



अनुसंधान नेशनल रिसर्च फाउंडेशन
ANUSANDHAN NATIONAL
RESEARCH FOUNDATION

Challenge Development of a Cost-Effective, Scalable, and Highly Accurate Individual Animal Identification System for Large-Scale National Livestock Management and Traceability Programs

Livestock plays a vital role in the agricultural economy of many developing countries, particularly in India, where it serves as a major source of livelihood, food security, and rural employment. The livestock sector disproportionately benefits smallholders and landless farmers, who together own approximately 70% of India's livestock population and derive nearly 50% of their income from livestock-related activities. Dairying alone contributes around 28.6% to Gross Agricultural Value Added (GAVA) and supports the livelihoods of nearly six million people.

Effective livestock management demands reliable individual animal identification enabling tracking of health status, vaccination records, breeding history, productivity data, and movement patterns. At the national level, robust identification systems are critical for disease eradication programs, disease-free zone management, and integration into global trade networks that require strict traceability standards.

Traditionally, animal identification has relied on methods such as ear tagging, branding, ear notching, tattooing, and nose printing. India's current ear-tagging system assigns each animal a unique 12-digit identification number and supports vaccination and health monitoring programs. However, this system faces significant challenges: low farmer acceptance due to its invasive nature, risk of wounds and infections, loss or deliberate removal of tags, and inconsistent traceability during animal transport, sale, or death. These limitations undermine the long-term reliability of the identification system.

Recent technological advancements including RFID, electronic ear tags, microchips, and biometric/image-based methods such as muzzle pattern recognition, facial recognition, and iris scanning offer the potential for non-invasive, permanent, and tamper-proof identification. The adoption of AI and ML techniques further enhances accuracy, automation, and data analytics.

However, no solution has yet achieved the combination of accuracy, cost effectiveness, scalability, and field operability required for deployment at national scale across India's approximately 500 million cattle and buffaloes.

AS-IS → TO-BE Transformation

Dimension	AS-IS - The Problem Today	TO-BE - What This Challenge Aims to Achieve
Identification Method	Invasive ear tagging is prone to loss, damage, infection, and deliberate removal.	Non-invasive or minimally invasive biometric/image-based identification that is permanent and tamper proof.
Accuracy	Subject to human error; tag loss and duplication compromise reliability.	Near 100% (minimum 99.5%) identification accuracy at scale.
Species Coverage	Primarily cattle-focused in practice.	Applicable to both cattle and buffaloes, with potential extension to small ruminants and swine.
Breed Identification	Not systematically captured; mixed breeds unrecorded.	Breed composition identified and recorded, including mixed breeds expressed as percentage contributions (e.g., %X + %Y)
Lifetime Stability	Tags degrade, fade, or are lost over time.	Identifying features stable across the animal's lifetime from early age, with no need for replacement.
Movement Tracking	Inconsistent, traceability breaks down during transport, sale, or death.	Seamless tracking of animal movement, including disease surveillance zones and disease free zones.
Data Management	Fragmented records, susceptible to manipulation or loss.	Comprehensive, tamper-proof digital records including ownership transfers, vaccination history, health status, and productivity data.
Product Traceability	Largely absent, no systematic linkage of livestock products to source animals.	Traceability of milk supported up to the point of pooling/bulking, meat traceability linked to individual animals.
Integration	Siloed systems with limited interoperability.	Seamless integration with national government databases and digital platforms.
Cost & Scalability	Existing technology not economically viable for large-scale deployment in developing regions.	Cost-effective and scalable solution deployable across India's ~500 million cattle and buffaloes and replicable in South Asia and Africa.
Field Operability	Equipment often bulky, complex, or impractical for rural field conditions.	Portable, easy-to-operate system suitable for field deployment by livestock workers.

What We Are Looking For

We seek proposals for an innovative, end-to-end individual animal identification system that addresses the limitations of current methods and meets the requirements outlined above. The



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proposed solution should demonstrate the following capabilities:

1. Identification & Biometrics

The system must offer non-invasive or minimally invasive identification using biometric or image-based techniques (e.g., muzzle pattern recognition, facial recognition, iris scanning) or other novel approaches. Identification accuracy must meet or exceed 99.5%. The identifying features must remain stable across the animal's lifetime and be applicable from an early stage of life. The system should also support breed identification, including mixed-breed animals, with the ability to record and report breed composition as a percentage mix (e.g., %X + %Y).

2. Species Applicability

The system must be applicable to both cattle and buffaloes, with a clear pathway for extension to other livestock species including small ruminants and swine.

3. Tamper-Proof Integrity

The identification mechanism must be resistant to physical damage, loss, or deliberate removal. The underlying data management system must incorporate secure mechanisms that prevent manipulation, with full change logs for every entry and modification.

4. Digital Record Management

The system should support comprehensive digital records encompassing ownership history, vaccination and health records, productivity data, and movement logs, with the ability to integrate with existing and future national-level government platforms.

5. Movement & Traceability

The system should enable efficient tracking of animal movement, particularly during transportation and when crossing disease surveillance or disease-free zone boundaries. For milk, traceability should be supported up to the point of pooling or bulking, recognizing that milk is aggregated at farm level as well as further along the supply chain. For meat, traceability should be maintained to the level of the individual animal.

6. Technology & AI/ML

Proposals are encouraged to leverage Artificial Intelligence and Machine Learning to improve identification accuracy, automate recognition processes, and enhance data analytics capabilities.

7. Cost-Effectiveness & Scalability

The solution must be economically feasible for large-scale deployment particularly in developing regions such as South Asia and Africa and capable of scaling to populations of the magnitude of India's ~500 million cattle and buffaloes. Equipment must be portable and operable under rural field conditions without requiring complex infrastructure.



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What will NOT be considered

Proposals will be disqualified if they involve any of the following -

- Use of conventional ear tagging systems combined only with mobile or digital applications for data capture, without introducing innovative identification technologies.
- Identification accuracy below 99.5%
- Conceptual proposals without a working prototype or preliminary validation data.
- Technologies not applicable to both cattle and buffaloes.
- Systems requiring bulky, complex, or expensive equipment unsuitable for field conditions.