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### Extension approaches for enhancing awareness and acceptance of novel food innovations

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#### Abstract

The rapid evolution of global food systems has driven the development of novel food innovations, including functional foods, fortified products, plant-based alternatives, and bioengineered ingredients. While these innovations offer substantial benefits in nutrition, health, and sustainability, their adoption is often limited by low consumer awareness, skepticism, and cultural barriers. Extension services play a critical role in bridging the gap between research and practice by promoting knowledge transfer, participatory learning, and capacity building. This review explores extension approaches for enhancing awareness and acceptance of novel food innovations, including participatory demonstrations, farmer and producer field schools, community-based nutrition campaigns, digital and ICT-enabled platforms, and public-private partnerships. It also examines factors influencing consumer adoption, such as perceived benefits, cultural norms, trust, and accessibility, and identifies challenges related to resource constraints, regulatory concerns, and resistance to change. Future directions emphasize digital integration, co-creation with communities, evidence-based messaging, and interdisciplinary collaboration to support sustainable, equitable, and health-promoting food systems. Effective extension strategies are essential for translating scientific innovations into practical dietary solutions that improve nutrition, food security, and public health.

**Keywords:** Food innovation, extension services, consumer awareness, participatory learning, novel foods, nutrition education, adoption and acceptance, community engagement

#### 1. Introduction

Global food systems are undergoing rapid transformation due to population growth, urbanization, climate change, and evolving consumer preferences. These changes have created an urgent need for innovative food products that address nutritional deficiencies, promote health, and support environmental sustainability. Novel food innovations—including functional foods, fortified products, plant-based alternatives, lab-grown proteins, and bioengineered ingredients—have emerged as promising solutions to meet these challenges <sup>[1-2]</sup>. Such innovations not only enhance the nutritional quality of diets but also provide opportunities for reducing the environmental footprint of food production and diversifying dietary options in both developed and developing countries. Despite the technological potential of novel food innovations, consumer awareness, perception, and acceptance remain significant barriers to their adoption. Consumers often exhibit hesitation toward unfamiliar foods due to factors such as food neophobia, lack of knowledge about health benefits, cultural preferences, and concerns regarding safety or processing methods. Consequently, even scientifically validated and nutritionally superior food products may fail to achieve widespread adoption without effective strategies for communication, education, and engagement <sup>[3]</sup>.

Extension services serve as critical intermediaries between research institutions, food industry stakeholders, policymakers, and end users. Historically focused on agricultural productivity, extension programs are increasingly recognized for their role in promoting food safety, nutrition, and innovation adoption. Through participatory learning approaches, capacity-building initiatives, demonstrations, and digital tools, extension services can improve consumer understanding, build trust, and facilitate behavioral change <sup>[4]</sup>. Moreover, extension programs provide feedback loops to researchers and producers, ensuring that innovations are culturally appropriate, economically viable, and aligned with consumer needs. This review examines the key extension approaches for enhancing awareness and acceptance of novel food innovations. It discusses participatory learning methods, farmer and producer field schools, community-based nutrition campaigns, digital and ICT-enabled platforms, and public-private partnerships. Additionally, it explores the factors influencing adoption, challenges to implementation, and future directions for strengthening extension-led dissemination of novel foods <sup>[5]</sup>. By integrating evidence from research and practice, this review highlights how extension services can accelerate the adoption of safe, nutritious, and sustainable food

innovations, contributing to healthier diets and resilient food systems worldwide.

**2. The Role of Extension in Food Innovation Adoption**

Extension services play a pivotal role as intermediaries between research institutions, the food industry, policymakers, and end consumers. Their primary function in the context of novel food innovations is to bridge the gap between scientific discovery and practical adoption, ensuring that new products are both accessible and acceptable to diverse populations [6]. Extension activities are not limited to information dissemination; they also focus on empowering stakeholders with the knowledge, skills, and confidence needed to adopt novel foods safely and effectively. One of the central roles of extension services is knowledge transfer. Scientific findings related to food innovations—ranging from biofortified crops to functional foods and plant-based alternatives—are translated into accessible, context-specific formats for producers, processors, retailers, and consumers. Clear, reliable communication of nutritional benefits, safety standards, and handling procedures is essential to build consumer trust, particularly for products perceived as unfamiliar or technologically advanced [7]. Capacity building is another key function. Extension agents provide hands-on training

and demonstrations to equip stakeholders with the technical skills needed for processing, storage, preparation, and consumption of novel foods. For example, small-scale producers may receive training on fortification methods, hygiene protocols, or fermentation techniques to produce functional foods, while consumers may learn safe preparation and storage practices to maximize nutritional benefits. Beyond technical skills, extension services facilitate behavioral change by addressing misconceptions, fears, and resistance toward novel foods. Participatory approaches, such as taste-testing sessions and community discussions, help reduce food neophobia and promote informed decision-making. These interactions also enable the incorporation of cultural preferences, dietary habits, and local culinary practices, increasing the likelihood of sustained adoption. Finally, effective extension programs provide feedback mechanisms, capturing consumer insights, preferences, and concerns to inform iterative product development. An integrating community feedback, researchers and producers can refine novel food products, making them more acceptable and aligned with local needs. In this way, extension services create a continuous loop between research, innovation, and practical application, ensuring that novel foods are both effective and culturally relevant [8-9].

**Table 1:** Types of Novel Food Innovations and Key Adoption Challenges

Novel Food Innovation	Description	Key Adoption Challenges	Role of Extension
Plant-based foods	Alternatives to animal-derived products	Taste perception, cultural acceptance	Consumer education, cooking demonstrations
Biofortified foods	Foods enhanced with micronutrients	Awareness, trust in health claims	Nutrition education, evidence-based messaging
Precision-fermented foods	Foods produced using microbial fermentation	Technological unfamiliarity, safety concerns	Transparency, participatory learning
Insect-based foods	Protein-rich foods from edible insects	Food neophobia, cultural resistance	Sensory trials, cultural contextualization
Functional and fortified foods	Foods with added health benefits	Label comprehension, misinformation	Label literacy, health communication

**Table 2:** Extension Approaches for Promoting Awareness and Acceptance of Novel Foods

Extension Approach	Target Group	Key Activities	Expected Outcomes
Participatory demonstrations	Consumers, households	Taste testing, cooking sessions	Increased familiarity and acceptance
Field schools and training programs	Farmers, processors	Production and handling training	Improved supply and quality
Digital and ICT-based extension	Urban and remote consumers	Apps, videos, social media	Wider outreach and engagement
Community campaigns	General public	Nutrition seminars, food fairs	Improved awareness and trust
Public-private partnerships	Producers, retailers	Pilot projects, market development	Scaled adoption and accessibility

**Table 3:** Factors Influencing Consumer Acceptance of Novel Food Innovations

Factor	Influence on Adoption	Extension Intervention
Perceived health benefits	Strong positive influence	Evidence-based nutrition education
Cultural compatibility	Determines acceptance or rejection	Local adaptation and messaging
Trust in information sources	Enhances confidence	Use of trusted extension agents
Sensory attributes	Affects repeat consumption	Taste trials and demonstrations
Price and availability	Determines accessibility	Market linkage and cost awareness

**Table 4:** Challenges and Strategic Responses in Extension for Novel Foods

Challenge	Description	Extension-Based Solutions
Food neophobia	Fear of unfamiliar foods	Experiential learning, peer influence
Limited resources	Funding and personnel constraints	Digital extension, partnerships
Rapid innovation pace	Constant emergence of new foods	Continuous training and updates
Regulatory uncertainty	Safety and labeling concerns	Policy alignment and communication
Misinformation	Public skepticism	Transparent, science-based messaging

**Table 5:** Future Directions for Extension-Led Adoption of Food Innovations

Priority Area	Strategic Focus	Expected Impact
Digital integration	Mobile apps, e-learning platforms	Expanded outreach
Participatory co-creation	Community involvement	Higher relevance and acceptance
Interdisciplinary collaboration	Food science + behavior science	Improved adoption outcomes
Policy support	Alignment with regulations	Consumer protection and trust
Sustainability focus	Environmental messaging	Long-term food system resilience

### 3. Extension Approaches for Novel Food Innovations

Several extension strategies have been developed to enhance awareness, acceptance, and adoption of novel food technologies. These approaches integrate technical training, participatory learning, and community engagement to ensure that innovations reach intended audiences effectively.

#### 3.1 Participatory Learning and Demonstrations

Participatory learning methods, such as hands-on workshops, cooking demonstrations, and taste-testing sessions, allow consumers and producers to directly engage with novel foods. Experiential learning reduces uncertainty and enhances perceived benefits, which increases the willingness to adopt new products. For instance, interactive demonstrations of plant-based meat alternatives, fortified beverages, or biofortified cereals enable participants to understand processing methods, nutritional advantages, and culinary applications, thereby fostering trust and acceptance [10].

#### 3.2 Farmer and Producer Field Schools

Farmer and producer field schools (FFS) provide structured, practical training for farmers, food processors, and small-scale entrepreneurs. These programs focus on local production of novel foods, such as nutrient-enriched crops, fermented functional foods, or fortified snacks. By combining technical knowledge with business and marketing skills, field schools ensure that producers can implement innovations effectively while making products accessible to local communities. FFS also facilitate peer-to-peer learning, which reinforces adoption and encourages knowledge sharing within networks [11-12].

#### 3.3 Digital and ICT-Enabled Extension

The integration of digital tools—including mobile applications, online training modules, social media campaigns, and e-learning platforms—enables rapid and cost-effective dissemination of information about novel foods. Consumers can access nutritional information, preparation methods, and safety guidelines remotely, while researchers and extension personnel can collect feedback in real time. ICT-enabled approaches are especially valuable for reaching urban populations and geographically isolated communities where traditional face-to-face extension may be limited [13].

#### 3.4 Community-Based Nutrition and Awareness Campaigns

Community engagement initiatives, such as public seminars, school-based programs, health fairs, and local food festivals, help raise awareness and build credibility for novel foods. These campaigns often leverage trusted local figures, including nutritionists, teachers, and community leaders, to

promote dietary diversity, functional foods, and food safety practices. By contextualizing information to local diets and cultural norms, these programs encourage informed choices and sustained behavior change [14].

#### 3.5 Public-Private Partnerships

Collaboration between government extension agencies, research institutions, and private food companies enhances resource sharing, capacity building, and technology dissemination. Public-private partnerships support pilot programs, distribution networks, and promotional activities, ensuring that novel foods are safe, accessible, and culturally acceptable. Such partnerships also facilitate scaling of innovations, improving the reach and impact of extension efforts [15].

### 4. Factors Influencing Awareness and Acceptance of Novel Food Innovations

The effectiveness of extension approaches in promoting novel food innovations is shaped by a range of interrelated socio-economic, cultural, and informational factors. One of the most influential determinants of acceptance is perceived benefit. Consumers are more likely to adopt novel foods when they clearly recognize advantages related to health improvement, enhanced nutrition, environmental sustainability, convenience, or sensory appeal. Functional benefits such as disease prevention, improved gut health, or reduced environmental footprints can significantly motivate acceptance when effectively communicated through extension activities [16]. However, if perceived benefits are unclear or outweighed by perceived risks, adoption is likely to remain limited.

Consumer knowledge and food literacy also play a crucial role in shaping awareness and receptivity. Individuals with a better understanding of food science, processing technologies, and nutrition concepts tend to show greater openness toward innovative food products. Extension programs that provide clear explanations of production methods, safety assessments, and health claims can reduce uncertainty and misinformation, thereby fostering informed decision-making. Conversely, low literacy levels or exposure to conflicting information may increase skepticism and resistance to novel foods [17]. Cultural norms, traditions, and dietary habits strongly influence food choices and acceptance. Foods that align with established culinary practices and belief systems are more readily accepted, while those perceived as culturally incompatible may face resistance. Extension approaches that respect local food cultures and integrate novel foods into familiar recipes or preparation methods are more effective in overcoming cultural barriers. This contextualization enhances relevance and helps position innovations as complementary rather than disruptive to traditional diets [17]. Another critical factor is trust in information sources. Consumers are more likely to

accept novel foods when information is delivered by credible and trusted actors such as extension agents, health professionals, community leaders, or peer educators. Transparent communication, consistency in messaging, and evidence-based recommendations strengthen confidence and reduce perceived risk associated with new technologies [18]. Finally, accessibility and affordability significantly influence adoption outcomes. Even when awareness and acceptance are high, novel foods must be economically viable and readily available to achieve widespread uptake. Extension programs that link awareness-building with market access, local production, and supply chain development are better positioned to support sustained adoption and impact.

### 5. Challenges and Limitations of Extension Approaches

Despite their potential, extension approaches for enhancing awareness and acceptance of novel food innovations face several persistent challenges. Resource constraints remain a major limitation, particularly in low- and middle-income settings. Limited funding, insufficient staffing, and inadequate infrastructure can restrict the geographic reach, frequency, and depth of extension activities. These constraints often limit opportunities for continuous engagement, follow-up training, and long-term impact assessment [19]. Resistance to change among consumers and producers poses another significant challenge. Food neophobia, skepticism toward new technologies, and strong attachment to traditional foods can slow adoption. Misinformation, negative media coverage, or past food safety incidents may further reinforce distrust. Overcoming these barriers requires sustained engagement, participatory learning, and repeated exposure rather than one-time awareness campaigns [20-26].

The rapid pace of technological innovation in the food sector also presents difficulties for extension systems. Continuous emergence of new products, processing methods, and ingredients demands regular updating of extension content and ongoing professional development for extension personnel. Without adequate training and institutional support, extension agents may struggle to keep pace with evolving innovations. Additionally, regulatory and food safety concerns influence consumer confidence. Uncertainty related to safety standards, labeling requirements, and health claims can create hesitation among both producers and consumers. Extension services must therefore work closely with regulatory bodies to communicate clear, accurate, and compliant information, ensuring that innovations are introduced responsibly and transparently [1]. Addressing these challenges requires integrated, flexible strategies that combine technical training, behavior change communication, and policy support while remaining responsive to local contexts.

### 6. Future Directions

To enhance the effectiveness of extension programs in promoting awareness and acceptance of novel food innovations, future efforts must adopt more adaptive, inclusive, and evidence-driven approaches. Integration of digital tools will be increasingly important, as e-learning platforms, mobile applications, and social media campaigns can complement traditional extension methods and enable

cost-effective, large-scale dissemination of information. Digital tools also facilitate real-time feedback and personalized engagement with diverse consumer groups [2]. Greater emphasis should be placed on participatory co-creation, involving consumers, producers, and communities in the design, testing, and adaptation of novel food products. Co-creation enhances cultural relevance, strengthens ownership, and increases trust, thereby improving adoption outcomes. Extension agents can play a facilitative role in linking community insights with research and product development processes.

Evidence-based messaging will remain central to future extension efforts. Clear, transparent, and scientifically validated communication regarding nutritional benefits, safety, and environmental impacts is essential to counter misinformation and build long-term confidence in food innovations. Simplifying complex scientific information without compromising accuracy will be a key skill for extension professionals. Alignment with policy frameworks and regulatory systems is also critical. Extension programs should support government initiatives aimed at food safety, nutrition improvement, and sustainable food systems, ensuring coherence between innovation promotion and regulatory compliance. Such alignment can accelerate responsible adoption and scaling of novel foods. Finally, interdisciplinary collaboration will be essential for designing effective extension interventions. Integrating expertise from food science, nutrition, behavioral science, communication, and marketing can strengthen program design and improve impact. By embracing these future directions, extension services can play a transformative role in shaping informed, confident, and sustainable adoption of novel food innovations [1,2].

### 7. Conclusion

Extension approaches play a critical role in bridging the persistent gap between food innovation research and consumer adoption. As novel food technologies—such as plant-based alternatives, fortified foods, precision-fermented products, and sustainable processing methods—continue to emerge, effective extension systems are essential for translating scientific advancements into practical, acceptable, and trusted food choices. By integrating participatory learning approaches, digital and ICT-enabled tools, community-based engagement, and public-private partnerships, extension services can significantly enhance consumer awareness, understanding, and confidence in novel food innovations. Importantly, successful adoption of new food products is shaped not only by technological performance but also by social, cultural, and economic factors. Extension programs that address food-related beliefs, taste preferences, affordability, and perceived risks are better positioned to overcome resistance and food neophobia. Transparent, evidence-based communication delivered through trusted intermediaries—such as extension agents, nutrition professionals, and community leaders—further strengthens consumer trust and facilitates informed decision-making. As global food systems face increasing pressures from population growth, climate change, and public health challenges, the role of extension services will become even more critical. Adaptive and inclusive extension strategies that align with policy frameworks,

regulatory standards, and sustainability goals can accelerate the responsible adoption of food innovations while ensuring equity and consumer protection. Strengthening extension capacity, investing in interdisciplinary collaboration, and leveraging digital platforms will be essential for maximizing the societal impact of novel food technologies. Ultimately, well-designed extension approaches can ensure that food innovations contribute meaningfully to healthier diets, environmental sustainability, and resilient food systems worldwide.

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