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Agricultural plastics and environmental sustainability: Assessment and remediation strategies

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Abstract

Due to agricultural plastic waste, the use of plastic films, irrigation pipes, greenhouse covers, and packaging materials in farming has become a significant environmental and socioeconomic problem worldwide. Crop health and biodiversity are negatively impacted by the disassembly and storage of such plastics, which also creates microplastics and pollutes water. The sources and varieties of agricultural plastics, their impacts on the environment and the economy, and the current methods of managing them—such as recycling, composting, and the use of biodegradable substitutes—are all methodically examined in this review. Additionally, new solutions, including the models of the circular economy, technologies of plastic to fuel, and smart tracking systems are touched upon. Problems, shortcomings, and gaps in the research are also brought to the fore to offer a holistic approach to sustainable management strategies. The paper highlights how combined policies, technologies and farmer education are required to reduce plastic pollution and enhance environmental friendly farming.

Keywords: Agricultural plastic waste, biodegradable plastics, recycling, soil contamination, circular economy, sustainable agriculture, environmental impact, waste management

Introduction

Plastic use in agriculture has transformed the agricultural practices of the modern era as it improves crop productivity, efficacy in utilizing water and management of the farms. Mulch films, greenhouse covers, irrigation pipes and packaging solutions are some of the materials that are widely used in the entire world especially in intensive agriculture systems [1, 2]. Although these plastics have economic and operational advantages, there in appearance in the environment has been of great concern in terms of soil health, biodiversity and sustainability in the long run [3, 4]. The world use of agricultural plastics has increased significantly in recent decades with millions of tons of polyethylene-implicated products being used every year [5, 6]. Poor disposal habits in most developing nations have increased the number of plastic deposits in the farmlands. These residues are slow to decompose, and after years and years, microplastics are left in soils [7, 8]. The absence of standardization of collection and recycling systems also contributes to the problem, and the agricultural waste of plastic materials is an urgent environmental concern [9]. Plastic residues have the potential to contaminate soil, changing its structure, reducing water infiltration, and harming microbial communities, all of which call for nutrient cycling [10, 11]. Additionally, microplastics can enter water bodies through runoff, which pollutes freshwater and marine environments. They can also enter the food chain, which can endanger the health of both humans and animals [12, 13].

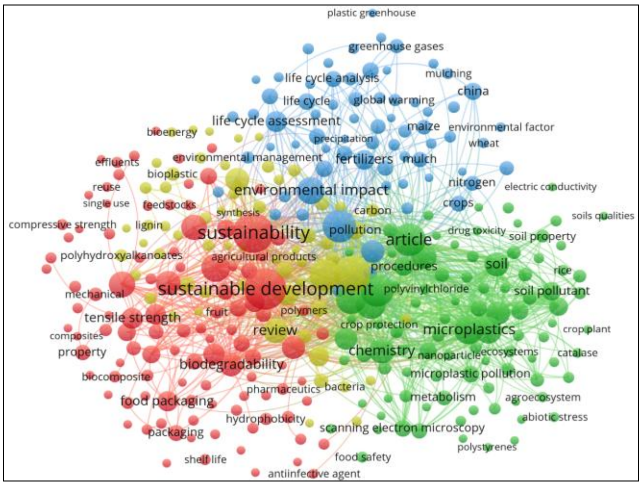

Fig 1: Some Important Keywords used in this paper

The key terms used in this paper are displayed in Figure 1. Numerous management strategies, including mechanical recycling, chemical recycling, composting, and the use of biodegradable substitutes, have been developed to address these issues [15, 16]. Though their effectiveness in the field has not yet been investigated, biodegradable plastics, particularly those containing polylactic acid (PLA) and starch-based polymers, have shown promise in reducing environmental impact [17]. Furthermore, the implementation of sustainable practices is greatly aided by policy frameworks and farmer awareness initiatives [18]. Research and practice are increasingly focusing on new technological approaches, such as plastic-to-fuel conversion, circular economy models, and intelligent tracking of plastic consumption [19, 20]. Pilot projects and case studies suggest that through the combination of technology and policy, it is possible to achieve a significant decrease in plastic waste in the farming systems [21]. As the extent of plastic application in agriculture continues to grow, there is an urgent necessity of the systematic reviews synthesizing the existing information about the origins, effects, and methods of control of plastic waste applications in agriculture. The present paper intends to offer this overview, with a focus on the environmental issues, assessment of existing and potential solutions, and gaps in research that can be researched in the future. It aims to sensitize policy makers, researchers and practitioners on sustainable ways through which agricultural plastic pollution can be mitigated by synthesizing the available literature.

Literature Review

The recent studies have widely investigated the use and implementation of sustainable materials in the field of agriculture as well as environmental management. Natural fiber composites have been of interest because of their environmental advantages, the variety of application and possibilities of further innovations in the future which may be sustainability oriented [1]. On the same note, insects such as the edible Tenebrio Molitor are being studied as biodegradable agents to handle solid waste, demonstrating their physiological stability and degradation process and noting the difficulties in scaling up the strategy [2]. This strategic approach has been associated with low-carbon agricultural growth in China, with high-standard construction of farmlands being among some of the active strategies [3]. To add to this, food packaging films / coating are also moving towards more environmentally friendly technology, with biodegradable options being used in place of synthetic options [4].

Table 1: Summary of Key Findings, Research Gaps, and Insights from Selected Sustainable Materials and Agricultural Studies (2025)

Ref No	Title	Author & Year	Findings	Research Gaps	Summary
1	Recent advances in sustainable natural fiber composites: Environmental benefits, applications, and future prospects	R. Ahmed *et al.*, 2025	Natural fiber composites reduce environmental footprint, improve mechanical properties, and have versatile applications in construction and packaging.	Limited large-scale adoption; lifecycle assessment under varying conditions.	Highlights environmental benefits and application potential of natural fiber composites while calling for studies on scalability and long-term performance.
2	Edible Tenebrio molitor as solid waste biodegraders: Exploring degradation mechanisms, physiological stress responses, application challenges, and future perspectives	Y. Tian *et al.*, 2025	*T. molitor* can biodegrade solid waste efficiently; physiological responses to waste types were characterized.	Scaling up for industrial applications; understanding long-term ecological impacts.	Shows potential of edible insects for waste management, but industrial deployment and ecological effects need further exploration.
3	The impact of China's high-standard farmland construction plan on low-carbon development in agriculture	Z. Guo & X. Zhang, 2025	High-standard farmland initiatives promote low-carbon practices and improve productivity.	Regional differences in implementation; detailed assessment of environmental trade-offs.	Demonstrates policy-driven low-carbon agricultural strategies in China while identifying gaps in comprehensive environmental assessment.
4	Recent progress in edible films and coatings: Toward green and sustainable food packaging technologies	I. Usman *et al.*, 2025	Edible films/coatings reduce plastic waste; advances in material formulations enhance shelf-life and food safety.	Limited commercialization; cost-effectiveness analysis needed.	Reviews green packaging technologies emphasizing biodegradability, functional performance, and scalability challenges.
5	A comprehensive review of local sustainable materials utilized in concrete production in Ghana	J. Obeng *et al.*, 2025	Local materials (e.g., laterite, rice husk ash) can replace conventional concrete components, lowering environmental impact.	Performance consistency under diverse conditions; long-term durability studies.	Highlights sustainable material use in concrete, advocating for further research on structural performance and standardization.
6	The Adsorptive and Scavenging Properties of Activated Carbon Make it Suitable as a Component of Active Food Packaging Materials	R. M. S. James *et al.*, 2025	Activated carbon can enhance food packaging by absorbing gases and moisture, prolonging shelf life.	Optimal loading levels; interaction with various food types; cost-benefit analysis.	Explores functional use of activated carbon in active packaging, suggesting further research on application optimization.
7	Evaluating hedgerow implantation with native species in Mediterranean agricultural landscapes: implications for CAP environmental measures—a case study in southern Spain	J. Montoliu *et al.*, 2025	Hedgerows improve biodiversity, soil health, and compliance with CAP environmental measures.	Long-term ecological monitoring; socio-economic implications.	Demonstrates ecosystem services of hedgerows and policy alignment while identifying knowledge gaps in long-term impact assessment.
8	Rethinking material use in low-trophic aquaculture: A global review	E. de Paz Miguel, 2025	Optimization of material use in aquaculture can reduce waste and environmental impacts.	Limited data on alternative materials' lifecycle; economic feasibility studies.	Advocates sustainable material strategies in aquaculture, highlighting research gaps in lifecycle assessment and cost-effectiveness.
9	Green Nanotechnology for Sustainable Ecosystems: Innovations in Pollution Remediation and Resource Recovery	M. A. Abdel-Fatah & E. F. Ewies, 2025	Nanotechnology provides tools for pollution cleanup and resource recovery, improving ecosystem sustainability.	Potential environmental risks; scalability challenges.	Highlights innovative nanotech applications for environmental management, emphasizing the need for safety and scalability studies.
10	Gallic Acid as a Sustainable and Green Crosslinker for Biopolymer-Based Food Packaging Materials	R. K. Gupta *et al.*, 2025	Gallic acid acts as an eco-friendly crosslinker, enhancing mechanical and barrier properties of biopolymers.	Industrial-scale processing; cost and performance under diverse storage conditions.	Demonstrates green chemistry approaches in packaging, with research gaps in commercialization and real-world performance.

Table 1 shows the summary of top 10 literature. Local materials are also being used to promote sustainable construction; Ghanaian studies demonstrate that using local materials to mix concrete can lessen its negative effects on the environment [5]. Active food packaging makes use of activated carbon's adsorptive qualities, which enhances the packaging solutions' functional sustainability [6]. It has been discovered that other agroecological systems, such as planting hedges in the Mediterranean region's agricultural landscape, have ecological benefits while adhering to legislative initiatives like the Common Agricultural Policy (CAP) [7]. In fish farming, reconsidering the material utilization at low trophic levels plays a vital role in enhancing sustainable production processes and reducing environmental effects [8]. Furthermore, green nanotechnology has seen the light of day as a pollution remedial and resource recovery technology, and the importance of innovation in ensuring the health of the ecosystem [9]. Biopolymer-based food packaging is also undergoing sustainable modifications of crosslinkers such as gallic acid in response to the move towards an environmentally benign material chemistry [10]. Although agricultural plastic mulch films have agronomic advantages, they do not have a sustainability trade-off, so the global meta-analysis is necessary to use them in a responsible manner [11]. PHA/PBAT reinforced with rice straw bio composites are being maximized on filler size and concentration to balance between mechanical and biodegradability [12]. Urban agriculture has been identified to generate better supply of vegetables without contributing to the emissions of greenhouse gasses, which proves that it is possible to conduct urban farming practices in an environmentally friendly way [13]. Also, socioeconomic studies of pesticide and fertilizer containers collection indicate that there are intricate land use processes with waste management trends [14]. The environmental impact of agriculture, and especially using plastics is actively being measured and researchers are pointing to its consequences in conservation and recycling of plastics in the U.S. [15]. Active packaging is also innovated such as sodium alginate films with curcumin/ B cyclodextrin Pickering emulsions which provide improved preservation of perishable foods such as blueberries [16]. The perception and attitude towards microplastic pollution in the Indian farmers signify that there are some growing issues surrounding the health and sustainability of agroecosystem [17]. Research on China's facility-based cultivation's potential to reduce greenhouse gas emissions has demonstrated the need for effective management practices [18]. Prospects Plastic mulch films and biogas residues can be co-pyrolyzed to improve waste and energy recovery [19]. Indian freshwater systems are being focused on microplastics ecological and health impacts, and the origin, effects and mitigation measures are being evaluated by researchers [20]. Lastly, emergent microplastics in soils that have been mulched, salt-affected, and affected by salinity have been reported to interfere with soil aggregate stability and nutrient dynamics, highlighting the cascade of plastic pollution impacts on soil health [21].

Environmental and Socio-Economic Impacts

The economic burden of agricultural plastic waste manifests in both direct and indirect costs. Coupled with the degradation or contamination, farmers have to use more money on its collection, disposal, and replacement of plastic materials [2, 20]. These expenses are magnified in areas that have scarce waste management facilities, which cause financial burdens to smallholder and subsistence farmers. The impact of plastic pollution on the public health is also evident because the food chains may include microplastics and chemical residues through the toxicity of the soils and water [3, 18]. The local water and agricultural produce might be more exposed to these contaminants to communities, as a result of which there can be health risks and medical expenses. This is an indication that there is a direct connection between the environmental degradation and social welfare. Lastly, the inadequate handling of agricultural plastics has more far-reaching impacts on society, such as problems in policy enforcement, inefficient waste management, and impeded implementation of sustainable ways of doing things [5, 14]. Such socio-economic effects cannot be resolved by a single-handedly technological intervention, regulating regulations, or sensitization to decrease the production of plastic waste and ensure the adoption of the circular economy in farming. The Environmental and Socio-Economic Impact of Agricultural Plastic Waste is indicated in the table 2.

Table 2: Environmental and Socio-Economic Impacts of Agricultural Plastic Waste

Impact Category	Description	Examples / Effects
Soil Contamination	Accumulation of plastic residues and microplastics in agricultural soils.	Reduced soil fertility, altered soil structure, compaction, and interference with microbial activity.
Microplastic Formation	Breakdown of plastics into small particles (<5 mm) that persist in the environment.	Long-term soil pollution, adsorption of pesticides/heavy metals, disruption of nutrient cycling.
Water Pollution	Runoff of plastic residues and chemicals into rivers, lakes, and coastal areas.	Contamination of water bodies, accumulation of microplastics, and interference with aquatic ecosystems.
Impact on Aquatic Ecosystems	Adverse effects on aquatic organisms due to ingestion or chemical exposure.	Reduced growth, reproductive issues, disruption of food webs, and bioaccumulation of pollutants.
Economic Burden	Costs associated with collection, disposal, and replacement of plastics.	Increased farm input costs, reduced productivity, and expenses for waste management.
Public Health Concerns	Transfer of microplastics and chemical residues through soil and water to food chains.	Potential health risks for communities consuming contaminated produce or water.
Policy and Regulatory Challenges	Inefficiencies in enforcing proper disposal and recycling practices.	Uncontrolled burning, illegal dumping, and lack of incentives for sustainable management.
Socio-Economic Consequences	Broader societal effects due to plastic pollution in agriculture.	Reduced livelihood opportunities in fisheries/aquaculture, increased healthcare costs, and social inequity.

Soil contamination and microplastic formation

The use of agricultural plastics, particularly polyethylene mulch films and packaging leftovers, break down to smaller materials with time, which results into the formation of microplastics in the soil. These microplastics have the potential physically to amend soil structure, decrease porosity and water-bearing ability, which negatively impacts crop expansion [3, 7]. Moreover, the unbiodegradability of these plastics disrupts the soil aeration and compaction processes consequently leaving a hostile environment to the beneficial microorganisms that promote the process of nutrient cycling [12]. Besides its structural effects, microplastics in the soil have the capacity to adsorb and concentrate pollutant including pesticides and heavy metals. This procedure causes the soil to be more toxic and this may slow down the production of delicate crops [9, 14]. With the time, the accumulation of the microplastics not only decreases the soil fertility but also leads to the degradation of the environment in the long term, complicating and increasing the cost of the remedial processes [2, 18]. The dynamics in the composition and activity of microbial communities have also been linked to continued introduction of plastic waste into fields. It is shown that contaminated plastic soils suppress a part of the microorganisms that decompose organic matter, which can reduce the productivity of the soil and its nutrient supply [5, 16].

Water pollution and impact on aquatic ecosystems

When agricultural fields are contaminated with plastic, microplastics and the chemicals contained in them find their way to adjoining water bodies via agricultural field runoff. The presence of such plastics in lakes, rivers and coastal regions may pose a danger to aquatic life [8, 11]. Scientists have also found that microplastics disrupt feeding, growth, and reproduction of numerous aquatic lives, despite their difference in size, such as plankton to fish [6, 17]. Some of the chemical additives present in plastics that can pollute water sources include stabilizers, colorants and plasticizers. Such pollutants could lead to ecological alterations in the long run and of course, the hormones of aquatic organisms [4, 13]. Moreover, dangerous microorganisms can be carried by the stubborn plastics in sediments, which brings additional danger to the environment and human health [1, 15]. Agricultural plastics also have significant socioeconomic implications to water pollution. The plastic pollution decreases the yields and increases the management costs of fisheries and aquaculture industries, and local populations might notice deteriorated water quality and increased cost of treatment. [10, 19]. Therefore, maintenance of aquatic ecosystems is important in sustaining livelihoods and food security besides biodiversity.

Current Management Strategies

Mechanical recycling has been an extensively used method of recycling in industrialized nations, and has demonstrated the possibility of lowering the need of virgin plastics [2, 7]. But when it is contaminated with soil, pesticides and organic material, its effectiveness is usually reduced and more expensive to process. Chemical recycling processes have also come up to supplement the traditional recycling processes. The processes decompose plastics to monomers or other chemical feedstocks, which in turn can be utilized in the production of new materials or fuels [5, 12]. Although chemical recycling has the ability to manage mixed or contaminated plastics more than mechanical recycling, high energy and cost of operation is a major challenge. However, studies and pilot projects are ongoing to investigate ways of making these solutions cost-effective. Composting and biodegradation are available as eco-friendly solutions especially to biodegradable agricultural plastics. Polylactic acid (PLA) and starch-based polymers in materials can be degraded under controlled conditions, and these materials turn into water, carbon dioxide, and biomass [3, 16]. Management strategies are policy based and therefore are important in promoting disposal and sustainability. Countries that have enacted regulations against the uncontrolled burning of plastic residues banning the uncontrolled burning of plastic residues, encouraging producer responsibility and promoting recycling of plastic materials have been enacted in a number of countries [1, 14]. These policies are supplemented by farmer awareness campaigns and educational campaigns which help bring changes in behaviour that would reduce the amount of plastic in the farmlands.

Innovative Solutions and Technological Advancements

The new technologies are changing the way agricultural plastic waste is managed with the focus on efficient waste processing and safer alternatives. Plastics that can break down, and which are particularly used in agriculture have attracted a significant amount of attention. They are films composed of starch, polylactic acid (PLA) and polyhydroxyalkanoates (PHA) degrading in the environment and leaving no microplastics behind [2, 9]. When compared to the conventional polyethylene plastics, field tests have revealed that they have the possibility of minimising environmental impacts and minimising soil pollution. Another promising strategy is plastic-to-fuel conversion technologies which transform agricultural plastics into fuels containing high energy content through a chemical process. Pyrolysis, gasification, and catalytic conversion processes can convert contaminated and mixed plastics into bio-oil, syngas, or char and will result in a reduction of waste and generate energy [5, 12]. The agricultural plastics are also using circular economy model so that they may experience a sustainable usage and recovery. This plan involves the sorting and classifying of the plastic waste materials followed by recycling or reuse as an energy source or a recycled product into the production process [1, 14]. The model improves resource efficiency, reduces the environmental costs and creates economic opportunities by converting waste into useful inputs. Smart monitoring systems and other solutions that are founded on the Internet of things are also changing the sustainable management of the agricultural plastics. It is possible to monitor plastic with the help of sensors and tracking technologies that are able to detect the residues on the field, optimize collection schedules and enhance efficiency and compliance [3, 16]. Online platforms that consolidate the information on farms, recycling, and policymakers are involved in decision making and make the initiatives regulating plastic waste management more successful. Finally, these technologies are scalable by means of collaborative work and research-based innovations. Partnerships with academia, industry and government agencies have led to pilot projects which have demonstrated combined solutions such as biodegradable plastics with a circular recovery, plastic-to-fuel conversion and smart collection systems [6, 18]. These hybrid solutions have a potential to resolve the environmental and socio-economic dilemma and the sustainability of agricultural practices in the world. The Innovative Solutions and Technological Advancements to address the Agricultural Plastic Waste Management are displayed in the Table 3.

Table 3: Innovative Solutions and Technological Advancements for Agricultural Plastic Waste Management

Solution / Technology	Description	Benefits	Limitations / Challenges
Biodegradable Plastics	Polylactic acid (PLA), polyhydroxyalkanoates (PHA), starch-based films designed to degrade in soil.	Reduces microplastic formation, maintains soil health, environmentally safe.	Variable degradation rates in field conditions, higher cost than conventional plastics.
Plastic-to-Fuel Conversion	Pyrolysis, gasification, and catalytic conversion of plastics into bio-oil, syngas, or char.	Reduces waste accumulation, generates energy, can handle mixed/contaminated plastics.	High energy requirements, operational costs, and emissions control needed.
Circular Economy Models	Collecting, recycling, and reintegrating plastic waste into production or energy systems.	Promotes resource efficiency, reduces environmental burden, creates economic value.	Requires strong infrastructure, policy support, and stakeholder coordination.
Smart Monitoring / IoT Systems	Sensors and digital platforms to track plastic usage, detect residues, and optimize waste collection.	Enhances efficiency, reduces unmanaged plastic disposal, data-driven decision-making.	Initial investment costs, technical training, and maintenance requirements.
Collaborative Initiatives & Research	Partnerships between academia, industry, and government to implement integrated solutions.	Combines multiple technologies, scalable impact, promotes knowledge sharing.	Requires coordination across multiple stakeholders, long-term planning, and funding.

Biodegradable plastics tailored for agriculture

Biodegradable plastics are increasingly being developed to replace conventional polyethylene-based products in agriculture. These materials, including polylactic acid (PLA), polyhydroxyalkanoates (PHA), and starch-based polymers, are designed to degrade under environmental conditions such as soil moisture, temperature, and microbial activity [2, 9]. Biodegradable films are unlike standard plastics, which cause the creation of microplastics and therefore reduce soil health and increase contamination in the long term. Field trials have also shown that the plastics can be successfully used to perform functions like mulching, irrigation covers and packaging with the added advantage of being environmentally safe to decompose [3, 16]. Regardless of their benefits, the biodegradable plastics have a number of challenges with regard to their practical implementation. The rate of degradation strongly differs according to the local conditions of the soil and climatic conditions, and even partial degradation may result in the remaining microplastics [5, 12]. Secondly, biodegradable polymers are more expensive than conventional plastics thus limiting its adoption, especially to the smallholder farmers. Current studies are aimed at enhancing the efficiency of degradation, reducing the cost of production, and the creation of standards to provide the same performance in the real-life agricultural environment [1, 14].

Plastic-to-fuel conversion technologies

Technologies that convert plastic to fuel offer a creative way to handle agricultural plastic waste that isn't amenable to mechanical recycling. Used or contaminated plastics can be converted into energy-rich fuels like bio-oil, syngas, and char through processes like pyrolysis, gasification, and catalytic conversion [6, 12]. By combining waste management with the production of renewable energy, this method not only reduces the amount of plastic that accumulates in agricultural areas but also produces usable energy. According to pilot studies, it is possible to convert mixed or contaminated plastics into fuel with a respectable energy efficiency [8, 17]. However, these technologies face limitations related to energy consumption, operational costs, and emissions management. High temperatures and specialized equipment are required, making initial investments significant for large-scale implementation [4, 15]. Additionally, proper monitoring is essential to prevent the release of harmful by-products during the conversion process. Despite these challenges, ongoing innovations in catalytic processes and reactor design are improving efficiency, making plastic-to-fuel conversion an increasingly viable option for sustainable agricultural plastic management [10, 19]. The Table 4 shows the Comparative analysis of Agricultural Plastic Waste Management Strategies and the figure 2 shows the Comparison of Agricultural Plastic Waste Management Strategies.

Table 4: Comparative Analysis of Agricultural Plastic Waste Management Strategies

Strategy / Solution	Waste Reduction (%)	Soil Health Improvement (%)	Implementation Cost (USD/ha)	Adoption Feasibility (1-5)
Mechanical Recycling	65	40	1200	4
Chemical Recycling	75	45	2000	3
Biodegradable Plastics	80	70	2500	3
Plastic-to-Fuel Conversion	85	50	3000	2
Circular Economy Model	90	65	2200	4
Smart Monitoring / IoT Systems	70	60	1800	4

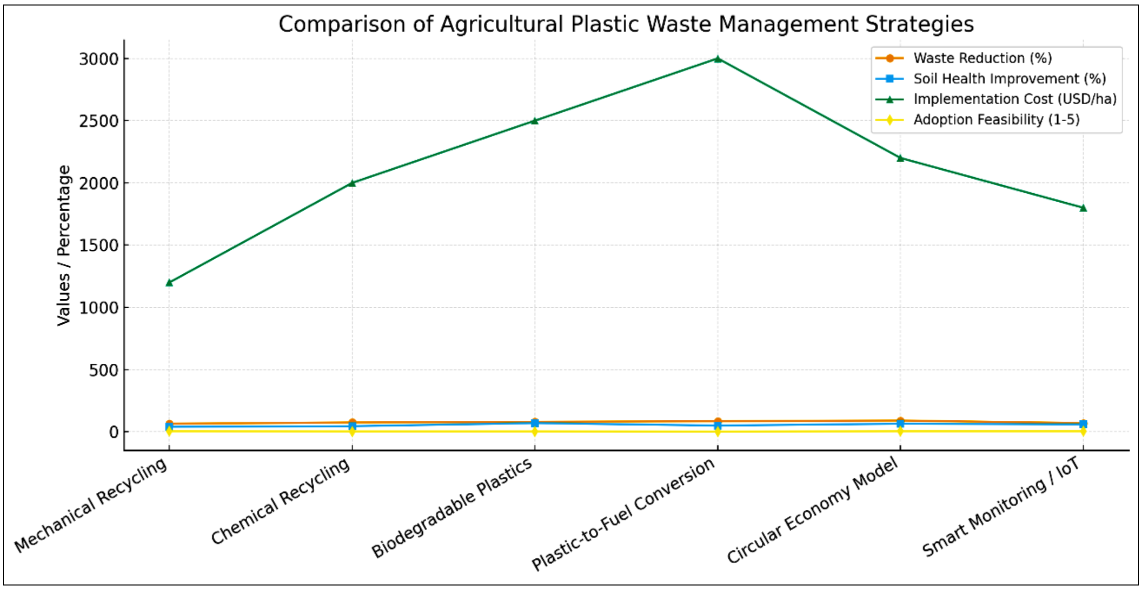

Figure 2: Comparison of Agricultural Plastic Waste Management Strategies

Challenges and Limitations

Technical constraint of recycling and degradation of agricultural plastic waste is one of the main challenges of the management of agricultural plastic waste. Contamination with soil, pesticides or mixed polymers can frequently inhibit mechanical recycling by decreasing the efficiency and raising processing costs [2, 7]. On the same note biodegradable plastics cannot completely degrade under different field conditions leaving behind residual microplastics in the soil [3, 16]. Such technical restrictions render the realization of a fully sustainable management system with the help of existing technologies only a challenging task. The problem is further worsened by economic and social reasons. Expensive nature of biodegradable options, plastic-to-fuel conversion systems and complex systems of monitoring curtilage reduces the adoption especially among the smallholder and resource-strained farmers [5, 12]. Also, inadequate awareness and absence of effective policy implementation results in poor disposal behaviour such as burning or uncontrolled dumping of plastics, which contribute to greater pollution of the environment [1, 14]. The solution to these constraints involves a combination of technological, financial and policy-based interventions.

Future Outcomes

Innovative, integrated, and sustainable methods are key to the future of agricultural plastic management. Together with effective plastic-to-fuel conversion technologies, developments in biodegradable polymer formulations have the potential to greatly reduce environmental contamination while generating revenue from waste [6, 18]. Furthermore, smart waste tracking and IoT-enabled monitoring systems can improve the collection and recycling procedure, increasing management's scalability and efficiency. It is anticipated that collaborative frameworks and policy interventions will be crucial in promoting the adoption of sustainable practices. The shift to a circular economy in agriculture can be aided by government incentives, industry collaborations, and farmer education initiatives, which will reduce plastic pollution and encourage environmental stewardship [4, 15]. Long-term results include cleaner water systems, healthier soils, lower greenhouse gas emissions, and more robust agricultural ecosystems that can sustainably produce food.

Conclusion

Plastic waste in agriculture is a major environmental and socio-economic problem and this is a result of the extensive application of plastic films, irrigation systems, greenhouse sheets, and packaging bags in agricultural practice. The act of preserving the traditional plastics in the soil and water will lead to the emergence of microplastic, soil contamination, disruption of microbial ecosystem, and adverse impact on aquatic organisms, and a financial burden to farmers and communities. Current-day management approaches have been restricted by contamination, high cost, and variation in degradation rate and have been applied using mechanical and chemical recycling, composting and policy-based approaches. The application of new technologies, such as biodegradable plastics, plastic-fuel conversion systems, circular economy, and IoT-based monitoring systems is a valuable solution that can decrease them and promote sustainable agricultural practice. However, it is not devoid of associated issues with technical viability, economic viability, and awareness and the integrated strategy incorporating technological discoveries, policy intervention, and active participation of farmers should be undertaken. A set of research studies, cooperation between stakeholders, and the introduction of sustainable waste management systems can help in achieving environmentally friendly agriculture, get rid of plastic pollution, conserve soil and water resources, and develop resilient food systems in the future. By taking into account the environmental and socio-economic features of the agricultural plastic waste, a transition to a circadian and sustainable strategy will be made, which will ensure positive results in the ecosystem, communities, and the world food supply in the long term.

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