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Review on organic livestock farming: A sustainable production system

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Abstract

The intensification of conventional livestock production systems has significantly increased animal productivity; however, it has simultaneously raised concerns regarding environmental degradation, excessive use of synthetic inputs, antimicrobial resistance, animal welfare, and food safety. Organic livestock farming has emerged as a sustainable alternative that emphasizes ecological balance, biodiversity conservation, animal welfare, and minimal reliance on synthetic chemicals. This review critically examines the principles, standards, and management practices of organic livestock farming, with particular emphasis on organic dairy production. Global trends in organic livestock production, market growth, and the comparatively small contribution of animal products to the overall organic sector are discussed. The review further evaluates the environmental, economic, social, and consumer-related benefits of organic livestock systems, along with the constraints limiting their widespread adoption, especially in developing countries. Special attention is given to India, highlighting its agro-climatic diversity, traditional low-input farming systems, and significant potential for organic livestock and dairy production. The review concludes that organic livestock farming can enhance sustainability, animal welfare, and product quality while offering premium market opportunities and improved rural livelihoods.

Keywords: Organic livestock farming, organic dairy, sustainable agriculture, animal welfare, India, organic certification

Introduction

Advancements in livestock production systems have substantially increased food availability through the widespread use of chemical fertilizers, antibiotics, veterinary pharmaceuticals, agrochemicals, and nutritionally optimized animal feeds. While these interventions have improved productivity, they have also raised growing concerns among consumers regarding food safety, environmental degradation, and animal welfare. Contemporary consumers are increasingly inclined toward foods that are free from chemical residues, produced in an environmentally responsible manner, and obtained from systems that ensure ethical treatment of animals. Furthermore, transparency in production processes and traceability across the food supply chain have become important determinants of consumer preference. In this context, organic production systems are widely recognized as a sustainable alternative, as they prioritize ecological integrity, natural resource conservation, and responsible livestock management (Chander *et al.*, 2011) [5].

Although organic production poses several technical and economic challenges for farmers in developing countries, it simultaneously provides significant opportunities for accessing premium domestic and international markets. The organic farming philosophy is founded on the principle that healthy soils foster healthy plants and animals, which ultimately contribute to human well-being and long-term environmental sustainability (Hamadani & Khan, 2015) [13]. By minimizing dependence on external synthetic inputs, organic systems aim to enhance biological processes and ecosystem resilience. Organic agriculture is carried out in close to 160 countries worldwide, spanning about 37.2 million hectares of farmland.

The global market for organic food and beverages has expanded rapidly, reaching an estimated value of US\$54.9 billion in 2009 (Willer & Kilcher, 2011) ^[29]. Asia represents the highest share of organic producers worldwide (around 40%), with Africa following at 28% and Latin America at 16%. India leads the world in terms of the number of organic producers, with over 677,000 certified farmers, followed by Uganda and Mexico. Even with its broad adoption, livestock products make up only a minor portion of the organic market compared with crop-based goods like cereals, fruits, and herbs. Consequently, the contribution of organic animal products to exports from developing countries remains relatively limited (Willer & Kilcher, 2011) ^[29].

The Codex Alimentarius Commission defines organic agriculture as a holistic production management system designed to enhance the health of agro-ecosystems, including biodiversity, biological cycles, and soil biological activity. This approach prioritizes farm-based management practices over the use of external synthetic inputs and acknowledges the importance of locally adapted systems tailored to specific ecological conditions. Organic agriculture therefore relies primarily on agronomic, biological, and mechanical methods wherever feasible rather than synthetic materials, to perform system-specific functions (Codex Alimentarius Commission, 2007) ^[7].

Organic animal husbandry constitutes a distinct branch of organic agriculture, emphasizing the use of organic and biodegradable inputs in animal nutrition, health management, housing, and breeding practices. The system strictly restricts the use of synthetic veterinary drugs, feed additives, growth promoters, and genetically engineered breeding materials, while promoting preventive health management and natural resistance (Chander *et al.*, 2011) ^[5]. Organic dairy farming refers to the management of milk-producing animals under organic production standards, which include feeding with organically cultivated feed and pasture, ensuring consistent access to outdoor areas and grazing, and minimizing the use of antibiotics and hormonal interventions. These practices aim to improve animal welfare, milk quality, and the overall sustainability of dairy production systems (Oruganti, 2011) ^[19].

Characteristics of Organic Livestock Production

Livestock production constitutes an integral component of organic farming systems and is designed to establish a harmonious and sustainable relationship among soil, plants, and animals within the farm ecosystem (Vaarst *et al.*, 2006) ^[27]. Organic livestock production emphasizes closed nutrient cycles, on-farm resource utilization, and ecological balance. The system strictly restricts the use of synthetic inputs, including chemically synthesized veterinary drugs, feed additives, growth promoters, and genetically engineered breeding materials (Chander *et al.*, 2011) ^[5]. A major requirement of organic livestock farming is that a substantial proportion of animal feed—typically at least 80%—must be organically produced, without the application of synthetic fertilizers, pesticides, or herbicides on crops or pasturelands. Organic livestock management prioritizes natural breeding methods, stress reduction, and disease prevention through improved housing, nutrition, and hygiene practices. The use of chemical allopathic veterinary medicines, including antibiotics and parasiticides, is progressively minimized and permitted only when alternative preventive or natural therapies fail. Emphasis is placed on preventive health care rather than curative treatment, thereby promoting natural

immunity and long-term animal health. Organic livestock standards require farmers to maintain detailed written records documenting animal health, feeding regimes, breeding practices, and medical interventions, ensuring traceability and transparency throughout the production process. Animals raised under organic systems are marketed as being free from persistent toxic pesticides, antibiotics, and synthetic parasiticides, contributing to enhanced food safety and consumer confidence (Von Borell & Sørensen, 2004) ^[28].

Reasons for Adopting Organic Dairy Farming

Organic livestock farming is not intended to maximize productivity in the same manner as conventional intensive systems; rather, it is designed to cater to a specialized premium market that demands superior product quality, strict adherence to production standards, advanced management skills, and formal certification (Sundrum, 2001) ^[26]. Organic markets increasingly require comprehensive farm-to-table traceability and assurance of ethical production practices. The growing adoption of organic dairy farming has been driven primarily by rising concerns regarding human health, environmental degradation, and long-term sustainability of agricultural systems (Panday, 2012) ^[20].

The motivations for adopting organic livestock farming can be broadly categorized based on the benefits accrued to different stakeholders, including consumers, producers, the environment, and society at large.

Consumer Benefits

Conventional livestock production systems may involve the use of animal by-products such as blood meal and bone meal in animal feeds, which carry the risk of contamination with pathogens from diseased animals, thereby increasing the likelihood of disease transmission (Watson & Redman, 1999) ^[30]. Additionally, conventional livestock products may contain dioxins—persistent environmental pollutants known to cause adverse reproductive, immunological, and carcinogenic effects in humans. More than 90% of human exposure to dioxins occurs through food consumption, particularly meat and dairy products, as well as through residues from pesticide and herbicide manufacturing processes.

Organic animal products are generally free from antibiotic-resistant bacteria due to the restricted use of antibiotics in organic systems. Pathogens such as *Escherichia coli* O157:H7, which have been increasingly reported in conventional livestock products and are associated with severe conditions such as hemolytic uremic syndrome (HUS), are less prevalent in organic animal foods. Furthermore, organic livestock production prohibits the use of synthetic pesticides, herbicides, and chemical feed additives, resulting in animal products with minimal or no chemical residues (Pathak *et al.*, 2003) ^[21]. Studies conducted in the United States and Europe have consistently demonstrated significantly lower pesticide residues in organic foods compared to conventionally produced counterparts (Benbrook *et al.*, 2001) ^[4].

The public health costs associated with conventional agriculture, particularly due to pesticide exposure, are considerable. It has been estimated that approximately 25 million agricultural workers, including livestock farmers in developing countries, suffer pesticide poisoning annually, highlighting the human health advantages of organic production systems (Jeyaratnam, 1990; Conway *et al.*, 1991) ^[15, 8].

Producer Benefits

Organic livestock farming relies minimally on expensive off-farm inputs, thereby reducing dependency on external resources. Feed and fodder are primarily produced on-farm, while animal manure is recycled within the system to enhance soil fertility and maintain nutrient balance. Organic systems encourage the use of locally adapted, disease-resistant, and climate-resilient animal breeds, enabling farms to withstand environmental stressors and climatic variability (Chander *et al.*, 2011) ^[5].

Organic livestock products generally command higher market prices compared to conventional products due to their perceived health, environmental, and ethical advantages. Consumers are increasingly willing to pay premium prices for organic animal products, driven by health consciousness, food safety concerns, and environmental awareness (Badertscher *et al.*, 1998) ^[2]. Several studies have reported lower disease incidence in organically managed animals, comparable or improved reproductive performance, and reduced reliance on veterinary pharmaceuticals when compared with conventional systems (Reksen *et al.*, 1999) ^[22]. These factors collectively contribute to improved farm sustainability and economic viability over the long term.

Environmental Benefits

Growing global concern for environmental protection has positioned organic farming as a key strategy for reducing ecological degradation. One of the core objectives of organic livestock farming is to significantly minimize environmental pollution and nutrient losses at the farm level (Sundrum, 2001) ^[26]. In many countries, including India, intensive agricultural practices aimed at maximizing productivity have led to widespread degradation of fertile soils, threatening long-term agricultural sustainability (Government of India, 2008) ^[12].

Organic farming systems emphasize soil conservation through continuous soil cover, improved organic matter content, and reduced soil erosion, thereby limiting the runoff and leaching of synthetic residues into surface and groundwater bodies. These systems also demonstrate climate-friendly characteristics by contributing to lower greenhouse gas emissions. Organic soils have enhanced carbon sequestration capacity, reducing atmospheric carbon dioxide levels. Additionally, nitrogen in organic systems is largely retained in stable organic forms, resulting in reduced nitrous oxide emissions. Methane emissions are also comparatively lower due to reduced stocking densities, improved pasture management, and greater reliance on roughage-based feeding systems.

Biodiversity conservation is another major environmental advantage of organic farming. The presence of diverse plant species, indigenous livestock breeds, and natural habitats within organic farms supports ecosystem resilience and wildlife protection (Nadia El-Hage, 2014) ^[24]. Furthermore, organic standards strictly prohibit the use of genetically modified organisms (GMOs) in crop and animal production, as GMOs are considered to undermine genetic diversity and introduce artificial alterations into natural genetic pools (FAO, 2012) ^[10].

Social and Economic Benefits

The agricultural sector in India has witnessed a steady decline in employment share, decreasing from 64.8% in 1993-94 to 48.9% in 2011-12 (NITI Aayog, 2015) ^[18]. Organic farming systems, however, offer enhanced employment opportunities

due to their lower reliance on mechanization and non-renewable energy sources. Studies indicate that organic farms generate approximately 10-20% more employment compared to conventional farms, as many farm operations are performed manually.

Organic agriculture also promotes improved working conditions for farm laborers by reducing exposure to hazardous agrochemicals and pesticides. Workers benefit from safer environments, improved health outcomes, and more stable livelihood opportunities. In addition, organic farming supports fair wages, strengthens rural economies, and encourages community participation in sustainable agricultural practices (FAO, 2012) ^[10].

Need for Organic Farming

Renewed interest in organic crop and livestock farming has emerged due to increasing concerns over conventional agricultural systems that rely heavily on synthetic inputs to maximize yields. Intensive farming practices-such as the introduction of exotic species, extensive land clearing, habitat fragmentation, vegetation loss, and soil erosion-have contributed significantly to biodiversity decline worldwide (Bengtsson *et al.*, 2005) ^[3].

Simultaneously, consumers are becoming more aware of food safety issues and are increasingly demanding environmentally safe, chemical-residue-free foods produced under high animal welfare standards and transparent supply chains. Organic production systems are well-positioned to meet these expectations by ensuring traceability, ecological sustainability, and ethical livestock management (Chander *et al.*, 2011) ^[5].

In developing countries, organic farming is often considered a viable alternative for sustainable agriculture, as it combines low external input requirements with environmental conservation and improved input-output efficiency. Organic agriculture addresses societal concerns related to public health, animal welfare, and environmental pollution while offering long-term sustainability benefits (Augustine *et al.*, 2013; Sundrum, 2001) ^[1, 26].

Prospects of Organic Dairy Farming in India

Organic dairy farming gained prominence globally during the 1990s and has since become a major segment of the organic food market. In India, however, its recognition and commercialization occurred relatively later (Oruganti, 2011) ^[19]. Several agro-climatic regions of India are highly conducive to organic milk production, including rain-fed areas of Rajasthan, Gujarat, Madhya Pradesh, hilly regions of Himachal Pradesh, Uttarakhand, Jammu and Kashmir, Tamil Nadu, and the entire North-Eastern region.

In many remote and mountainous areas, as well as among tribal communities, modern Green Revolution technologies and agrochemicals have not been widely adopted. These regions, therefore, practice agriculture that is largely organic by default and have been identified as potential "organic zones" (Singh, 2007) ^[25]. The eastern region of India also holds significant promise for organic farming due to minimal chemical input usage, with an estimated 18 million hectares available for systematic organic production (Ghosh, 2006) ^[11]. Organic dairy farming has strong potential in India because smallholder, low-input, crop-residue-based livestock systems contribute nearly 70% of the country's total milk production (Kumar *et al.*, 2005) ^[16]. Such systems are well aligned with organic principles and are expected to offer economically viable and environmentally sustainable production models

(Hermansen, 2003) ^[14]. Farmer education, exposure to mass media, and innovation adoption have been shown to positively influence knowledge and acceptance of organic farming practices (Naik *et al.*, 2009) ^[19].

Scope of Organic Livestock Farming in India

Organic livestock farming is particularly suited to Indian conditions due to the country's rich indigenous knowledge systems and traditional farming practices. Indian agriculture is characterized by vast rain-fed areas, extensive drylands, and relatively low chemical input usage. In tribal, hilly, and North-Eastern regions, subsistence farming has been practiced for generations with minimal external inputs, rendering these systems organically managed by default (Reddy, 2010) ^[23].

Only about 30% of India's cultivable land receives substantial fertilizer inputs under irrigated conditions, while the remaining 70%-predominantly rain-fed-uses negligible quantities of synthetic fertilizers. Farmers in these regions rely heavily on farmyard manure, compost, and locally available organic resources for soil fertility management. India currently has over 1,426 certified organic farms producing approximately 14,000 tonnes of organic output annually (Chandrashekar, 2010) ^[6].

The North-Eastern region alone offers nearly 18 million hectares of land suitable for organic farming due to its minimal exposure to agrochemicals. With large tracts of land under naturally organic cultivation, India holds immense potential to expand organic livestock production and emerge as a significant global supplier of organic animal products (Exim Bank Report, 2002) ^[9].

Conclusion

Organic farming has emerged as a credible and sustainable approach to producing safe, high-quality food while preserving soil health, environmental integrity, and animal welfare. The rapid global expansion of organic agriculture reflects growing consumer awareness regarding food safety, traceability, environmental sustainability, and ethical production practices. Organic livestock and dairy farming, in particular, represent dynamic and expanding sectors with significant potential to enhance rural livelihoods and support sustainable agricultural development.

In India, traditional low-input livestock systems, extensive rain-fed agriculture, and the widespread use of organic manures provide a strong foundation for organic livestock production, much of which already operates under organic-by-default conditions. However, the successful expansion of organic livestock farming will require supportive policies, improved certification mechanisms, farmer capacity building, market infrastructure development, and targeted research efforts. With appropriate institutional support and consumer awareness, organic livestock farming can play a vital role in promoting sustainable agriculture, improving animal welfare, and meeting the growing demand for safe and ethically produced animal products.

Conflict of Interest

Not available.

Financial Support

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