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Digital Governance for Sustainable Nutrition: Advancing SDG 2 (Zero Hunger)

Dr. Ankita Shrivastava, Assistant Professor, AAFT University of Media and Arts, E-mail-ankita.srivastava@aaft.edu.in
Anusha Ahuja, M.Sc Nutrition and Dietetics, Manav Rachna University, Delhi, E-mail-anushaahuja25@gmail.com

Abstract:

Despite significant progress in public health, India still faces major challenges in achieving food security and nutrition. Approximately 194 million people are undernourished, and stunting and wasting rates among children remain high. Key issues include fragmented food supply chains, inefficient public distribution systems, lack of real-time monitoring, delayed targeting of vulnerable populations, corruption, and poor data-driven decision-making. Regional disparities, low digital literacy, and infrastructural gaps further limit the effectiveness of national nutrition programs. These systemic challenges slow India's progress toward Sustainable Development Goal 2 (Zero Hunger). Digital governance provides a transformative solution to these ongoing issues. By integrating mobile-based nutrition apps, GIS-enabled food distribution networks, AI-driven data analytics, and e-governance portals, the government can improve transparency, reduce leakages, and ensure fair access to nutritious food. Initiatives like POSHAN Abhiyaan, the electronic Public Distribution System (e-PDS), and Integrated Child Development Services (ICDS) show how technology can enhance program delivery, track real-time outcomes, and involve communities in monitoring and reporting. Additionally, digital tools empower citizens with nutrition awareness, participatory reporting, and personalized diet-planning resources. This fosters accountability and local engagement. Challenges such as limited internet connectivity, low digital literacy, and data privacy concerns are being tackled through capacity-building programs, inclusive design, and regulatory frameworks. This paper offers a problem-solving framework for India, showing how digital governance can close policy gaps, strengthen program implementation, and promote sustainable nutrition practices. By combining technology, governance, and community engagement, India can effectively address malnutrition, reduce inequalities in food access, and accelerate progress toward SDG 2. The insights provide scalable strategies for policymakers, NGOs, and digital innovators aiming to resolve systemic nutrition challenges with technology-driven interventions.

1. Introduction

Global malnutrition continues to be one of the most pressing public health challenges of the 21st century. The Global Nutrition Report (2023) indicates that more than 735 million individuals suffer from chronic hunger, while countless others experience micronutrient deficiencies, commonly referred to as "hidden hunger" (FAO, 2023). This phenomenon poses a significant threat to the achievement of Sustainable Development Goal 2 (SDG 2): Zero Hunger. This objective aims to eradicate all types of malnutrition and ensure universal access to safe, nutritious, and sufficient food by 2030. Despite ongoing initiatives, global efforts remain insufficient, particularly in low- and middle-income countries where structural inequalities in food systems persist (UNICEF, 2022).

India plays a pivotal role in the global nutrition context. With the highest number of undernourished individuals in the world—approximately 194 million—India experiences alarming rates of stunting (35.5%), wasting (19.3%), and anemia among women of reproductive age (57%) as reported by NFHS-5 (MoHFW, 2021). The nation confronts a "double burden" of malnutrition, encompassing both undernutrition and an increasing prevalence of overweight individuals. This complicates the development of national nutrition strategies. Although India has implemented multiple national programs, such as POSHAN Abhiyaan, ICDS, and PDS, traditional governance struggles with systemic issues including bureaucratic delays, inconsistent data, inadequate service delivery, resource leakages, weak oversight, and insufficient community engagement (NITI Aayog, 2022).

In this light, digital governance has emerged as an effective means to enhance public health nutrition. Digital governance integrates technology with decision-making, monitoring, and service delivery frameworks. Globally, digital advancements, including real-time dashboards, mobile delivery services, blockchain traceability, AI/ML-based predictive models, and digital agriculture platforms, have revolutionized food systems (World Bank, 2021). India is also embracing various digital solutions, such as Poshan Tracker, e-PDS, DBT systems, mobile health applications, GIS-based mapping, and digital agriculture projects, to improve food distribution and nutrition service efficiency.

Aim and Scope of the Paper

This research paper thoroughly analyzes how digital governance can serve as a catalyst in achieving SDG 2 in India. It explores:

- Global And Indian Case Studies on Digital Governance in Nutrition
- Existing Nutritional Challenges Faced by The Country
- The Prospective Role of Digital Tools in Enhancing Governance, Transparency, And Community Engagement
- Examples Of Successful Initiatives
- Current Gaps and Limitations
- Actionable Recommendations and Future Pathways

The study intends to furnish policymakers, researchers, technologists, and nutrition specialists with a comprehensive understanding of leveraging digital governance to expedite India's nutrition objectives.

2. Understanding Digital Governance in the Nutrition Sector

2.1 Concept and Key Elements

Digital governance involves the strategic use of Information and Communication Technologies (ICTs) to enhance efficiency, transparency, and equity in public service delivery (OECD, 2020). In nutrition, it transforms data collection, analysis, and utilization to inform policies, monitor programs, and engage citizens. Key tools include mobile applications, digital identity systems, automated service platforms, cloud-based databases, and AI analytics, collectively improving nutrition program delivery.

Core Elements:

Data Management and Analytics

- Real-time dashboards, unified monitoring frameworks, and cloud databases track child growth, maternal health, and food distribution.
- AI/ML supports predictive modeling, identifying vulnerable populations before malnutrition escalates (World Bank, 2021).

Digital Identity and Authentication

- Systems like Aadhaar ensure precise beneficiary identification, reducing duplication and exclusion.
- Biometric verification strengthens supply chain integrity and targeting efficiency.

Automated Service Delivery

- Digital ration distribution, SMS alerts, and direct benefit transfers reduce errors, fraud, and delays.

E-Portals, Mobile Apps, and Frontline Worker Technologies

- Platforms like Poshan Tracker and Anganwadi facilitate real-time tracking, reporting, and nutrition education for beneficiaries.

Citizen Dashboards and Participatory Tools

- Dashboards and mobile reporting systems empower communities to monitor progress, identify gaps, and strengthen accountability.

Significance:

Digital governance enhances transparency, reduces corruption, and strengthens inter-ministerial collaboration. Real-time data and citizen participation improve evidence-based interventions, aligning with SDG 2 goals.

2.2 Global Trends in Digital Nutrition Governance

Bangladesh – *A2i Initiative:* Rural digital centers provide maternal and child nutrition counseling via mobile platforms, improving service access in remote areas (UNDP, 2021).

Kenya – *M-Farm:* Connects farmers to markets, offers real-time price data, strengthens income security, and reduces exploitation by middlemen.

Brazil – *Hunger Zero (Fome Zero):* Digital management systems coordinate food subsidies, monitor community kitchens, and track household nutrition, significantly reducing hunger pre-2015.

Lessons for India:

- Community-centered systems enhance trust and participation.
- Integration across platforms prevents data silos and improves efficiency.
- Transparency tools reduce leakage and corruption.
- Multilingual, user-friendly interfaces promote inclusivity.
- Reliable infrastructure and workforce training are crucial for sustainable implementation.

Conclusion:

Global experiences show that effective digital governance, combined with political commitment and citizen engagement, can significantly strengthen nutrition systems and improve outcomes.

3. Nutrition Landscape in India: Challenges

India faces high malnutrition despite economic growth and policy efforts. Stunting, wasting, maternal undernutrition, and micronutrient deficiencies persist, reflecting gaps in service delivery and resource allocation.

3.1 Malnutrition Burden

- Child Undernutrition: NFHS-5 reports 35.5% stunted, 19.3% wasted, 32.1% underweight.
- Micronutrient Deficiencies: Anaemia affects 57% of women, 25% of men, 67% of children; deficiencies in iron, folate, vitamin A, and zinc impair health.
- Vulnerable Populations: High malnutrition in Bihar, Jharkhand, UP, MP; better outcomes in Kerala, Tamil Nadu. At-risk groups include tribal communities, urban poor, pregnant/lactating women, and children under five.

3.2 Barriers in Traditional Programs

- Fragmented Supply Chains: Multiple intermediaries, poor coordination, stock delays.
- PDS & ICDS Inefficiencies: Irregular supplies, outdated records, delayed nutrition and monitoring.
- Monitoring & Reporting: Paper-based systems slow interventions and crisis response.
- Corruption & Leakages: Diversion and manipulation reduce program effectiveness.
- Weak Community Engagement: Low awareness, minimal participation, and limited accountability in local committees.

4. The Impact of Digital Governance on Nutrition Systems

Digital governance is transforming India's nutrition framework by improving responsiveness, transparency, and citizen-centricity through real-time data platforms and AI-driven analytics.

4.1 Data-Driven Decision Making

Digital systems provide timely, actionable data for policy and program planning. Real-time dashboards consolidate data from POSHAN Tracker, ICDS-CAS, e-PDS, and state MIS, enabling monitoring of ration distribution, child growth, and worker attendance. AI and machine learning predict malnutrition hotspots using socio-economic, climatic, and seasonal data, guiding resource allocation. GIS mapping identifies service gaps, optimizes supply routes, and strengthens last-mile delivery of food and supplements.

4.2 Increasing Transparency and Minimizing Fraud

Digital tools reduce human intervention and establish secure, verifiable records. Aadhaar-linked ration cards prevent duplication and fraud. e-PDS tracks food grain distribution from procurement to delivery, while digital stock records, automated weighing, and SMS alerts minimize diversion. Blockchain technology adds immutable traceability of commodities, enhancing stakeholder trust.

4.3 Improving Service Delivery and Targeting

Mobile applications like Poshan Tracker and mAnganwadi enable real-time documentation of child growth, ANC/PNC checks, and supplementation coverage. Automated algorithms identify high-risk households for targeted support. Digitized growth monitoring tools, including smart weighing devices and mobile-linked MUAC tapes, allow early detection of nutritional deficits, ensuring timely intervention.

4.4 Empowering Citizens with Digital Solutions

Digital governance fosters participatory, accessible nutrition services. AI-based apps provide personalized diet planning, nutritional guidance, and health risk assessments. Community dashboards display essential indicators, promoting transparency and local oversight. Mobile reporting platforms allow beneficiaries to report service gaps, corruption, or stock shortages, reinforcing accountability. SMS/IVRS campaigns deliver behavior change messages, reminders for vaccinations, and maternal health education in local languages.

5. Case Studies of Digital Nutrition Governance in India

The implementation of digital governance has revolutionized nutrition systems in India. Numerous significant initiatives illustrate how technology can enhance service delivery, improve monitoring, prevent fraud, and engage citizens in supporting nutritional outcomes.

5.1 POSHAN Abhiyaan

Launched in 2018, POSHAN Abhiyaan is India's flagship initiative integrating digital governance into nutrition programs to reduce stunting, wasting, undernutrition, and anemia. Frontline workers, including Anganwadi Workers (AWWs), are equipped with smartphones, digital weighing scales, and biometric tools, enhancing documentation accuracy and service delivery. The Poshan Tracker mobile application enables real-time monitoring of child growth, nutrition supplement distribution, and service updates, with dashboards at state and district levels for targeted interventions. Community engagement is strengthened through Jan Andolan campaigns, social media, and digital promotion of Poshan Maah and Poshan Pakhwada, increasing public participation and nutrition awareness.

5.2 e-PDS (Electronic Public Distribution System)

The e-PDS reform under the National Food Security Act leverages digitization to improve access to subsidized food. GPS tracking of food grain transport and Aadhaar-based biometric verification at Fair Price Shops ensure traceability and prevent identity fraud. Evaluations indicate reduced leakages, fewer ghost beneficiaries, and improved system reliability, supported by automated stock registers, SMS alerts, and digital weighing machines. State-level innovations provide models for national replication: Chhattisgarh implemented computerized supply-chain management, door-to-door ration deliveries, and online grievance redressal, while Andhra Pradesh introduced e-PoS devices, real-time inventory tracking, and Aadhaar seeding, enhancing accountability and minimizing theft.

5.3 ICDS Common Application Software (CAS)

The ICDS Common Application Software (CAS) was among India's first initiatives to digitize maternal and child health and nutrition service delivery. CAS enabled frontline workers to digitally record children's weight, height, and nutritional status, generating alerts for cases requiring urgent attention. This facilitated timely follow-ups and reduced errors associated with under- or over-reporting of malnutrition. Despite its potential, CAS faced challenges such as poor internet connectivity, device malfunctions, and limited digital literacy among workers. Lessons from CAS informed us of the development of the Poshan Tracker, which offers enhanced features, improved database integration, and lower technical requirements.

5.4 Additional Innovations Enhancing Digital Nutrition Governance

Digital agriculture platforms, including e-NAM, Digital Green, and weather advisory tools, support nutrition-sensitive agriculture by connecting farmers to markets, offering digital training, and promoting climate-smart practices, thereby improving food availability and household income. Start-ups have also been innovated in supply chains and food fortification using blockchain for traceability, IoT for cold chain monitoring, and AI for quality assurance of fortified foods. Furthermore, digital payment transfers (DBT) under programs such as PMMVY and food subsidies ensure prompt fund delivery to beneficiaries, reducing middlemen, minimizing leakages, and increasing women's autonomy—key factors for enhancing household nutrition outcomes.

6. Advantages of Digital Governance in Supporting SDG 2 (Zero Hunger)

Advantage	Key Features / Benefits
Enhanced Transparency	Complete visibility of food distribution via GPS tracking, electronic ledgers, biometric verification, dashboards. - Reduced duplication and fraud through digital records and Aadhaar integration; minimizes corruption and phantom beneficiaries.
Improved Efficiency & Timeliness	Real-time dashboards enable faster decision-making and monitoring of nutrition status, stock, and workforce. - AI and predictive analytics identify at-risk children and mothers for early interventions.
Fairness & Inclusion	Targeted delivery to underprivileged and high-burden communities. - Digital tools reduce urban–rural gaps, ensuring consistent service in remote areas.

Citizen Involvement & Accountability	Community oversight via dashboards and reporting platforms strengthens ownership. - Crowdsourced grievance redressal enables timely correction of service issues.

Table 1. Advantages of Digital Governance in Supporting SDG

7. Challenges and Limitations in Digital Nutrition Governance

Despite the promise of digital solutions, several barriers continue to limit their effectiveness in India's nutrition system.

7.1 Infrastructure Gaps

Poor internet connectivity in rural and tribal areas disrupts real-time monitoring and beneficiary verification on platforms like Poshan Tracker and e-PDS. Many frontline workers also lack reliable smartphones, power supply, and device support, reducing the smooth use of digital tools.

7.2 Digital Literacy Barriers

Low digital skills among AWWs, ASHAs, and beneficiaries lead to frequent errors and limited adoption. A persistent gender gap in mobile ownership and digital confidence further restricts women's participation in digital nutrition programs.

7.3 Data Privacy and Ethical Concerns

Large nutrition databases store sensitive information that may face risks of data breaches or misuse. Weak data governance frameworks create issues around consent, privacy, data sharing, and public trust.

7.4 Implementation Challenges

Digital tools can unintentionally increase frontline workloads through repetitive data entry and complex interfaces. Lack of interoperability between systems like Poshan Tracker, HMIS, and e-PDS limits coordinated action. Financial constraints also affect device procurement, training, and long-term system maintenance.

8. Problem-Solving Framework for India

To effectively utilize digital governance for achieving nutrition security, India needs a comprehensive and coordinated framework that tackles policy deficiencies, enhances infrastructure, boosts human capacity, and encourages innovation.

8.1 Policy Recommendations

Strengthening policy frameworks is essential for advancing digital nutrition governance in India. Establishing a National Digital Nutrition Mission (DNNM) can bring fragmented initiatives under a unified, interoperable structure, ensuring coordinated action and long-term sustainability across ministries. Alongside this, robust regulatory mechanisms for data governance covering privacy, consent, access control, and grievance are vital to building trust and safeguarding citizens' information. Integrating nutrition-related data streams across key ministries such as Health, Women and Child Development, Agriculture, Rural Development, and Food & Public Distribution will create a comprehensive evidence base, enabling more accurate assessments and more effective, multisector interventions.

8.2 Strengthening Digital Infrastructure

Strengthening digital infrastructure is crucial for the successful deployment of technology-based nutrition initiatives. Public–private partnerships with telecom providers, technology firms, and NGOs can expand network connectivity, create community internet hubs, and drive innovation in underserved regions. Ensuring affordable smartphone access for frontline workers—through subsidies, repair support, and maintenance provisions—further enables consistent and reliable use of essential digital platforms. Together, these measures build a robust foundation for effective digital nutrition governance.

8.3 Capacity Building

Capacity building is essential for the effective implementation of digital nutrition systems. Structured digital literacy training, continuous mentorship, and peer-learning opportunities help Anganwadi workers, ASHAs, and community members use tools like the Poshan Tracker with confidence and accuracy. Equally important is the development of user-friendly platforms designed in local languages, with simple navigation and audio-visual guidance to ensure accessibility for users with varied literacy levels. Together, these measures strengthen digital adoption and enhance the overall efficiency of nutrition programs.

8.4 Community Engagement Models

Community engagement is strengthened through digital tools that promote transparency and shared responsibility. Citizen dashboards allow the public to access local nutrition data, monitor service quality, and report issues, encouraging active participation. At the same time, involving nutrition volunteers, Self-Help Groups, youth groups, and Panchayati Raj institutions in digital reporting and awareness activities builds community ownership and strengthens accountability within nutrition programs.

8.5 Innovation and Research Focus

Emerging technologies are strengthening nutritional systems through smarter, data-driven solutions. AI supports personalized nutrition by offering tailored diet advice and assessing individual risks. Predictive machine-learning models help identify malnutrition hotspots and guide timely interventions. Digital agriculture tools using climate data, price trends, and supply-chain analytics improve food availability and support farmer resilience. Together, these innovations make nutrition programs more targeted, efficient, and responsive.

9. Future Directions for Achieving SDG 2 Through Digital Governance

Achieving SDG 2 will require India to combine technological innovation with inclusive, multi-sector strategies. Scaling successful pilots such as blockchain-based traceability, smart agriculture tools, and real-time child growth monitoring across states will be essential, while ensuring these solutions fit local needs. Integrating digital agriculture platforms, climate-smart tools, and nutrition planning can strengthen food system resilience and ensure year-round availability of diverse foods. At the same time, designing gender-sensitive and inclusive platforms is critical to reducing digital gaps and improving equitable access to nutrition services. By developing scalable and cost-effective digital frameworks, India can position itself as a global leader in digital nutrition governance. Moving forward, strong collaboration aligned with SDG 17 between government agencies, private innovators, NGOs, academic institutions, and global partners—will be vital to driving sustainable, systemic transformation.

10. Conclusion

Digital governance has become a crucial strategy for addressing India's enduring nutrition challenges, including undernutrition, micronutrient deficiencies, and inequities in access to food security programs. Integrating data-driven systems through initiatives like POSHAN Abhiyaan, e-PDS, ICDS-CAS, and agri-nutrition innovations demonstrates the potential of technology to improve service delivery, monitoring, and system efficiency. Key successes include enhanced transparency, efficient resource allocation, and equitable access. Real-time dashboards reduce information gaps, biometric authentication limits leakages, and digital tracking ensures that nutrition services reach the intended beneficiaries. These systems also empower frontline workers and foster community participation, strengthening accountability and trust. Achieving SDG 2 (Zero Hunger) requires coordinated efforts across stakeholders. Policymakers must invest in infrastructure and capacity building, researchers should evaluate and refine digital interventions, technologists need to develop user-friendly solutions, and communities must actively engage in monitoring and feedback.

In essence, digital governance extends beyond administrative improvement; it is a powerful instrument for nutritional equity, ensuring safe, sufficient, and nutritious food for all. With sustained innovation and collaboration, India can advance toward a well-nourished population and fulfill the objectives of SDG 2.

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