengaan van klimaatverandering | 0.43 | 0.82 | 1.91 | |
| Het aanbieden van ggv sluit aan bij de focus om innovatief voedsel aan te bieden | 0.40 | 0.80 | 2.00 | |
| | | | | |
| **All answers** | **0.68** | **0.74** | **1.09** | |

Source: Authors.

Notes: The abbreviation “ggv” means “genetisch gemodificeerde voedselproducten”, i.e., retail food products with at least one genetically modified (GM) ingredient required to be labelled according to EU regulation. In bold all answers with a coefficient of variation larger than 1 in absolute terms indicating a high diversity of opinions to that question. When the coefficient of variation in absolute terms is smaller than 1, this indicates that all respondents tended to have more or less the same opinion.

## A.3 Questionnaire

**Achtergrond informatie, die kan worden genoemd (als het gevraagd wordt bijvoorbeeld), maar hoeft niet in ieder geval genoemd te worden:**

- onderzoek van de Wageningse Universiteit voor de Nederlandse overheid, specifiek voor de Commissie Genetische Modificatie (COGEM)
    - COGEM adviseert en informeert de regering over/ethisch-maatschappelijke aspecten verbonden aan genetische modificatie

- (vragenlijst is gericht aan de medewerker van uw supermarkt die medezeggenschap heeft over het aanbieden van genetisch gemodificeerde voedselproducten in uw winkel?
- Eerst enkele algemene vragen
- Daarna zal aantal stellingen voorgelegd worden
    - aan te geven in hoeverre deze stellingen in uw filiaal invloed hebben op het al dan niet aanbieden van genetisch gemodificeerde voedingsmiddelen

even kort over de achtergrond: Deze onderzoek is gericht op genetisch gemodificeerde (gg-) voedselproducten, dus "*afkomstig van organismen waarvan het genetisch materiaal is gewijzigd op een manier die van nature niet voorkomt, bijvoorbeeld door de introductie van een gen uit een ander organisme."*

- Dit is het soort voedselproduct dat ik in mijn vragenlijst bedoel met "genetisch gemodificeerd voedsel"/ "gg voedsel" of "genetisch gemodificeerd levensmiddel" en waarover ik u verschillende vragen zal stellen.
- In Nederland is het niet toegestaan gg-gewassen te telen.
- Wel mogen voedselproducten waarin gg-ingrediënten verwerkt zijn, geïmporteerd en verkocht worden. Als deze bewerkte producten voor meer dan 0,9% uit genetisch gemodificeerde ingrediënten bestaan, dan is het in Nederland en Europa verplicht dit op het etiket te vermelden.

**Deze eerste deel van deze vragenlijst is gericht op algemene informatie over uw winkel.**

1. Is deze winkel een franchise onderneming?

| **Ja** | **Nee** | **Ik weet het niet** |
|---|---|---|
| | | |

2. Wat is uw functie in deze winkel?

| **Functie** | **Kruis voor ja** |
|---|---|
| Supermarktmanager | |
| Inkoopmanager | |
| Vervangend supermarktmanager | |
| Franchise ondernemer | |
| **Anders, namelijk:** | |

3. Wie hebben er allemaal beslissingsbevoegdheid over het aanbod van genetisch gemodificeerde levensmiddelen in uw winkel?

| **Belanghebbenden** | **3a. Beslissingsbevoegdheid**<br><br>(ja/ nee) | **3b. Rangschik de belanghebbenden op basis van hun beslissingsbevoegdheid van meeste naar minste invloed**<br>(0 = laagste beslissingsbevoegdheid, grootse getal = grootse bevoegdheid) |
|---|---|---|
| Supermarktmanager | | |
| Franchise ondernemer | | |
| Category-/ accountmanager in het hoofdkantoor | | |
| Inkoopmanager in het hoofdkantoor | | |
| | | |
| **Anders, namelijk:** | | |
| | | |
| | | |

**In de volgende vragen zou ik graag willen weten, welke overwegingen in uw filiaal een rol spelen/ belangrijk zijn om wel of geen genetisch gemodificeerde voedselproducten in uw winkel aan te bieden. Ik lees u nu zo'n 20 korte stellingen voor. Ik vraag u om op iedere stelling vanuit uw filiaal perspectief te antwoorden.** U geeft de antwoordoptie aan die uw mening - vanuit het filiaal perspectief – het beste weergeeft. De zes antwoordmogelijkheden voor alle uitspraken zijn:

- Helemaal mee eens
- Mee eens
- Neutraal (dus u heeft wel een mening erover, maar die is noch voor noch tegen de gemaakte uitspraak)
- Oneens

- Helemaal mee oneens
- Geen mening (u wenst hier geen antwoord op te geven)

4.1 Weet u wat genetisch gemodificeerd voedsel is?

| | **Ja** | **Nee** |
|---|---|---|
| **Antwoord** | | |

4.2 Bied uw filiaal op dit moment genetisch gemodificeerde voedselproducten aan?

| | **Ja** | **Nee** | **Ik weet niet** |
|---|---|---|---|
| **Antwoord** | | | |
| **Vervolgvraag** | ga dan door met vraag 5 | ga dan door met vraag 6 | ga dan door met vraag 5 |

5. Wat zijn in uw filiaal de overwegingen om genetisch gemodificeerd voedsel **wel** aan te bieden? Dus ik wil graag weten waarom U overwogen heeft om genetisch gemodificeerd voedsel in het schap op te nemen.

| | **Helemaal mee eens** | **Eens** | **Neutraal** | **Oneens** | **Helemaal mee oneens** | **Geen mening** |
|---|---|---|---|---|---|---|
| **5.1 gg-producten hebben een hogere voedingswaarde voor de klant** | | | | | | |
| **5.2 gg-producten leveren prijsvoordeel op voor de klant** | | | | | | |
| **5.3 gg-producten hebben een betere prijsstabiliteit onder wisselende marktomstandig-heden** | | | | | | |
| **5.4 gg-producten verhogen de omzet van deze filiaal** | | | | | | |
| **5.5 de verkoop van gg-producten helpt om nieuwe klanten aan te trekken** | | | | | | |
| **5.6 Vele consumenten zijn geïnteresseerd in gg-producten** | | | | | | |
| **5.7 GG-producten zorgen voor een goed imago van mijn filiaal** | | | | | | |
| **5.8 GG-producten zorgen voor een hogere opbrengst van mijn filiaal** | | | | | | |
| **5.9 De gemiddelde consument toont veel interesse in gg-producten** | | | | | | |
| **5.10 Er is grote vraag naar gg-producten** | | | | | | |
| **5.11 De retailorganisatie waar dit filiaal onder valt heeft het** | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| **besloten (overkoepelend beleid)** | | | | | | |
| **5.12 De toeleverancier van dit filiaal heeft het besloten** | | | | | | |
| **5.13 GG-producten worden door de klant geaccepteerd** | | | | | | |
| **5.16 De lange termijn effecten van gg voedsel productie zijn voldoende bekend** | | | | | | |
| **5.17 Er bestaat veel publieke interesse in gg-producten** | | | | | | |
| **5.18 Er bestaan geen gevaren voor de volksgezondheid bij consumptie gg-producten** | | | | | | |
| **5.19 Het is moreel juist om gg-voedselproducten aan te bieden** | | | | | | |
| **5.20 gg-producten zorgen voor een betere reputatie voor mijn winkel** | | | | | | |
| **5.21 Een gemakkelijkere vorm van marketing zorgt voor lagere kosten** | | | | | | |
| **5.22 GG-producten hebben een hogere kwaliteit dan het oorspronkelijke product** | | | | | | |
| **5.23 GG-producten zijn veiliger voor de klant dan het originele product** | | | | | | |
| **5.24 GG-producten dragen bij aan het tegengaan van klimaatverandering** | | | | | | |
| **5.25 GG-producten dragen bij aan verduurzaming in de voedselvoorziening** | | | | | | |
| **5.26 Aanbieden van gg-producten sluit aan bij de identiteit van mijn retailorganisatie** | | | | | | |
| **5.27 Er heerst voldoende beleidszekerheid over gg voedsel** | | | | | | |
| **5.28 gg-voedsel speelt een belangrijke rol in de toekomst van de wereldwijde voedselvoorziening** | | | | | | |
| **5.30 gg-producten hebben een betere continuïteit in de** | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| **aanlevering (betere verkrijgbaarheid)** | | | | | | |
| **5.31 GG-producten hebben een langere houdbaarheid voor de klant** | | | | | | |
| **5.32 GG-producten helpen met de differentiatie van mijn aanbod** | | | | | | |
| **5.33 Nieuwe marktsegmenten waar mijn filiaal onderdeel van kan zijn** | | | | | | |
| **5.34 Het aanbieden van gg-producten sluit aan bij de focus om innovatief voedsel aan te bieden** | | | | | | |
| **5.35 Vele klanten zijn nieuwsgierig om gg-producten te proeven** | | | | | | |
| **5.36 Meer en meer mensen willen gg voedsel kopen** | | | | | | |
| **5.37 GG-voedsel helpt de algemene prijsinflatie te beperken** | | | | | | |
| **5.38 Het eten van gg voedsel heeft geen risico voor de gezondheid van de klant** | | | | | | |
| **5.39 Anders, namelijk:** | | | | | | |

6.1 Hoeveel genetisch gemodificeerde voedselproducten worden in deze winkel verkocht?

6.2 Welke merken genetisch gemodificeerde voedselproducten worden in deze winkel verkocht? Denk daarbij bijvoorbeeld aan producten gemaakt uit mais of soja.

| **Categorie** | **Aantal verschillende genetisch gemodificeerde voedselproducten** | **Merken** |
|---|---|---|
| Snoep, koek, chips | | |
| Oliën en vetten | | |
| Meel en bloem | | |
| Mayonaises | | |
| Margarines | | |
| Mais en soja | | |
| **Anders, namelijk:** | | |

Ga door met vraag 7.

7. Wat zijn in uw filiaal de overwegingen om **geen** genetisch gemodificeerd voedsel aan te bieden? Dus ik wil graag weten waarom U overwogen heeft om geen genetisch gemodificeerd voedsel in het schap op te nemen.

| | **Helemaal mee eens** | **Eens** | **Neutraal** | **Oneens** | **Helemaal mee oneens** | **Geen mening** |
|---|---|---|---|---|---|---|
| **7.1 gg-producten hebben een lagere voedingswaarde voor de klant** | | | | | | |
| **7.2 gg-producten zijn duurder voor de klant** | | | | | | |
| **7.3 GG-producten hebben een slechtere prijsstabiliteit onder wisselende marktomstandigheden** | | | | | | |
| **7.4 De omzet van dit filiaal zal dalen door het aanbieden van gg-producten** | | | | | | |
| **7.5 Het aanbieden van gg-producten zal leiden tot minder klanten** | | | | | | |
| **7.6 Weinig consumenten zijn geïnteresseerd in gg-producten** | | | | | | |
| **7.7 GG-producten zorgen voor een slecht imago van mijn winkel** | | | | | | |
| **7.8 GG-producten zorgen voor een lagere opbrengst in mijn filiaal** | | | | | | |
| **7.9 De gemiddelde consument toont weinig interesse in gg-producten** | | | | | | |
| **7.10 Er is geringe vraag naar gg-producten** | | | | | | |
| **7.11 De retailorganisatie waar deze filiaal onder valt heeft het besloten (overkoepelend beleid)** | | | | | | |
| **7.12 De toeleverancier van dit filiaal heeft het besloten** | | | | | | |
| **7.13 gg-producten worden door de klant niet geaccepteerd** | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| **7.14 Ik frees boycots die bij deze filaal zullen komen door aanbieden van gg-producten** | | | | | | |
| **7.15 Ik frees anti-gg producten protesten zullen ontstaan** | | | | | | |
| **7.16 De lange termijneffecten van gg voedsel productie zijn onzeker** | | | | | | |
| **7.17 Er bestaan grote publieke zorgen over gg-producten** | | | | | | |
| **7.18 Gevaren voor de volksgezondheid bij consumptie van gg-producten** | | | | | | |
| **7.19 Het is moreel onjuist om gg voedsel te verkopen** | | | | | | |
| **7.20 gg-producten zorgen voor een slechtere reputatie voor mijn winkel** | | | | | | |
| **7.21 Ingewikkelde marketing dat zorgt voor hogere kosten** | | | | | | |
| **7.22 gg-producten hebben een lagere kwaliteit dan het oorspronkelijke product** | | | | | | |
| **7.23 GG-producten zijn onveiliger voor de klant dan het originele product** | | | | | | |
| **7.24 GG-producten dragen niet bij aan het tegengaan van klimaatverandering** | | | | | | |
| **7.25 GG-producten dragen niet bij aan een verduurzaming van het voedselsysteem** | | | | | | |
| **7.26 Niet aanbieden van gg-producten sluit aan bij de identiteit van mijn retailorganisatie** | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| **7.27 Er heerst beleidsonzekerheid over gg voedsel** | | | | | | |
| **7.28 GG-producten hebben geen belangrijke rol in de toekomstige wereldwijde voedselvoorziening** | | | | | | |
| **7.29 Verkoop van gg-producten verhoogt het risico op schadeclaims op korte of langere termijn** | | | | | | |
| **7.30 GG-producten hebben een slechtere continuïteit in de aanlevering (slechte verkrijgbaarheid)** | | | | | | |
| **7.31 GG-producten hebben een kortere houdbaarheid voor de klant** | | | | | | |
| **7.35 Te weinig klanten zijn nieuwsgierig om gg-producten te proeven** | | | | | | |
| **7.36 Minder en minder mensen willen gg voedsel kopen** | | | | | | |
| **7.37 GG-voedsel helpt niet om de algemene prijsinflatie te beperken** | | | | | | |
| **7.38 Eten van gg-voedsel heeft te veel risico voor de gezondheid van de klant** | | | | | | |
| **7.39 Anders, namelijk:** | | | | | | |

**Nu nog weinige afsluitende vragen:**

**8.1 Overweegt u om in te toekomst (meer) gg voedsel in uw filiaal te verkopen?**

| Ja | Nee | Ik weet niet |
|---|---|---|
| | | |

**8.2 Bent u dagelijks bezig met genetisch gemodificeerde voedselproducten in uw winkel?**

| Ja | Nee |
|---|---|
| | |

**8.3 Spelen de afwegingen over gg voedsel een rol in de dagelijkse bezigheden?**

| Ja | Nee |
|---|---|
| | |

Zo ja, met welke frequentie? Kunt u dat toelichten? :_____

**8.4 Zijn er ooit vragen van klanten binnengekomen over genetisch gemodificeerde voedselproducten?**

| Ja | Nee | Ik weet niet |
|---|---|---|
| | | |

Zo ja, hoeveel ca.? Kunt u dat toelichten? :_____

Nu volgen een paar reflectievragen om dit onderzoek zo compleet mogelijk te maken. Graag met ons meedenken en een inschatting van deze vragenlijst of ideeën voor verbetering met ons delen. Gelieve de vragen zo goed mogelijk te beantwoorden.

**9 Heeft u ooit genetisch gemodificeerd voedsel gekocht?**

| Ja | Nee | Ik weet het niet |
|---|---|---|
| | | |

**10 Zijn er nog opmerkingen over het onderwerp gg voedsel?**

.....

**Bedankt voor uw medewerking!**
**Uw antwoorden zijn van heel veel waarde voor ons.**