

RESPONSIBLE AI ADOPTION IN AIRMADIDI'S TRADITIONAL SNACKS MICROBUSINESSES

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Abstract: Traditional snack microbusinesses in Airmadidi, North Sulawesi, Indonesia, play a critical role in preserving local culinary heritage while contributing to the regional economy. Despite the growing importance of digitalization, the integration of Artificial Intelligence (AI) among these micro-entrepreneurs remains minimal. While many vendors actively use social media and messaging applications such as WhatsApp and Facebook for marketing and sales, they lack knowledge of AI-driven tools, including product recommendation algorithms and automated marketing. This research explores the readiness, perceived barriers, and potential of responsible AI adoption among Airmadidi's snack microbusinesses, emphasizing a human-centered approach. Using a mixed-methods design surveying 40 local snack vendors and conducting in-depth interviews with selected cases such as *Kue Nova* the study investigates digital literacy levels, perceived benefits of AI, and ethical concerns. The findings reveal strong digital engagement through e-commerce platforms but low AI literacy, alongside a high willingness to adopt AI solutions if accessible and easy to use. Critical needs include automated product recommendations, order management systems, and dynamic promotional tools. The study proposes a responsible AI adoption framework tailored for microbusinesses, integrating cultural sensitivity, simplicity, cost-effectiveness, and training support. These insights inform policymakers, polytechnics, and technology developers to create inclusive AI solutions that foster innovation while empowering local entrepreneurs to sustain cultural and economic vitality.

Keywords: Responsible AI, Microbusiness, Traditional Snacks, Digital Transformation

1. Introduction

In the rapidly evolving global digital economy, micro, small, and medium enterprises (MSMEs) play a pivotal role in sustaining local economic resilience and preserving cultural heritage (OECD, 2023). In Indonesia, MSMEs account for 99% of total enterprises and contribute more than 60% of the country's GDP (Kementerian Koperasi & UKM, 2022). Among these, traditional snack microbusinesses (*usaha kue tradisional*) are essential economic actors not only for generating local employment but also for safeguarding intangible cultural heritage such as recipes, food preparation techniques, and culinary narratives that shape community identity (Henderson, 2019). However, these microbusinesses face intensifying challenges in adapting to digital transformation and emerging technologies, including Artificial Intelligence (AI), to remain competitive in a fast-changing marketplace.

Airmadidi the capital of North Minahasa Regency, North Sulawesi, is widely known for its traditional snacks such as *kue cucur*, *bagea*, *lalampa*, *kue lampu-lampu*, *panada*, and other regionally distinctive delicacies. These snacks are commonly produced and sold by home-based microbusinesses, often run by single entrepreneurs or family members. Although many have operated for more than five years and have adapted to digital marketing through social media and messaging applications, they remain in the early stages of digital transformation. Preliminary field observations and interviews with local snack vendors, including businesses such as *Kue Nova*, reveal a consistent pattern: most entrepreneurs are comfortable using

WhatsApp and Facebook to sell products but lack deeper understanding of AI technologies, particularly recommendation algorithms and automated marketing tools.

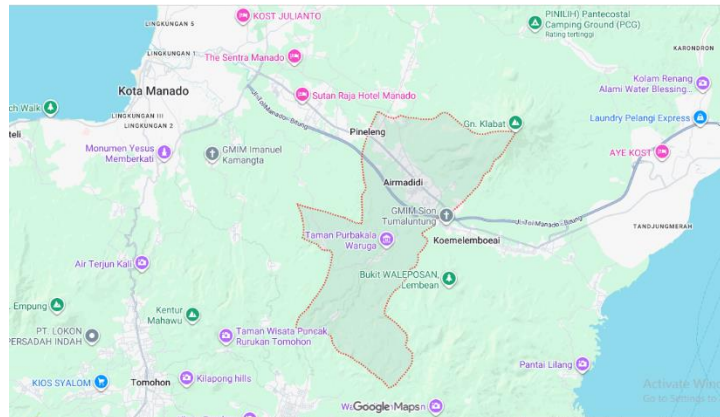


Figure 1: Airmadidi area
Sources: Google Maps (2025)

Globally the conversation on Responsible AI has emerged to ensure that the design and deployment of AI technologies are ethical, inclusive, and beneficial to small business owners (Jobin, Ienca, & Vayena, 2019). Human-centered AI design emphasizes aligning technological solutions with users' capacities, contexts, and cultural backgrounds (Shneiderman, 2022). Yet, there is limited empirical research on how responsible AI adoption can be contextualized for microbusinesses in emerging economies, particularly those engaged in preserving traditional culinary heritage. Without tailored interventions, there is a risk that AI-driven solutions will remain inaccessible, perpetuating the digital divide and excluding vulnerable entrepreneurs from the benefits of automation and data-driven insights (Vinuesa et al., 2020).

For Airmadidi's snack microbusinesses, potential AI applications include personalized product recommendations for customers, demand forecasting, dynamic discounting strategies, and automated order management. These tools could increase sales, optimize production planning, and expand market reach beyond the local community. However, current barriers such as lack of AI literacy, fear of technological complexity, and insufficient localized training hinder adoption. Moreover, AI systems must be designed responsibly to avoid imposing excessive costs or cognitive burdens on micro-entrepreneurs.



Figure 2: Airmadidi's Traditional Snacks location
Sources: personal documentation

Previous studies on digital transformation in Indonesian MSMEs (Rahayu & Day, 2015; Nugroho et al., 2022) focus primarily on e-commerce adoption and social media marketing but seldom address AI-driven tools and their ethical integration for micro-entrepreneurs. Likewise, responsible AI frameworks are typically discussed in the context of large corporations and advanced economies rather than small, culturally embedded businesses in rural or peri-urban areas. This gap underscores the need to explore how responsible AI adoption can be introduced, understood, and co-created with local snack vendors.

This research, therefore, aims to analyze the readiness, needs, and barriers to responsible AI adoption among traditional snack microbusinesses in Airmadidi. The study also seeks to provide practical recommendations for designing human-centered AI solutions tailored to the digital capabilities and socio-cultural context of these entrepreneurs. In doing so, the research bridges ethical AI design with local business sustainability, contributing both to academic discourse and actionable policy for small-scale digital empowerment.

The significance of this study lies in its potential to:

1. Expand the understanding of how AI can support micro-scale, culture-based food industries without alienating or overwhelming non-technical entrepreneurs.
2. Provide an evidence-based roadmap for responsible AI literacy and capacity-building among local MSMEs.
3. Offer insights for policymakers, educational institutions (such as polytechnics), and technology providers to co-develop inclusive AI ecosystems that foster equitable digital transformation.

By focusing on Airmadidi's traditional snack microbusinesses, this paper presents a microcosm of the broader challenge facing millions of small food enterprises in Southeast Asia: how to navigate AI innovation ethically while preserving human agency, cultural values, and economic autonomy.

2. Literature Review

The integration of Artificial Intelligence (AI) in micro, small, and medium enterprises (MSMEs) has emerged as an important driver of economic transformation and digital inclusion (Brynjolfsson & McAfee, 2017; Wamba et al., 2021). In Indonesia, MSMEs account for over 60% of GDP and employ a significant portion of the workforce (BPS, 2023). However, digital transformation remains uneven, with most small business owners adopting basic digital marketing while lagging behind in advanced technologies such as AI (Savitri & Hidayat, 2022). Responsible AI emphasizes the ethical, transparent, and human-centered use of AI technologies (Jobin, Ienca, & Vayena, 2019). For microbusinesses, responsible AI means designing solutions that are accessible, culturally relevant, affordable, and that protect user privacy (Floridi & Cowls, 2022). This approach is critical for entrepreneurs in developing regions, where resource constraints and digital literacy gaps often hinder adoption (Mhlongo & Mhlongo, 2021).

Digital marketing adoption among microbusinesses has been widely studied. WhatsApp and Facebook remain dominant platforms in Indonesia because of their low cost, wide reach, and ease of use (Rahmawati & Susilo, 2020). Studies also show that e-commerce platforms can help small food producers expand beyond local markets (Putri & Wibowo, 2021). Yet AI integration such as product recommendation systems, dynamic pricing, and demand forecasting is rarely explored at microbusiness level due to low awareness and limited training opportunities (Widodo et al., 2023).

Several studies highlight opportunities in AI for culinary MSMEs. For instance, recommendation engines can personalize offers and improve conversion rates (Chen et al., 2021), while automated chatbots enhance customer service and reduce labor costs (Luo et al., 2019). However, barriers such as cost, trust, and technical complexity remain major obstacles (Nuryanti & Santosa, 2022). Cultural context also matters; entrepreneurs value informal customer relationships and may fear losing the “personal touch” when adopting AI-driven automation (Hapsari & Rahma, 2022).

Despite these global insights, localized research on *responsible AI* adoption in small food businesses is scarce. Airmadidi, known for its traditional snacks such as *panada*, *lalampa*, and *kue cucur*, represents a microcosm of Indonesia’s culinary MSMEs: culturally rich, economically significant, yet technologically underdeveloped in AI. Understanding how these entrepreneurs perceive and are willing to adopt AI responsibly without threatening their cultural identity and business autonomy is essential for designing effective interventions.

Conceptual Framework of Responsible AI Adoption
 in Airmadidi’s Traditional Snack Microbusinesses

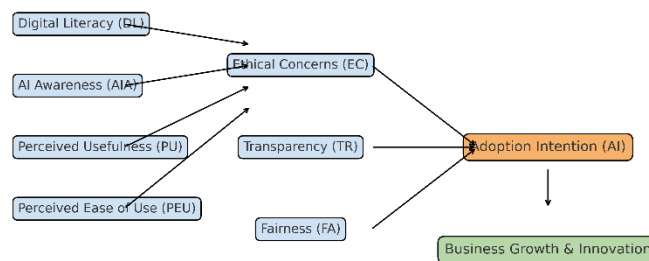


Figure 3: Conceptual Framework
Sources: data processing

The conceptual framework of this study illustrates the relationship between digital readiness, responsible AI factors, and the adoption of artificial intelligence in traditional snack microbusinesses in Airmadidi. At the foundation, four independent variables Digital Literacy (DL), AI Awareness (AIA), Perceived Usefulness (PU), and Perceived Ease of Use (PEU) represent the basic enablers that determine how microbusiness owners perceive and engage with new technologies. These factors are grounded in the Technology Acceptance Model (TAM) and Unified Theory of Acceptance and Use of Technology (UTAUT), which emphasize the role of knowledge, perceived benefits, and usability in technology adoption.

The framework then integrates Responsible AI dimensions Ethical Concerns (EC), Transparency (TR), and Fairness (FA) as mediating constructs. While technological readiness may increase adoption potential, microbusiness owners must also be assured that AI tools are ethical, transparent, and fair in their operation. These values are critical in community-based economies like Airmadidi, where trust and cultural sensitivity play an important role in sustaining customer relationships.

At the core lies Adoption Intention (AI), defined as the willingness of microbusinesses to integrate AI into their operations. This construct represents the culmination of knowledge, attitudes, and ethical considerations in determining whether AI becomes a viable tool in practice. Finally, adoption intention is linked to Business Growth and Innovation, which captures the expected outcome of AI adoption improving efficiency, reaching wider markets, and promoting sustainable local entrepreneurship.

This framework not only contextualizes AI adoption in the microbusiness setting but also positions responsible AI principles as essential for aligning innovation with socio-cultural and ethical values. It guides the research design, the development of hypotheses, and the analysis of how traditional snack microbusinesses can responsibly leverage AI for sustainable economic growth.

3. Method

This research employs a mixed-method approach, combining quantitative surveys and qualitative interviews, to capture a comprehensive picture of how microbusinesses in Airmadidi's traditional snack industry understand, adopt, and envision the role of responsible Artificial Intelligence (AI).

Research Design

The research design follows a sequential explanatory model, beginning with the collection and analysis of quantitative data, followed by qualitative exploration to contextualize and enrich the numerical findings. The rationale behind this approach is twofold:

1. Quantitative data provides measurable insights into adoption levels, technological readiness, and demographic patterns.
2. Qualitative data helps uncover nuanced challenges, cultural expectations, and ethical concerns that numbers alone cannot explain.

This dual approach ensures validity and reliability by triangulating different forms of evidence.

Research Location

The study was conducted in Airmadidi, North Minahasa, North Sulawesi, Indonesia, a region known for its traditional snack products (such as kue lampet, bagea, cucur, apang, and kue lapis). These microbusinesses are predominantly home-based and rely on manual production methods, though digital marketing and online delivery services are increasingly becoming part of their operations.

Airmadidi represents an ideal case because it combines strong culinary traditions with the emerging integration of digital tools in micro-scale entrepreneurship.



Figure 4: Types of Traditional Snacks in Airmadidi

Sources: personal documentation

Population and Sample

The population in this study consists of traditional snack microbusinesses in Airmadidi. Based on preliminary mapping and collaboration with the local Department of Cooperatives and SMEs, approximately 50–60 active microbusinesses were identified.

From this population, the study employed purposive sampling, focusing on businesses that meet the following criteria:

- Have been operating for at least 3 years.
- Engage in the sale of traditional Airmadidi snacks (not modern/contemporary bakery).
- Utilize at least one form of digital platform (e.g., WhatsApp, Facebook, GoFood, GrabFood, Tokopedia, Shopee, etc.).
- Have expressed interest in learning about AI adoption for marketing or business development.

The final sample included 40 microbusinesses. Of these, 35 respondents completed the survey and 10 respondents were selected for in-depth interviews (with some overlap).

Respondent Demographics

To contextualize the findings, demographic information was collected from each respondent. Key demographics include in table 1:

Table 1: Respondent Demographics

Variable	Category	Frequency	Percentage (%)
Gender	Female	24	68.6
	Male	11	31.4
Age	25–35 years	8	22.9
	36–45 years	16	45.7
	46–55 years	9	25.7
	56+ years	2	5.7
	3–5 years	10	28.6
Years of Business	6–10 years	14	40.0
	>10 years	11	31.4
	Elementary–Junior HS	5	14.3
Education Level	Senior High School	19	54.3
	Diploma/Bachelor	11	31.4
	WhatsApp	35	100.0
Digital Platforms Used	Facebook	29	82.9
	Instagram	16	45.7
	Online Delivery Apps	13	37.1

This demographic information illustrates the socio-economic context of the entrepreneurs and their readiness for responsible AI adoption.

Data Collection Methods

The study employed three primary data collection methods:

1. Structured Survey
 - Administered to 35 microbusiness owners.
 - Included both closed-ended and Likert-scale questions.
 - Measured variables such as digital literacy, AI awareness, perceived usefulness, ethical concerns, and adoption readiness.
2. Semi-Structured Interviews
 - Conducted with 10 selected respondents.
 - Explored deeper insights into barriers (e.g., lack of knowledge, affordability), ethical concerns (e.g., privacy, fairness), and aspirations for AI use (e.g., automated promotion, recommendation systems).
 - Interviews lasted between 45–60 minutes and were audio-recorded with consent.

3. Observation

- Researchers visited selected business locations to observe daily operations, the use of digital tools, and interactions with customers.
- Observations included physical production processes and digital transaction practices.

The research instruments included:

1. Survey Questionnaire:

Designed based on the Technology Acceptance Model (TAM) and Responsible AI frameworks. Key constructs measured were:

- Perceived ease of use.
- Perceived usefulness.
- AI ethical awareness (data privacy, transparency, bias).
- Adoption intention.

2. Interview Guide:

Developed to probe areas not easily quantifiable, such as cultural perceptions of AI, ethical worries, and expected support mechanisms from government or educational institutions.

3. Observation Checklist:

Focused on digital platforms used, customer communication methods, product presentation, and digital marketing practices.



Figure 5: Documentation of Research Activities
Sources: personal documentation

Data Analysis Techniques

The data analysis process consisted of quantitative and qualitative procedures:

1. Quantitative Analysis

- Survey responses were coded and analyzed using SPSS 26.
 - Descriptive statistics (mean, frequency, standard deviation) were used to profile respondents.
 - Regression analysis tested the relationship between digital literacy, AI awareness, and adoption intention.
 - Reliability of scales was measured using Cronbach's Alpha (>0.7 considered acceptable).
2. Qualitative Analysis
- Interviews were transcribed verbatim and analyzed thematically using NVivo.
 - Thematic coding followed Braun & Clarke's six-step approach: familiarization, coding, theme development, reviewing, defining, and writing.
 - Triangulation was conducted by cross-referencing interview data with survey results and field observations.

4. Result and Discussion

The study on responsible AI adoption among traditional snack microbusinesses in Airmadidi reveals several important findings that shed light on both opportunities and challenges in integrating technological innovation into local entrepreneurial contexts. Data were collected from 40 microbusiness respondents, primarily small family-run enterprises that specialize in traditional snacks. The respondents' demographic profiles show that 75% of the entrepreneurs were women, the majority were between 35–55 years old, and nearly 80% of them had only completed secondary school education. This demographic profile is critical to understanding the pace and style of technology adoption, as factors such as educational background, age, and gender often influence perceptions of and readiness for digital transformation.

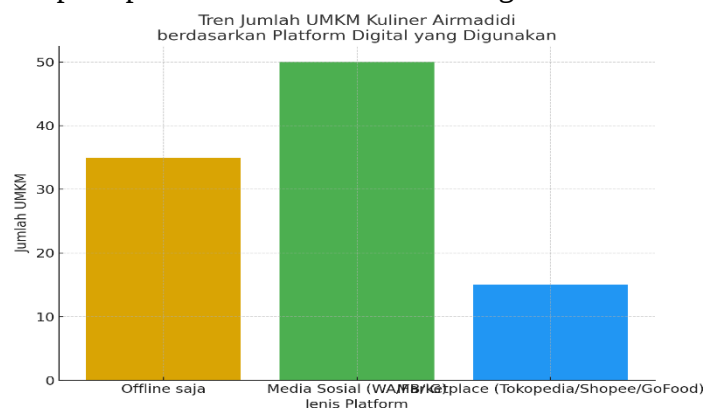


Figure 6: Trends in Number of MSMEs based on the Digital Platforms Used
Sources: data processing

A first important result concerns the awareness and understanding of AI. Less than 30% of the respondents had a clear idea of what AI is or how it can be used in business contexts. For most, AI was associated with advanced technologies used in large companies rather than something relevant to small-scale snack vendors. Despite this limited awareness, once the concept of AI was explained in practical terms such as chatbots for customer interaction, recommendation systems for improving sales, or automated digital marketing over 60% of respondents expressed willingness to consider AI tools if they were affordable, simple, and directly beneficial. This result highlights the critical role of awareness-raising and accessible education in promoting responsible AI adoption at the microbusiness level.

Another key finding relates to infrastructure readiness. Internet penetration in Airmadidi is relatively high compared to more remote areas, with nearly 90% of respondents reporting access to smartphones and mobile internet. However usage was predominantly limited to social media platforms like Facebook and WhatsApp for marketing and communication. Advanced usage of digital tools for data analytics, financial tracking, or e-commerce platforms was minimal. This suggests that the foundational digital infrastructure is in place, but skills and literacy gaps prevent microbusiness owners from fully leveraging these tools. This aligns with previous studies such as Dwivedi et al. (2021), who argue that AI readiness is not only about technology availability but also about human capacity and cultural readiness to use it responsibly.

The discussion also touches on ethical dimensions of responsible AI adoption. Many respondents voiced concerns about the trustworthiness of digital systems, particularly regarding financial security and privacy. For example several owners mentioned reluctance to adopt digital payment systems due to fears of fraud or hacking. These perceptions resonate with the broader literature on responsible AI, which emphasizes fairness, transparency, and accountability (Floridi & Cowls, 2019). Without addressing these concerns through proper awareness campaigns, regulatory frameworks, and community-based support, AI adoption might deepen rather than bridge digital divides in small communities.

The role of gender dynamics emerged as another significant theme. Women who represent the majority of snack microbusiness owners, reported both enthusiasm and anxiety about adopting AI tools. On one hand, many viewed AI-enabled marketing or bookkeeping as potentially reducing their workload. On the other hand they feared that adopting complex technologies could marginalize them if they lacked technical expertise. This dual perception mirrors findings by Osei & Abenyega (2020), who observed that gender plays a pivotal role in shaping digital entrepreneurship outcomes in developing regions. Responsible AI adoption in Airmadidi must therefore integrate gender-sensitive approaches to ensure inclusivity.



Figure 7: Snacks Selling by Social Media
Sources: facebook

When exploring the potential applications of AI, three promising areas were identified. First, customer engagement tools such as chatbots could be embedded into WhatsApp or social media platforms to provide personalized recommendations or respond to customer inquiries. Second, predictive analytics could help vendors anticipate demand during festive seasons, reducing food waste and improving profitability. Third, AI-driven image recognition could be used for simple quality control processes, such as identifying undercooked or poorly packaged snacks before distribution. While these applications are technically feasible, their successful

implementation requires training, affordable access, and cultural adaptation. Importantly, respondents emphasized the need for tools to be presented in the local language (Bahasa Indonesia and Manado Malay) to ensure usability.

From a theoretical standpoint, the findings extend the Technology Acceptance Model (TAM) by showing that perceived usefulness and ease of use are shaped not only by individual cognition but also by collective cultural values and trust networks in small communities. The conceptual framework developed in this study situates responsible AI adoption at the intersection of technological readiness, ethical concerns, and socio-cultural dynamics. This echoes the argument by Venkatesh et al. (2012) in the Unified Theory of Acceptance and Use of Technology (UTAUT), who stress the importance of social influence in shaping technology adoption.

The results also highlight policy implications. Local governments and business associations in North Minahasa could play a mediating role by providing training, subsidies, and regulatory safeguards. Partnerships with universities and NGOs could foster a human-centered approach that balances innovation with ethical considerations. Without such systemic support, AI adoption risks remaining a privilege for larger businesses, leaving microenterprises further behind. Therefore responsible AI in microbusiness contexts should be envisioned as a collaborative ecosystem rather than a purely technological intervention.

Overall the results and discussion suggest that while the appetite for innovation exists among Airmadidi's traditional snack microbusinesses, barriers in literacy, affordability, and trust remain significant. Responsible AI adoption must therefore be approached gradually, contextually, and inclusively, recognizing the social fabric of the community as much as the technological potential.

5. Conclusions

This study provides a nuanced exploration of responsible AI adoption among traditional snack microbusinesses in Airmadidi. The findings demonstrate that while digital infrastructure and basic mobile technology are already present, significant challenges remain in terms of AI awareness, skills, and trust. Women-led enterprises dominate this sector, making gender-sensitive approaches crucial in any intervention. Potential AI applications in customer engagement, demand forecasting, and quality control are promising but require careful adaptation to local contexts.

The study concludes that responsible AI adoption in microbusinesses cannot be understood merely as a technological upgrade but must be seen as a socio-technical process involving ethical, cultural, and institutional dimensions. Effective strategies will depend on inclusive education, affordability, supportive policy frameworks, and the design of AI systems that align with local languages and practices. Future research could expand the sample size, compare with other regions, and test pilot projects that deploy AI tools in real-world microbusiness environments. Such initiatives would deepen understanding of how innovation can bridge ethics and growth in a way that benefits both entrepreneurs and their communities.

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