

Exploring Neuromarketing Strategies Towards Boosting Consumer Engagement with Rural Agricultural Products: A Systematic Review

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Abstract: Rural agricultural products play a crucial role in local economies and cultural heritage; however, they encounter significant market challenges, such as limited consumer trust, weak branding, and inadequate marketing resources. Neuromarketing, which involves the application of neuroscience tools such as eye-tracking, electroencephalogram (EEG), functional magnetic resonance imaging (fMRI), and functional near-infrared spectroscopy (fNIRS), provides a novel approach to understanding consumers' unconscious responses to marketing stimuli. This systematic review synthesises the literature on neuromarketing strategies designed to enhance consumer engagement with rural agricultural products. Multiple searches were conducted across various academic databases (e.g., Google Scholar, ScienceDirect, PubMed, PsycINFO, JSTOR, AGRIS) using targeted keywords (e.g., "consumer neuroscience," "rural agricultural products," "sensory marketing"), focusing on peer-reviewed English studies published from 2018 onwards. From an initial pool of 236 articles, screening and eligibility checks yielded 14 highly relevant studies. Key themes that emerged include the influence of emotional and cognitive stimuli, packaging design, narrative storytelling, labelling, pricing, and ethical cues on

consumer behaviour. For instance, appealing emotional narratives and authentic cultural storytelling consistently enhance recall and brand loyalty. Clear, trust-building labels (e.g., "organic," "antibiotic-free") engage decision-making regions of the brain, serving as cognitive shortcuts that strengthen perceived value. Additionally, visual design elements such as prominent eco-labels and origin indicators capture attention and convey quality. Despite their value, existing studies face key limitations such as small, non-representative samples and artificial settings. However, applying neuroscience insights can help rural producers enhance packaging, branding, and storytelling to build consumer trust and promote sustainable economic growth.

Keywords: Neuromarketing, consumer engagement, rural agricultural products, systematic review.

1. Introduction

Rural agriculture often serves as the backbone of developing economies. Agriculture can constitute a substantial share of GDP and provide livelihoods for the majority of rural populations (Mulibana & Tshikovhi, 2024). Rural agricultural products thus sustain livelihoods and embody local culture and biodiversity. However, these products encounter systemic market challenges. Firstly, limited funding, technology, and market insights hinder rural producers' capacity to promote their products effectively (Ndlovu & Masuku, 2021). Secondly, there exists a pervasive lack of consumer trust, particularly in urban areas where buyers may favour standardised, well-known brands over locally produced goods (Phiri, 2024). This issue is further exacerbated by the inadequate representation of the unique value propositions of rural products, such as their organic nature, cultural significance, and sustainable production methods (Gunasekaran & Murugan, 2020).

To address these barriers, innovative, data-driven marketing strategies are required. Neuromarketing presents a novel solution by applying neuroscience tools to uncover the

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subconscious drivers of consumer decision-making (Alsharif et al., 2021). This interdisciplinary approach integrates methods such as Electroencephalography (EEG), Functional Magnetic Resonance Imaging (fMRI), eye-tracking, and Functional Near Infrared Spectroscopy (fNIRS) with traditional marketing research to reveal the emotional, cognitive, and sensory triggers that influence purchasing behaviour (Pluta-Olearnik & Szulga, 2022). By tapping into these deeper psychological insights, neuromarketing can assist marketers in creating compelling narratives, optimising packaging, and highlighting authenticity cues that resonate with rural consumers. Therefore, this paper reviews the existing body of research to explore how neuromarketing strategies can address the specific challenges faced by rural agricultural products.

To problematise the study, the constrained marketing resources, limited consumer awareness, and inherent biases towards urban-produced brands undermine the marketability of rural products (Ndlovu & Masuku, 2021; Phiri, 2024). Despite traditional marketing efforts to address these limitations, substantial challenges persist, underscoring the need for innovative, data-driven strategies.

Neuromarketing, a convergence of neuroscience and traditional marketing, has emerged as a novel approach capable of uncovering subconscious consumer motivations, potentially bridging the identified marketing gaps (Alsharif et al., 2020). Neuromarketing techniques such as eye-tracking, EEG, fMRI, and fNIRS have proven effective in numerous sectors by elucidating consumer cognitive and emotional responses (Pluta-Olearnik & Szulga, 2022). These tools are particularly relevant to the challenges at hand. Eye-tracking pinpoints which visual elements of packaging or branding capture consumer attention, helping rural producers optimise product design and shelf appeal even with limited marketing resources. EEG provides real-time measures of consumers' emotional engagement and attention to marketing stimuli, yielding insights into how rural-themed narratives or branding elicit trust and positive emotions. Likewise, fMRI can reveal deeper neural activation patterns associated with trust, reward, and decision-making, shedding light on how consumers perceive value in rural products or respond to authenticity cues. Meanwhile, fNIRS offers a more portable brain-imaging option that can be used in naturalistic settings, making it feasible to study consumer reactions in rural markets or at agricultural fairs. This systematic review examines existing research on neuromarketing strategies in agricultural contexts, guided by the research question: How do neuromarketing techniques (such as EEG, fMRI, eye-tracking, and fNIRS) enhance consumer trust, perception, and purchase intentions toward rural agricultural products? By emphasising neuromarketing techniques, this review demonstrates how these approaches can strategically address the marketing challenges encountered by rural products, notably by enhancing consumer trust, increasing brand recognition, and establishing impactful branding, as supported by neuroscience research.

2. Methodology

This systematic review was guided by the research question stated above. A comprehensive search strategy was implemented to ensure thorough coverage of relevant literature. Searches were conducted using Google Scholar, ScienceDirect, PubMed, PsycINFO, JSTOR, and AGRIS Web of Knowledge. These databases were selected for their broad coverage across multiple disciplines: Google Scholar provides an expansive cross-disciplinary search; ScienceDirect offers access to key scientific and marketing journals; PubMed covers biomedical and neuroscience research; PsycINFO indexes psychological and cognitive science studies; JSTOR includes a wide array of scholarly publications; and AGRIS focuses on agricultural science literature. This combination ensured that literature from marketing, neuroscience, psychology, and agricultural domains was captured. Targeted keywords were employed, including "neuromarketing strategies," "consumer neuroscience," "consumer engagement," "purchase intention," "rural agricultural products," "local food marketing," "sensory marketing," "emotional branding," "buying behaviour," "brand loyalty,"

"farm products marketing," "neuromarketing and rural markets," "consumer perception," and "agricultural branding." A combination of keyword searches such as "neuromarketing strategies" and "rural agricultural products", "consumer neuroscience" and "farm products marketing", "sensory marketing" and "local food marketing", "emotional branding" and "agricultural branding", "consumer engagement" AND "agricultural products", and "brand loyalty" and "rural agriculture" was utilised to maximise the identification of relevant literature.

The identified studies were then screened following PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines to ensure methodological rigor. Literature selection was initially based on titles and abstracts, followed by full-text reviews guided by predefined inclusion and exclusion criteria. Inclusion criteria specified peer-reviewed studies published in English from January 2018 onward that explicitly examined neuromarketing strategies, consumer neuroscience, or consumer engagement in relation to rural agricultural products or local food marketing. Exclusion criteria removed non-peer-reviewed literature, studies without clear connections to these neuromarketing domains, duplicates, publications predating 2018, and works not in English. Initially, 236 articles were identified across the databases. After removing duplicates, 151 unique articles remained. These were further screened for relevance based on titles and abstracts, narrowing down to 24 articles eligible for full-text review. Ultimately, 14 articles met all criteria and were included in the review for analysis.

2.1 Presentation of literature search

Figure 1 illustrates the PRISMA-based literature extraction process, detailing study identification, screening, eligibility checks, and final selection, thereby enhancing transparency and clarity in the systematic review.

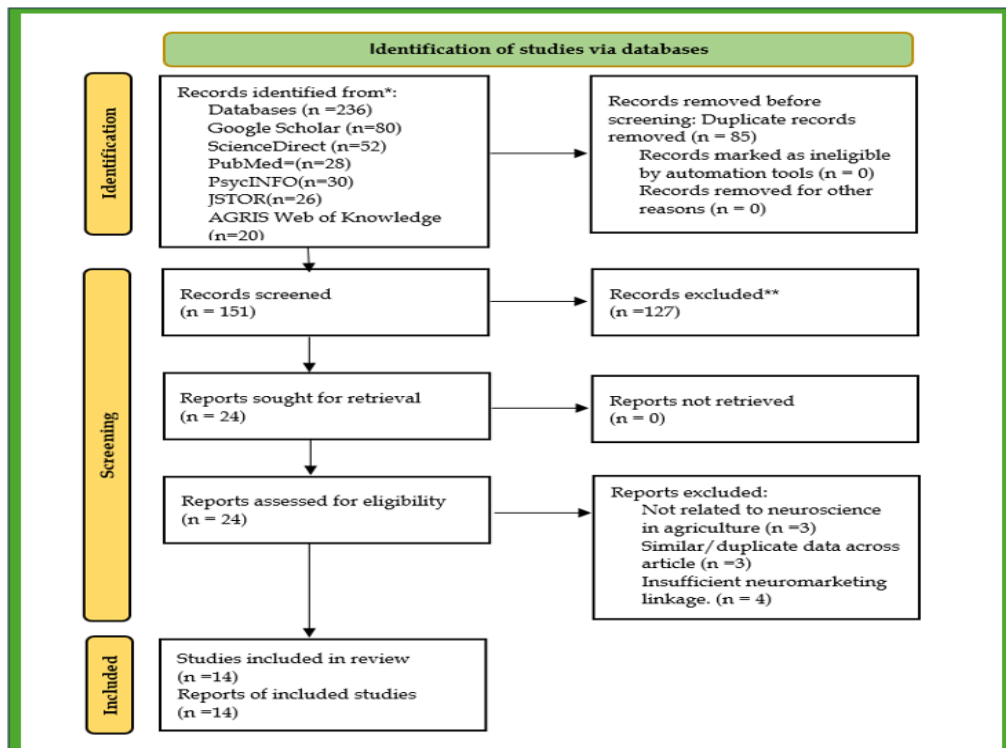


Figure 1: A systematic flow diagram illustrating the article selection process

Figure 1 illustrates that this study reviewed the literature on neuroscience applications in marketing, consumer neuroscience, neuroeconomics, and agriculture from 2018 onwards. Non-peer-reviewed, duplicate, non-English articles, and studies published before 2018 were excluded. After removing duplicates, 127 articles were eliminated, narrowing the selection to 24, with 14 chosen based on relevant keywords. Most of the literature focused on consumer science, neuroeconomics, and neuromarketing, while research on neuroscience in agriculture remained limited. Table 1 summarises the included articles, outlining the authors, publication year, objectives, methods, and key findings.

Table 1: Summary of articles included in this systematic review

Authors	Years	Objectives	Methods	Main Findings
Apriliantry et. al	2018	The study examines how different agricultural buyers impact farmers' perceived value, trust, commitment, and performance using EEG-measured biological responses.	EEG	Buyer type shapes farmers' perceptions and emotional responses, influencing value, trust, commitment, and performance. Perceived value is key to building trust and improving performance.
Meyerding & Merz	2018	The study analyses consumer visual attention patterns using eye-tracking, choice experiments, and stated preference methods to explore the link between visual attention and decision-making in consumer choices.	Eye-tracker	The CBCA indicated a strong preference for regional and domestic apples, with price being a key factor. Stated preference methods showed higher consumer interest in environmental sustainability and fair farmer compensation. Eye-tracking revealed less attention to less important attributes, though no significant correlation between preferences and visual attention was found.
Meyerding & Mehlhose	2020	To examine the feasibility of using a mobile functional near-infrared spectroscopy (fNIRS) system for neuromarketing research, particularly in the context of brand and label effects on consumer decision-making.	fNIRS	The organic and regional food labels led to a significant increase in prefrontal cortex (PFC) activity compared to the same products without any label. The strong cola brands, Coca-Cola and Pepsi, led to higher PFC activity compared to the weak cola brands, Topstar and Vita Cola, both when

Georgakarakou et al.	2020	How various packaging features (eco-labels, image, shape, colour) of organic agricultural products (feta cheese and olive oil) affect consumers' eye reactions and influence their perception, attitude and buying behaviour.	Eye-tracker	viewing the brand cues and when tasting the cola Consumers focus more on brand name, informational text, and place of origin rather than colour, shape, or images on packaging. While eco-labels attract attention, consumers prefer accompanying textual explanations. Angled packaging shapes are favoured over rounded ones for their familiarity and practicality.
Rödiger & Hamm	2020	The study examines consumer attention to organic food prices and packaging, comparing regular and conventional buyers. It explores whether regular organic consumers ignore prices more and assesses how visual attention and attitudes influence purchasing decisions.	Eye-tracker	Most consumers examine product prices, but regular organic buyers pay less attention to them. Longer fixation on organic packaging predicts organic product selection, while attention to conventional prices and packaging lowers the likelihood. Positive attitudes toward organic food's value for money also increase the chances of choosing organic products.
Mehlhose & Risius	2021	The objectives of the study are to observe the neural reaction of participants to differently framed food labels for products of animal origin, claiming the presence or absence of an additional quality aspect, and under the influence of emotional priming.	FNIRS	The idyllic prime led to increased neural activity in the orbitofrontal cortex (OFC) and frontopolar prefrontal cortex (FPC) compared to the oppressive prime. The "antibiotic-free" label combined with the idyllic prime led to increased neural activity in the dorsolateral prefrontal cortex (dlPFC) compared to the "antibiotic" label. No other significant differences were found for the other label and prime combinations.

Russo et al.	2021	Investigate how the communication of territoriality influences consumers' quality perception, willingness to pay, and exploration of packaging in the Italian fisheries sector.	Eye-tracker	The presence of references to the territorial origin (Sicily) of the fish products significantly increased the perceived quality, willingness to pay, and estimated price of the products. The time spent by participants looking at the product name was positively correlated with the perceived quality, willingness to pay, and estimated price.
Ruso et. al	2022	This study evaluates the emotional impact and memorisation of two video commercials promoting traditional Southern Italian cheeses, focusing on emotional sequencing. It aims to help small local producers develop effective communication strategies for territorial agri-food products.	EEG	The video with a negative-positive emotional sequence (The Myth) elicited stronger emotional reactions and better memorisation than the predominantly positive video (Rewind). Differences were significant overall but not for individual themes, likely due to storytelling or participant traits.
Robu, et al.	2022	Emphasising the specificity of neuromarketing in the agri-food sector.	Eye-tracker and EEG	Neuromarketing techniques are increasingly used and accepted in market research. Neuromarketing techniques can complement traditional quantitative market research methods. Neuromarketing techniques can help develop more effective marketing strategies and advertising.
Kumar et al.	2022	To discuss the importance of animal welfare during the slaughtering process and to highlight the use of EEG as a tool to	EEG	EEG is an effective tool for assessing unconsciousness and pain perception during animal stunning and slaughter. Variables like F50 and F95 help

		assess pain perception and the state of consciousness in animals during slaughter.		measure anaesthesia depth, varying with different anaesthetics. EEG is also used to evaluate stunning efficiency and animal welfare in poultry slaughter.
Proi et al.	2023	To analyse the influence of aquaculture eco-labels' visual elements (size and saliency) on consumers' visual attention and choice.	Eye-Tracker	The size of eco-labels influenced consumers' visual attention and choices, with larger eco-labels being preferred. Saliency of eco-labels had a limited effect on visual attention and no effect on choices. Consumers were influenced by the visual design elements of eco-labels, such as colour, shape, and language.
Lalani et al.,	2023	The study examines systems thinking (ST) from a social science perspective, explores cognitive neuroscience tools for assessing ST in low-income countries, and investigates its correlates, such as observational learning and prospective thinking.	FNIRS	Higher degrees of systems thinking are associated with better environmental decision-making in a variety of country settings. Higher degrees of systems thinking are associated with the use of climate-smart agriculture practices like conservation agriculture, which in turn are associated with increased productivity, household income, and food security.
Kumar et al.	2023	To evaluate the electrical activity of the brain (EEG) and physiological responses of goats when exposed to the slaughter of a conspecific, to assess the emotional stress and "slaughter empathy" experienced by the goats.	EEG	Goats exhibited significant increases in beta and theta waves, along with median frequency (F50), in response to the slaughter environment, indicating heightened brain activity and emotional stress. Physiological signs of stress, such as elevated heart rate and blood glucose levels, were also observed.

Barbierato, E.	2024	To understand the marketing strategies that could be implemented to make the regional wine sector in the Marches Region of Italy more stable and competitive in the Italian and global markets.	EEG	The study revealed variations in emotional responses during different phases of wine expectation tests and highlighted the value of EEG in capturing cognitive and emotional aspects of wine consumption. It serves as a foundation for positioning Italian and Marche Region wines globally while preserving local identity.
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As shown in Table 1, various studies have utilised neuroscience tools such as EEG, fMRI, eye-tracking, and fNIRS to examine consumer behaviour and decision-making across different contexts, including agricultural products and environmental choices. These studies primarily explored visual attention and neuroeconomic methods to reveal consumer preferences, demonstrating their value in understanding decision-making processes. However, their application in agricultural settings remains relatively limited.

3. Presentation and Discussion of Findings

To synthesise the results of the included studies, a thematic analysis was conducted, extracting and coding key outcomes for recurring patterns. These were then organised into overarching themes that reflect the main factors influencing consumer engagement with rural agricultural products. The identified themes include emotional and cognitive responses to marketing stimuli, visual attention and packaging design, storytelling and emotional sequencing in marketing content, the role of labels in shaping consumer perception, price and purchase decision-making in organic and local products, and ethical and psychological considerations in agricultural marketing.

3.1 Emotional and cognitive responses to marketing stimuli

The reviewed studies indicate that emotional and cognitive responses to marketing stimuli play a crucial role in shaping consumer judgments and behaviours towards rural agricultural products. EEG studies demonstrate that positive emotional cues, such as appealing brand imagery or authentic narratives, enhance favourable product evaluations and strengthen consumers’ intentions to purchase. For instance, Apriliantry et al. (2018) found that positive emotional experiences, triggered by visually appealing and emotionally resonant branding, reinforced consumers’ perceptions of product quality and increased purchase intentions. Similarly, Barbierato (2024) demonstrated that EEG-measured engagement with wine advertising deepened brand associations and heightened the likelihood of repurchase, underscoring the significance of emotional involvement in marketing outcomes. Furthermore, Lalani et al. (2023) highlighted that marketing messages encouraging deeper reflection on product origin or sustainability elicited heightened cognitive processing, thereby improving consumer receptivity and fostering long-term commitment.

Collectively, these findings suggest that campaigns should bridge emotional resonance and cognitive appeal: rural marketers may benefit from crafting narratives that evoke empathy, authenticity, and cultural significance while also providing substantive, credible information. By integrating affective and intellectual engagement, neuromarketing strategies can assist rural products in transcending price-based competition, forging deeper consumer connections, and ultimately building trust and loyalty in markets where familiarity and brand recognition are often limited.

3.2 Visual attention and packaging design

The reviewed studies found that packaging design and visual cues are fundamental in communicating the value proposition of rural products, especially when consumers have limited prior knowledge of them. Eye-tracking research consistently shows that salient visual elements, such as enlarged eco-labels or origin seals, capture consumer attention and increase product recognition. For instance, Proi et al. (2023) found that larger eco-labels on aquaculture packaging led to greater visual engagement and higher purchase intentions. Similarly, Georgakarakou et al. (2020) observed that consumers fixate longer on textual details like brand name, origin, and certification marks, implying an active search for information about provenance and quality. These findings suggest that packaging that emphasises credible information can build trust and aid decision-making.

Moreover, the studies found that highlighting territorial origin and authenticity through packaging can provide a competitive edge. Additionally, Russo et al. (2021) explain that products explicitly referencing regional origin resonate with consumers' desire for authenticity and can command a price premium. This suggests that rural marketers should design packaging to underscore local production methods, traditional craftsmanship, or unique cultural heritage. Combining visually compelling design elements (for example, bold labels or quality seals) with concise, informative text can appeal to both the emotional and rational aspects of purchasing decisions, reinforcing the product's story and credibility.

3.3 Storytelling and emotional sequencing in marketing content

The reviewed studies found that narrative storytelling, especially when structured around clear emotional arcs, powerfully shapes consumers' perceptions of rural products. Research indicates that stories that move from a problem or challenge to a positive resolution boost consumer recall and deepen brand engagement (Russo et al., 2022). Advertisements that begin with hardship and conclude with hope create a strong emotional impact and make the marketing message more memorable. Such sequences harness fundamental psychological processes, engaging memory and empathy systems and making the advertisement more impactful. In essence, storytelling can embed cultural heritage, sustainability values, and real farmer experiences into the promotional mix, making the intangible qualities of rural agriculture more tangible to the audience.

More broadly, the studies found that embedding authentic narratives into marketing content enhances consumer trust and loyalty. Storytelling that highlights farmers' challenges, sustainable practices, or community origins fosters empathy and admiration. Consumers who feel a personal connection to a product's origin story are more likely to pay a premium and remain loyal, thereby strengthening the consumer-brand relationship. This approach aligns with consumers' existing affinity for community-driven, ethically grounded initiatives and reinforces long-term brand engagement. This finding is consistent with broader consumer psychology literature, where storytelling techniques in digital marketing have been shown to significantly enhance brand loyalty by engaging consumers emotionally and cognitively (Mandung, 2025; Hong et al., 2022).

3.4 Role of labels in shaping consumer perception

The reviewed studies found that labels on rural agricultural products significantly shape consumer perceptions and decision-making. For instance, Robu et al. (2022) reinforced the effectiveness of neuromarketing techniques in agricultural advertising, emphasising their role in complementing traditional marketing methods. These studies highlight the importance of clear and strategically framed labels in enhancing consumer trust and willingness to pay for agricultural products.

Accurate and appealing labelling is critical for influencing how consumers interpret product value, safety, and ethical considerations. By using advanced neuromarketing tools like FNIRS, researchers have discovered that positive or trust-building labels, such as "antibiotic-free" or "organic," stimulate

areas of the brain associated with decision-making and reward (Mehlhose & Risius, 2021). This heightened neural activation signifies that labels function as shortcuts for consumers to evaluate product attributes, potentially overriding even more intrinsic factors like price.

Additionally, Meyerding and Mehlhose (2020) document that organic and regional labels can foster stronger cognitive processing, suggesting that clear, credible labelling cultivates deeper consumer engagement. In rural markets where brand awareness may not be as established, labels are especially important for consumer trust. By spotlighting quality standards, ethical production methods, or artisanal processes, rural producers can effectively address consumer uncertainty, thereby encouraging trial and repeat purchases.

3.5 Price and purchase decision-making in organic and local products

The reviewed studies indicate that price remains a significant factor in the purchase decisions for organic and local products; however, its impact is nuanced by consumer values and perceived benefits. Numerous studies highlight that price is a salient consideration, yet habitual purchasers of organic or local goods often prioritise intrinsic qualities over cost. For example, Rödiger and Hamm (2020) noted that although price was important for organic buyers, those already committed to organic products frequently focus more on health and quality attributes. Similarly, Meyerding and Merz (2018) found that consumers are willing to pay a premium for locally produced products when they perceive added value in freshness, cultural authenticity, or environmental stewardship.

In light of this evidence, the studies suggest that rural marketers should emphasise value-driven narratives rather than competing solely on price. By clearly communicating how local and organic products align with consumers' health, ethical, or sustainability goals, producers can reframe higher prices as indicators of superior quality. When consumers perceive authenticity or tangible benefits associated with the premium, price differences become less of a barrier. This value-based positioning can enhance brand image and loyalty, rendering demand less sensitive to minor price variations.

3.6 Ethical and psychological considerations in agricultural marketing

The reviewed studies found that ethical and psychological factors, such as animal welfare and environmental responsibility, significantly influence consumer responses to agricultural marketing. Neuroscientific research demonstrates strong emotional and neural reactions to animal welfare cues. For example, Kumar et al. (2023) used brain imaging to show that observing livestock distress evokes heightened stress responses, underscoring the importance of humane practices in the production process. Likewise, Kumar et al. (2022) demonstrated how EEG markers of animal pain perception can inform ethical labelling and transparency, suggesting that knowledge of humane treatment may influence consumer perceptions. These findings highlight that awareness of ethical issues can powerfully shape consumers' evaluations of rural products.

Beyond animal welfare, the literature indicates that emphasising responsible sourcing and community impact resonates with consumers. The reviewed studies suggest that highlighting fair labour practices, support for local communities, and ecological farming appeals to ethically conscious buyers. Marketing these values through targeted labels, compelling storytelling, and consistent branding allows rural producers to differentiate their products and mitigate reputational risk. By communicating ethical integrity in their brand messaging and practices, producers can strengthen trust and foster enduring loyalty among transparency-seeking consumers, ultimately contributing to the long-term sustainability of rural markets.

4. Implications for Business Practice

The thematic findings suggest several practical implications for rural agricultural businesses. These include optimising packaging and visual design, leveraging emotional storytelling and branding,

implementing strategic labelling and ethical messaging, utilising accessible neuromarketing tools for small businesses, and fostering innovation and collaboration within the industry.

4.1 Optimising packaging and visual design

Neuromarketing research underscores that thoughtfully designed packaging significantly influences the performance of rural products in the market. Eye-tracking studies consistently show that salient visual elements, such as prominent eco-labels, bold origin seals, or high-contrast cultural imagery, capture consumer attention and increase product recognition (Proi et al., 2023; Georgakarakou et al., 2020). For instance, Proi et al. (2023) found that larger eco-certification labels drew greater visual engagement and higher purchase intentions. By emphasising trustworthy cues like regional emblems or organic symbols, packaging conveys authenticity and quality, thus building consumer trust even before the purchase (Russo et al., 2021). Practically, rural producers can leverage neuromarketing tools, such as eye-tracking, to iteratively refine their packaging designs. Combining compelling imagery with concise text highlighting sustainable practices or authentic origins appeals to both emotional and rational decision-making. Packaging, therefore, becomes a strategic asset, distinguishing products on crowded shelves and directly communicating unique value propositions through neuroscience-informed visual designs.

4.2 Leveraging emotional storytelling and branding

Embedding emotional narratives into marketing materials deepens consumer connections with rural agricultural products. Studies show that narratives structured with emotional arcs—moving from initial hardship to hopeful resolution—boost recall and brand engagement by activating empathy and memory (Russo et al., 2022; Apriliantry et al., 2018). Advertisements highlighting farmers' struggles and community achievements create an emotional impact, making messages memorable and persuasive (Russo et al., 2022). Such storytelling translates intangible cultural and sustainability values into tangible consumer experiences. Integrating authentic heritage elements, traditional farming methods, or environmental stewardship into narratives fosters empathy, admiration, and loyalty, thereby increasing consumer willingness to pay premiums. Practically, rural businesses can partner with local communities and use consumer feedback to craft genuine stories of origin and craftsmanship, bridging emotional and cognitive engagement while strengthening long-term brand affinity and consumer loyalty.

5.3 Strategic labelling and ethical messaging

Strategic labelling that communicates ethical practices and regional authenticity can serve as a powerful market differentiator, especially given the growing consumer emphasis on transparency and values-driven consumption (Mehlhose & Risius, 2021; Meyerding & Mehlhose, 2020). Neuromarketing studies indicate that labels highlighting ethical attributes such as "organic," "antibiotic-free," or provenance activate brain areas linked to decision-making and reward, quickly conveying safety, quality, and ethical commitments (Kumar et al., 2022; Kumar et al., 2023). Functional near-infrared spectroscopy (FNIRS) studies have revealed that ethically framed labels heighten neural activation, enhancing perceived value and confidence. Producers should strategically design labels to explicitly showcase ethical practices, fair labour standards, and local sourcing to appeal to values-driven consumer segments. Such labelling not only meets regulatory standards but also positions rural brands as ethical market leaders, fostering trial purchases, trust, and long-term loyalty (Meyerding & Mehlhose, 2020).

4.4 Accessible neuromarketing tools for small businesses

Advances in consumer-grade neuroscience technologies enable small rural businesses to effectively apply neuromarketing insights. Affordable devices such as portable EEG headsets and webcam-based eye-tracking software provide practical methods for gauging consumer subconscious reactions

(Robu et al., 2022). For example, low-cost EEG systems allow the measurement of emotional engagement with product designs or advertisements, while accessible eye-tracking solutions help record gaze patterns without the need for specialised lab equipment (Robu et al., 2022). Small-scale cooperatives can utilise these affordable technologies to gather physiological or visual attention data during market trials or product testing. Systematic analysis of these consumer reactions facilitates the iterative refinement of marketing materials based on real-time, evidence-based feedback, thus enabling data-driven decisions without significant financial investment.

4.5 Fostering innovation and industry collaboration

Beyond immediate marketing outcomes, these neuromarketing-driven strategies can cultivate a broader reputation for innovation and authenticity within rural sectors. Rural businesses employing neuroscience-informed marketing can establish themselves as innovative and trustworthy, thereby attracting partnerships and investments (Agrawal & Chaurasia, 2024). Over time, such a science-informed brand image facilitates collaborations across sectors, including food retailers, technology providers, and certification bodies seeking authentic, narratively rich products. Demonstrating tangible improvements in consumer engagement through neuroscience-driven approaches may encourage strategic partnerships with distributors and broader agri-food networks (Agrawal & Chaurasia, 2024). Additionally, sharing neuromarketing knowledge through industry associations or cooperative research projects can significantly reduce costs and accelerate market adaptation. Harmonising traditional rural values with cutting-edge consumer neuroscience insights enhances immediate marketing effectiveness while fostering long-term economic and social development in rural communities.

5. Limitation of Findings

Despite offering valuable insights, the present review and its underlying studies have several limitations that affect the generalisability of the conclusions. These limitations are grouped into four thematic categories: Sample limitations and generalisability, experimental and environmental constraints, technical and ethical constraints, and design and measurement constraints.

5.1 Sample limitations and generalisability

Many neuromarketing studies in this domain suffer from limited and biased samples, raising concerns about generalisability. For instance, Meyerding and Merz (2018) focused narrowly on consumer responses to organic apple labels in Germany, limiting the applicability to broader agricultural markets. Similarly, studies by Proi et al. (2023) and Russo et al. (2021) relied predominantly on small convenience samples of university students, whose demographics may differ significantly from those of rural consumers. Such homogeneous sampling undermines external validity, as results may not accurately reflect real-world perceptions, purchasing power, or cultural values. Additionally, several studies have disproportionately targeted younger, tech-savvy demographics, such as Millennials and Gen Z, neglecting older or less technologically oriented consumers (Barbierato, 2024). Generational differences in trust, attention, and media literacy can substantially impact responses to marketing stimuli. Consequently, findings drawn from skewed samples might not generalise to diverse rural populations, limiting their practical usefulness and potentially leading to ineffective marketing strategies.

5.2 Experimental and environmental constraints

Several limitations arise from the experimental settings and conditions used in neuromarketing studies. Primarily, the heavy reliance on controlled laboratory settings, often involving static images and brief viewing periods, may fail to replicate real-world shopping experiences (Georgakarakou et al., 2020; Meyerding & Mehlhose, 2020). Unlike the dynamic environment of actual stores, where consumers interact physically and socially with products, laboratory settings eliminate crucial

contextual cues, potentially overestimating certain effects and limiting ecological validity. Additionally, most experiments focus on immediate reactions, neglecting long-term decision-making processes (Lalani et al., 2023). For example, a single exposure to a sustainability-themed advertisement might evoke a positive response initially, but without assessing longer-term impacts, the study might inaccurately conclude its effectiveness. This short-term focus misses cumulative or delayed marketing effects that are vital for sustained consumer behaviour. Consequently, these experimental and environmental constraints mean that findings must be interpreted cautiously, as strategies effective under laboratory conditions may underperform in the complexity of real-world markets.

5.3 Technical and ethical constraints

Neuromarketing research faces significant technical and ethical challenges. Technically, the high costs and complexity of neuroscience tools such as EEG and fMRI limit their broader use. For instance, Kumar et al. (2022) highlight difficulties in recording EEG data, especially outside controlled laboratories, due to confounding factors like animal stress, breed variability, and noisy rural environments. These technical barriers result in smaller sample sizes, fewer repetitions, and limited settings, reducing the robustness and generalisability of findings. Ethically, neuromarketing raises concerns about privacy, autonomy, and psychological harm, particularly in emotionally charged agricultural contexts. Additionally, Kumar et al. (2023) explored sensitive topics like “slaughter empathy,” potentially exposing participants to distressing stimuli. Such studies risk psychological discomfort and ethical scrutiny regarding animal welfare, restricting the scope of permissible research questions. Consequently, important but controversial stimuli might remain untested, potentially underestimating consumer reactions to ethically charged issues. Overall, these technical and ethical constraints significantly limit the validity, completeness, and practical application of neuromarketing insights.

5.4 Design and measurement constraints

Neuromarketing studies exhibit design and measurement limitations that significantly affect their validity. Firstly, experiments frequently employ overly simplified scenarios, such as unfamiliar or generic products, which do not accurately reflect actual purchasing decisions influenced by brand familiarity (Rödiger & Hamm, 2020). Additionally, experimental conditions may encompass multiple confounding variables simultaneously, such as emotional narratives alongside product features, thereby complicating the clear attribution of effects (Russo et al., 2022). Moreover, many studies lack adequate segmentation analysis, treating diverse participants as homogeneous groups. Furthermore, Barbierato (2024) emphasises that consumer reactions vary by demographic factors; neglecting this variability may obscure crucial insights.

On the measurement side, each neuromarketing tool possesses intrinsic limitations. For instance, Meyerding and Mehlhose (2020) note that functional near-infrared spectroscopy (fNIRS), while convenient, measures only superficial cortical activity, thus neglecting deeper emotional processing areas such as the amygdala. Similarly, studies employing unfamiliar or fictitious labels may yield skewed results due to participant confusion (Mehlhose & Risius, 2021). Lastly, reliance on a single measurement technique, such as eye-tracking (Russo et al., 2021), provides incomplete insights, as each method captures only a partial dimension of consumer responses. Overall, these design and measurement constraints necessitate caution in interpreting findings, as they may oversimplify or misrepresent real consumer behaviours.

Despite its limitations, this systematic review offers valuable insights by synthesising the literature to highlight effective strategies, such as emotional storytelling, trust-building labels, and targeted designs, that consistently emerge across contexts. These patterns provide actionable guidance and

identify areas requiring further research. Thus, the review enhances understanding of neuromarketing's role in rural agriculture and serves as a foundation for future practice.

6. Conclusion

This systematic review has answered its research question by identifying which neuromarketing strategies enhance consumer engagement with rural agricultural products. Across the 14 included studies, neuroscience-informed approaches were shown to positively influence rural consumer behaviour. For example, interventions that employed emotional branding, culturally authentic narratives, and trust-enhancing labels consistently increased attention, recall, and purchase intentions (e.g., Apriliantry et al., 2018; Russo et al., 2022). Visual design cues, such as prominent eco-labels or origin indicators, also attracted consumer attention and signalled quality. These findings imply clear practical steps for marketers. Rural producers can apply these insights by incorporating authentic storytelling into their branding and by using clear, appealing labels and visually salient packaging to communicate value and build trust. Such strategies can strengthen brand loyalty and perceived authenticity, helping rural products stand out in competitive markets.

Despite the highlighted limitations, this review demonstrates the potential of neuromarketing to enhance rural agricultural marketing by offering actionable insights for consumer engagement, supporting evidence-based strategies, and contributing to sustainable rural development.

7. Future Research Directions

Future research in neuromarketing for rural agricultural products should aim to address current limitations by using more representative samples and real-world settings to improve external validity. Many existing studies rely on small, homogeneous groups and laboratory environments, which limits their applicability to diverse rural consumer populations. Therefore, future studies should use larger, more inclusive samples that reflect the demographic and behavioural diversity of rural areas. Longitudinal designs are also needed to assess the sustained impact of neuromarketing on consumer trust, engagement, and purchasing behaviour.

Methodological advancements are essential, particularly the integration of neuromarketing tools such as EEG, fMRI, and eye-tracking with behavioural experiments and qualitative approaches. Research should also explore how these strategies interact with cultural, economic, and social factors, including cognitive biases, social norms, and trust-building elements, to better understand rural consumer decision-making.

Another key area is improving the accessibility of neuromarketing tools for rural marketers. Due to the high costs and technical demands of current methods, future studies should investigate cost-effective, mobile, and AI-driven tools that can offer real-time consumer feedback on product design and branding strategies. Finally, ethical considerations must be more thoroughly addressed. Topics such as consumer privacy, animal welfare, and transparency in marketing should be central to future research. Studies should examine how ethical branding influences trust and loyalty among rural consumers. Together, these directions will help refine neuromarketing approaches, making them more effective and sustainable for rural producers.

8. Declarations

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