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SOWING THE SEEDS OF REGULATION: LEGAL LANDSCAPES OF GREEN AI IN GLOBAL AGRICULTURE

ABSTRACT:

With the ever-growing adoption of artificial intelligence (AI)-based systems, the carbon footprint of AI is no longer negligible. AI researchers and practitioners are therefore urged to hold themselves accountable for the carbon emissions of the AI models they design and use. This led in recent years to the appearance of researches tackling AI environmental sustainability, a field referred to as Green AI. Despite the rapid growth of interest in the topic, a comprehensive overview of Green AI research is to date still missing. This paper critically analyses the laws regarding Green AI in different countries and suggest various legal reforms needed in the law and ways to improve the laws.

1. INTRODUCTION:

Agriculture, one of the oldest and most crucial industries globally, faces increasing demands for food and employment due to the rapidly growing world population. Traditional farming methods are no longer sufficient to meet these needs. Therefore, new automated techniques are being introduced to fulfill food requirements and create job opportunities for billions of people worldwide.

Agriculture is the most important sector of Indian economy as it accounts for 18 percent of India's gross domestic product (GDP) and it provides employment of the 50 per cent of country youth. The US Environmental Protection Agency (EPA) evaluates that agriculture give over roughly $330 billion in annual revenue to the economy.[1] largest producer of vegetables and fruits in the world. But due to many problems in agriculture it's a significant departure from the traditional farming practiced in the country since ages that has resulted in low yields and excessive dependency on monsoon rains which has kept Indian farming at subsistence level.

Climate change population growth and food security cases are such factors which have propelled the industry into discovering more innovative outlooks to protecting and improving crop yield[2].

[1] (Madhusudhan, 2015
[2] (Kumar and Joshiba, 2019)

Day by day increasing consumption and rising need of better yield of vegetation and food are estimated to be one of the essential factors calling for robots in agriculture [3]. Increasing intake motivates farmers to increase farming operations and provide an upward push to the requirement of automating farming operations. In such situation the use of cutting-edge technologies like Artificial Intelligence may help Indian farmers to choose the right crop and minimize the risks. As a result, AI is steadily appearing as part of the industry's technological evolution.

John McCarthy, who is often referred to as the father of AI, defined it as:"The science and engineering of making intelligent machines, especially intelligent computer programs."[4]"Artificial Intelligence is the study of agents that receive percepts from the environment and perform actions."

Green AI refers to the development and use of artificial intelligence technologies with an emphasis on environmental sustainability and reducing the ecological impact of AI systems. The success was that AI can identify a disease with 98% accuracy, AI gives growers a tool against cereal-hungry bugs, Sensors monitor the fruit's headway toward perfect ripeness, adjusting the light to accelerate or slow the pace of maturation, this kind of farming requires considerable processing power. AI-powered solutions will improve quality & ensure faster go to-market for crops [5].

The rapid adoption of Artificial Intelligence (Al) in India has brought about significant legal and ethical challenges that require urgent attention. As Al systems increasingly influence critical sectors such as healthcare, law enforcement, finance, and governance, issues like accountability, algorithmic bias, data privacy, and liability have come to the forefront. Despite the transformative potential of Al, India's existing legal framework, including the Information Technology (IT) Act, 2000, and the Digital Personal Data Protection Act, 2022, does not adequately address Al-specific concerns. This lack of comprehensive regulation poses risks to human rights, innovation, and societal welfare, highlighting the need for a balanced approach to Al governance that ensures transparency, fairness, and accountability.

2. AI IN AGRICULTURE: TRANSFORMING FARMING PRACTICES:

i. Precision Water Management:

[3] (Smith, 2019)
[4]Stuart J. Russell and Peter Norvig, wrote inbook "Artificial Intelligence: A Modern Approach":
[5] (Soffar, 2019) [29]

Advanced AI-powered techniques, including predictive analytics, decision trees, and clustering algorithms, enable farmers to identify optimal irrigation schedules, detect anomalies, and prevent water waste. Moreover, the integration of solar photovoltaic water pumping systems, powered by predictive energy harvesting models, ensures a consistent and sustainable water supply.

ii. Precision Livestock farming:

The role of livestock in today's agriculture is inevitable. AI-powered technologies like IoT, edge computing, and blockchain enable real-time monitoring of livestock health, detecting patterns and potential issues, and improving overall animal welfare.

iii. Crop Productivity and Fertility:

AI technologies like Geographic Information Systems (GIS), and Spectral Analysis enable precise soil health assessment, optimizing fertilizer application, and risk management. This data-driven approach enhances crop quality, boosting productivity and profitability

iv. Harvesting, Pruning and Ploughing:

The inclusion of AI based robots and techniques like Smart Spectrometer, Complexity-Driven Convolutional Neutral Networks, etc. can be used in the process of harvesting, pruning and ploughing by overriding the obstacles and reducing operating time consumed usually by traditional methods.

v. Energy Management:

Leveraging Machine Learning (ML) algorithms, such as predictive analytics and regression analysis, enables accurate energy demand forecasting, optimizing energy resource allocation. Agriculture energy internet is a budding concept wherein clean energy is generated for isolated locations.

vi. Nanotechnology:

This delivers fertilizers and pesticides directly to target tissues, monitoring plant growth via sensors, and revolutionizing agricultural challenges.

vii. Control Plant Diseases:

AI can detect weeds and recommend optimal control measures, including personalized agronomic product combinations for effective elimination.

viii. Self-driving tractors:

AI addresses labour shortages in farming with self-driving tractors and IoT, offering accurate, mistake-free, and cost-effective solutions that can operate around the clock with precision

While the aforementioned points highlight the significant impact of AI in agriculture, its applications are wide and far-reaching, and the uses enumerated above are by no means exhaustive. Additionally, AI can also be leveraged in areas such as decision making, resolving food shortages, effective distribution and price fixation of crops.

3. ADVANTAGES OF INTEGRATION OF AI IN AGRICULTURAL DOMAIN:

Agriculture is becoming digital and smarter, AI in agriculture is appearing in three major categories which are agricultural robotics, soil & crop monitoring, and predictive analytics, Farmers are using sensors and soil sampling to collect data and this data is stored on-farm management systems that allow for better processing & analysis. Agricultural provide information of soil's strengths and weaknesses, the emphasis is on standardized the potential for healthy crop yield production and preventing defective weak crops, the growth in AI technology has enable agro-based businesses to run more efficiently.

Artificial intelligence helps farmers get more produce from the land in limited resources, the farmer can protect corn from grasshoppers by using AI to detect a swarm in an undetermined parcel of his field, Images of the plant flow into an artificial intelligence algorithm that foreshow how long it will take for the blossom to become a ripe tomato ready for picking & packing. Machine learning helps to recommend seeds, the technology is also being applied in another applications such as Automated machine adjustments (combine, planter down force, etc.), Weather identification, image movement, Machine forecasting, Disease recognition, Disease maintenance and or and pest break-down prediction, Field accessibility or harvest advisory type estimations, Irrigation and water management, Nutrient use and fertility recommendations, Autonomous machines or robots.

AI systems have the ability to solve some of the most challenges or problems of farmers are grappling with such as climate change, infestation of insect and weeds and reduced yields. The collars are embedded with transponders that can tell when a cow is ready for milking and connects with machines for the automatically milking, intelligence can improve plant breeding and crop management practices, many tech companies invest in algorithms that are becoming useful in agriculture, they use natural language toolkit for field notes, and yield on satellite imagery. Prediction algorithms-based, a robot called See & Spray reportedly leverages computer vision to control and precisely spray weeds on cotton plants, Precision spraying can help prevent herbicide resistance, The cameras & sensors use machine learning where them images are captured and the machines can be taught in different weeds, Then the right herbicides are sprayed precisely as per encroachment area.

4. DISADVANTAGES OF INTEGRATING AI IN AGRICULTURAL DOMAIN:

Although Artificial intelligence advances the agriculture industry in many ways, there are many worries relating to the forthcoming of AI on employment and the manpower of the agricultural sectors, Agriculture is a $3 trillion industry that employs over 1.5 billion people, which is a massive 20% of the world's population, there are predictions of there being millions of unemployed field workers in the next decades primarily due to the effect of AI in the agriculture industry.

Field tasks which are monotonous can be easily automated this can gradually make certain roles obsolete, Humans will be replaced by smart robots that can safely navigate the space, find and move agricultural products as well as perform simple and complex field operations. The cost of technology such as drones has made it unavailable outside of the government and research bodies, it is costly to buy the drones, the biggest challenge will be funding internally from the government efforts and research institutions

5. UNITED NATIONS PERSPECTIVE ON GREEN AI IN AGRICULTURE:

5.1. Al for Climate Action Innovation Factory:[6]

This initiative, launched at the Al for Good Summit, aims to use Al to combat climate change with a focus on agriculture. It showcases Al-driven strategies at major climate conferences like COP29

[6] https://aiforgood.itu.int/about-us/ai-for-climate-action-innovation-factory/

to foster international collaboration in addressing agricultural challenges worsened by climate change.

5.2. Coalition for Environmentally Sustainable Artificial Intelligence:

This coalition, consisting of over 100 partners including tech companies and international organizations, ensures that Al development aligns with environmental sustainability goals. It emphasizes the need for standardized methods to measure Al's environmental impact and promotes research into sustainable Al practices.[7]

5.3. Goals and Objectives:

i. Enhancing Food Security:

The UN believes Al can significantly help achieve Sustainable Development Goal (SDG). By improving data systems related to soil health, water availability, and pest control, Al can help farmers make better decisions that increase productivity while reducing environmental harm.

ii. Promoting Sustainable Practices:

Al technologies are being developed to optimize resource use in agriculture, thus reducing greenhouse gas emissions from food production. The UN stresses the importance of integrating these technologies into agrifood systems, especially in regions like Africa that face significant food insecurity and climate issues.

5.4. Challenges and Considerations:

Despite the potential of Green Al in agriculture, there are concerns about its environmental footprint. The UN highlights the need for sustainable energy sources to power Al systems and address issues like electronic waste from data centers. A balanced approach is necessary to maximize Al's benefits while minimizing its ecological impact.[8]

6. EUROPEAN UNION'S POLICY ON GREEN AI IN AGRICULTURE:

[7] https://www.unep.org/news-and-stories/press-release/new-coalition-aims-put-artificial-intelligence-more-sustainable-path
[8] https://unu.edu/article/artificial-intelligence-can-transform-global-food-security-and-climate-action

6.1. European Green Deal:

The EU Green Deal aims to make Europe climate-neutral by 2050, highlighting sustainable agriculture as essential. This deal drives innovation in smart agriculture, promoting technologies like precision farming and Al. These advancements aim to increase productivity while reducing environmental impacts, supporting the EU's sustainability goals.

6.2. Common Agricultural Policy (CAP)[9]:

The CAP has been revised to prioritize a farmer-centric approach focusing on food security, income stabilization for farmers, and sustainable practices. The CAP encourages adopting digital technologies, including Al, to enhance agricultural resilience and competitiveness. It supports initiatives like the IT4LIA Al Factory, which boosts Al capabilities in agriculture through significant funding and infrastructure development.

6.3. Technological Integration

6.3.1. Al and Digitalization[10] :

The EU is promoting the use of Al in agriculture to optimize resource use, improve decision-making, and enhance crop management. Initiatives like creating a common European agricultural data space facilitate data sharing among stakeholders, ensuring farmers can effectively use Al technologies. This approach increases productivity and addresses environmental concerns by promoting more efficient use of resources like water and fertilizers.

6.3.2. Research and Development:

The EU is investing in research and testing facilities for Al applications in agriculture. These facilities aim to develop trustworthy Al systems that can be integrated into agricultural practices. They focus on creating solutions that address real-world challenges faced by farmers, such as climate variability and resource scarcity.[11]

[9] https://www.agrifoodtef.eu/index.php/news/ai-and-agriculture-future-being-shaped-it4lia-ai-factory-and-eu-agricultural-policy
[10] https://www.europarl.europa.eu/RegData/etudes/STUD/2023/734711/EPRS_STU(2023)734711_EN.pdf
[11] https://www.europarl.europa.eu/RegData/etudes/STUD/2021/662906/IPOL_STU(2021)662906_EN.pdf

6.4. Challenges and Considerations

While the EU supports Green Al in agriculture, it also acknowledges potential risks associated with increased technology use. These concerns include:

a. **Environmental Impact:** Managing the energy consumption of Al technologies to prevent adverse environmental effects.
b. **Data Governance:** Ensuring fair access to data generated by agricultural technologies to prevent monopolistic practices and ensure equitable benefits for all stakeholders.
c. **Digital Divide:** Addressing disparities in access to technology among farmers to ensure everyone benefits from advancement.[12]

7. UNITED STATES STANCE OF AI IN AGRICULTURE:

The agro-industry is transforming significantly by integrating AI technologies, fundamentally enhancing various aspects of agricultural practices. Precision agriculture leverages AI tools such as drones, sensors, and satellite imagery to monitor crops in real-time. This allows for optimized resource usage and data-driven decision-making, thereby increasing efficiency and reducing input costs.

7.1. Farming Legislation:

California has implemented various laws to support sustainable agriculture. These laws address water conservation, soil health, and pesticide reduction. The Sustainable Groundwater Management Act (SGMA) requires local agencies to create groundwater management plans, which impact farmers' water usage.[13]

7.2. Agricultural Technology Regulations:

New regulations emphasize data privacy and security in smart farming systems. The California Consumer Privacy Act (CCPA) is key in regulating how agricultural data is collected and used,

[12]https://www.eunews.it/en/2025/02/19/eu-vision-of-agriculture-and-food-simplification-and-innovation-but-how-green/
[13]https://farmonaut.com/usa/californias-agricultural-revolution-how-ai-and-new-laws-are-shaping-sustainable-farming/

ensuring farmers have control over their data. This is crucial as Al technologies in agriculture collect large amounts of data.[14]

7.3. Legal Risks and Responsibilities

7.3.1. Data Ownership and Liability:

The legal aspects of agricultural data are complex. While some data is considered trade secrets, much of it isn't protected by current privacy laws. This raises concerns about liability when Al systems provide incorrect recommendations or misuse data. For example, if an Al suggests pesticide use that violates regulations, it becomes challenging to determine liability among the software developer, data provider, and farmer.

7.3.2. Trust and Transparency:[15]

Building trust between farmers and Al developers is essential for technology adoption. Farmers worry about data usage and sharing, especially regarding government oversight. Clearer legislation on data ownership and cooperative frameworks can help build trust and encourage Al adoption.

7.4. Opportunities for Green Al:

7.4.1. Precision Agriculture:

Al is revolutionizing precision agriculture by enabling data-driven decisions that improve productivity and reduce environmental impact. This includes optimizing irrigation, predicting crop yields, and better pest management. Drones for crop monitoring showcase how technology enhances farming efficiency and sustainability.[16]

7.4.2. Alignment with Sustainable Goals:

Al in agriculture supports broader sustainability goals like the UN Sustainable Development Goals (SDGs). Al-driven practices that conserve resources and lower carbon footprints help the agricultural sector contribute to a sustainable future.

[14]https://www.aimspress.com/article/doi/10.3934/agrfood.2024052?viewType=HTML
[15]https://acsess.onlinelibrary.wiley.com/doi/10.1002/agj2.21353
[16]https://agfundernews.com/guest-article-ai-can-transform-precision-agriculture-but-what-are-the-legal-risks

8. INDIA LEGAL FRAMEWORK AND INITIATIVES FOR GREEN AI IN AGRICULTURE:

8.1. National Strategies and Initiatives:

i. **National Strategy for Artificial Intelligence**: This is formulated by the NITI Aayog. This strategy signifies on the leveraging of AI for the economic growth, enhancing social outcomes, and helping in addressing and resolving key national restraints. This strategy focuses on five major sectors, Agriculture is one among them. This strives to bring a balance between innovation and risk associated.

ii. **AI for Agriculture Innovation (AI4AI) Initiative**: This was launched in collaboration with the World Economic Forum and the Government of Telangana. This AI4AI aims to empower smallholder farmers through AI-driven tools.

iii. **National Pest Surveillance System:** The Ministry of Agriculture & Farmers Welfare is developing a National Pest Surveillance System in collaboration with the private sector. This system employs AI and Machine Learning models to detect crop issues, providing timely information to farmers for prompt action. The initiative aims to enhance crop health, potentially increasing yields and improving farmers' livelihoods.

iv. **Kisan e-Mitra Chatbot:** As part of its digital outreach, the Ministry has introduced 'Kisan e-Mitra,' an AI-powered chatbot designed to address farmers' queries regarding the PM Kisan Samman Nidhi scheme. This tool facilitates efficient information dissemination, enabling farmers to access essential details about the scheme and other agricultural practices.

The above are only few significant strategies which reflect the nation's commitment towards application of AI in agriculture.

8.2. Legal Issues:

8.2.1. Data Privacy and Ownership:

The AI techniques used to leverage agriculture prevalently depend on the data collected through various sources. This creates a question of ownership on this data as to who owns this data, whether it is the farmer, technology providers or some third party. This is a very crucial question to be determined as to see whose privacy is to be protected. The concept of data protection is regulated primarily by the **Digital Personal Data Protection Act, 2023** in India. While this act in its Section 6 signifies the principles of consent and transparency which is to be ensured in the data collection, processing and the management of agricultural data. This is also advocated in the landmark case of **Justice K.S. Puttaswamy (Retd.) &Anr. vs. Union of India & Ors[17].**, wherein the Supreme

[17] (2017) 10 SCC 1

Court establishes the concept of right to privacy as a part of fundamental right to life under Article 21 of the Constitution.

Inadequacy of this data may result in drastic consequences like financial loss, damage of reputation, etc., to resolve this issue, farmers can use blockchain technologies that will secure the integrity, authenticity and confidentiality of their data.

8.2.2. Patentability:

There is a question whether AI inventions are patentable, as the Indian Patents Act, 1970, does not explicitly exclude AI-generated inventions from patentability.Section 3(k) of the **Indian Patents Act, 1970** states that a mathematical or business method or a computer programme *per se* or algorithms are not patentable. This ambiguity raises uncertainty about the patentability of AI-driven innovations in agriculture. The above uncertainty further raises question as to who is the inventor of the invention for applying for patent under Section 6 of the Act.As evident in the landmark case of **DABUS (Device for the Autonomous Bootstrapping of Unified Sentience)**, the patentability of AI-generated inventions remains uncertain."[18]

8.2.3. Issues regarding Copyright:

Section 2(o) of the **Indian Copyright Act, 1957** defines "literary work" as computer programmes, tables and compilations including computer databases. This definition doesn't give the clarity as to whether an AI generated work comes under this category. Dependent to this uncertainty we also have another unanswered question as to who is an author under Section 17 if in case this comes under the category of literary work. In the landmark case of **Naruto v. Slater**[19], the court's decision sheds light on the issue of authorship and ownership of creative works generated by non-human entities, stating that a majority of the panel affirmed the district court's dismissal on the grounds that Naruto, as an animal, lacked statutory standing to sue under the Copyright Act.

[18] European Innovation Council and SMEs Executive Agency, DABUS CASE ARRIVING ON INDIA: PART 1,europa.eu (14 February 2025), https://intellectual-property-helpdesk.ec.europa.eu/news-events/news/dabus-case-arriving-india-part-1-2025-02-14_en#:~:text=Dabus%20Case%3A%20Legal%20Challenges%20and,inventions%20without%20direct%20human%20intervention.

[19]Naruto v. Slater, No. 16-15469 (9th Cir. 2018), (United States)

8.2.4. Liability and Accountability:

The AI-driven technologies like autonomous drones, used in agriculture make their independent decisions. This creates a complexity while determining the liability in circumstances where these systems malfunction. The question as to who is held liable whether it rests with the farmer, the technology provider or equipment manufacturer is unanswered.

The **Information Technology Act, 2000** deals with electronic records and cybersecurity aspects. But this act does not explicitly cover AI-based systems. However, we can apply its data protection and intermediary liability mentioned in Section 43A, section 72A and section 79 respectively, as it may indirectly apply to AI applications in agriculture.

Next, the Consumer Protection Act, 2019 holds under Section 82 products and service providers accountable for defects and deficiencies. As the question regarding the owner is unanswered as to whether it is a farmer, technology provider or manufacturer, we can't hold manufactuers, service providers and sellers liable for any harm caused due to AI based systems used in agriculture.

8.2.4. Bias and Fairness:

The working of an AI-driven system primarily depends on the basis of the data that is being fed into it. If by any chance the fed data is being biased or unrepresentative, the system is likely to display these biases in its predictions, solutions and recommendations. When this is applied in agriculture, this results in discriminatory practices that disproportionately affect the farmers, marginalized communities and indigenous practices. Data is usually collected from places with advanced infrastructure and large scale commercial intense farming and is being digitalized. This leaves the small-scale farmers, indigenous methods and remote region as unrepresented. Further, as the data mostly represent, high-yield, high-input practices, the AI-driven systems, thus, recommend crops or methods of above nature, which makes it unsuitable for small-scale farmers.

The **NITI Aayog's National Strategy for Artificial Intelligence (NSAI)**[20] is a strategic framework, relevant in guiding the above issue, wherein the strategy states that:

[20]NITI AAYOG, NATIONAL STRATEGY FOR ARITIFICAL INTELLIGENCE #AIFORALL (June 2018)

a. "To ensure inclusive growth, AI systems must be trained on datasets that are representative of the population and diverse in terms of geography, socio-economic status, and cultural contexts."
b. "Fairness and inclusivity should be key principles guiding the design and deployment of AI systems in agriculture to prevent marginalization of vulnerable groups."

Thus, this strategy signifies the necessity of fairness and inclusivity in the Ai-driven systems.

8.2.5. Lack of transparency:

The nature of advanced AI-driven models is “black-box”, which means the predictions and recommendations made by these models lack any explanation or reason for such conclusions. Most farmers usually have experience in the field acquired through years and generations, when a particular recommendation is made these systems without reasoning behind it, there arises a doubt in the mind of the farmers and creates a mistrust on these systems.

As the **NITI Aayog’s National Strategy for Artificial Intelligence**, emphasises the need of transparency and explainability as fundamental principles for responsible AI deployment.

8.2.6. Lack of specific legislation:

Presently, our country lacks specific legislation governing the AI applied in the field of agriculture. However, our government is working towards establishing a robust legislation in this regard. The **Digital India Act, 2023** marks a pivotal stride in regulating emerging technologies including AI. This act has proposed to categorize AI systems on the basis of the risk level being associated- low, medium and high. This Act in integration with the **Digital Personal Data Protection Act**, ensures the compliance of data protection regulations.

8.2.7. Data Sovereignty:

The application of AI-driven systems in agriculture encompasses the collection and processing of vast amount of data such as geospatial data, crop yield data, personal data which is in a way sensitive and vital information relating to land use and crop yields. To protect the interest of farmers and the national security, it is vital that this data being collected and processed remains withing the sovereignty of the nation and is subject to national legislations. The **Digital Personal Data Protection Act, 2023** is India’s primarily statute regulating the collection, processing and

storage of personal data. This act necessitates informed consent from farmers before collecting their personal data, ensuring transparency and accountability. Farmers also have the right to data portability under the act. The proposed **Digital India Act** and **National Data Governance Framework Policy** are being highly expected to address the ambiguities in non-personal data regulation and cross-border data flow, ensuring ethical and secure AI deployment in the field of agriculture. These regulations by protecting the interest of farmers and strengthening national security, makes India a leader in responsible AI governance in agriculture.

9. CONCLUSION:

Green AI represents a paradigm shift towards integrating artificial intelligence with sustainable practices, aiming to minimize environmental impacts while maximizing efficiency in various sectors, particularly agriculture. Each region's approach reflects its unique legal landscape and commitment to sustainability.

In the **United Nations**, initiatives emphasize the role of AI in achieving Sustainable Development Goals (SDGs), particularly in combating climate change and promoting sustainable agricultural practices. The UN's focus on collaborative frameworks ensures that AI technologies are developed responsibly, addressing legal and ethical considerations while fostering innovation.

The **United States** approach is characterized by a regulatory framework that encourages technological advancement while addressing data privacy and environmental concerns. Legal issues surrounding data ownership and liability are pivotal as AI becomes more integrated into agricultural practices. The emphasis on transparency and trust is essential for farmers to adopt these technologies confidently.

In the **European Union**, the commitment to sustainability is enshrined in policies like the European Green Deal and the Common Agricultural Policy (CAP). These frameworks promote the adoption of Green AI by incentivizing sustainable practices and ensuring compliance with environmental standards. The EU's focus on research and development further supports the integration of AI into agriculture, emphasizing both innovation and ecological responsibility.

India's perspective on Green AI is increasingly relevant as it seeks to enhance agricultural productivity while addressing environmental challenges. Legal frameworks are evolving to

support sustainable practices, but challenges remain in data governance and access to technology for farmers. The integration of Green AI could significantly impact resource management in agriculture, promoting efficiency and sustainability.

In conclusion, the collective efforts of these regions demonstrate a growing recognition of Green AI as a vital component of sustainable development. By addressing legal issues and fostering collaborative initiatives, stakeholders can harness the potential of AI technologies to create a more sustainable agricultural future. This multifaceted approach not only mitigates environmental impacts but also promotes economic growth and resilience in agricultural systems worldwide.Holistically, Artificial Intelligence seamlessly integrates into the entire agricultural lifecycle, optimizing each phase with remarkable efficiency.

10. SUGGESTIONS:

10.1. Legal Reforms:

Considering the nature of complexities and ambiguities that arise due to the integration of AI in agriculture, it is the need of the hour to develop robust legal frameworks that ensure ethical and responsible AI deployment. This helps in protecting the interest of the farmers and the strengthening the national security. The proposed Digital India Act, 2023 and National Data Governance Framework Policy are keenly expected to serve the above purpose in India.

10.2. Encourage public-private partnerships (PPP):

Small scale farmers very often lack the resources and the technical knowledge to utilise advanced AI-driven systems. This gap can be resolved through Public-private partnerships that offers necessary infrastructure, training and even financial aid. Further, by including multiple stakeholders, PPPs create a holistic and inclusive solution that can resolve all the diverse agricultural needs, reinforcing sustainable growth and equitable progress in the agricultural domain. This is implemented through initiatives like National e-Governance Plan in Agriculture (NeGPA).

10.3. Capacity Building:

Capacity building is vital in maximizing the impact of AI in the agricultural domain. It ensures that stakeholders at all levels- from policymakers to small-scale farmers, are equipped with full potential necessary for these technologies. By solidifying institutions, enhancing research and development capabilities, fostering strategic collaborations, capacity lays a strong foundation for sustainable agricultural development.

10.4. Digital literacy:

A major obstacle to the widespread adoption of AI in agriculture, especially in India, is the limited digital literacy among farmers. To address this, it is essential to introduce educational programs, hands-on workshops, and training modules that are customized to local languages and cultural contexts. This approach will enable farmers to better understand and trust AI-based systems. On a global scale, entities such as the United Nations Development Programme (UNDP) and the World Bank can play a crucial role in supporting capacity-building efforts in developing countries, thereby accelerating AI integration in the agricultural sector.

10.5. Promoting Fairness:

Yet another obstacle in the deployment of AI in agriculture is that bias in the fed up data, this should be eradicated by ensuring that the datasets are collected from diverse representatives. NITI Aayog and other regulatory bodies at the national level should enforce guidelines for reinforcing fairness, transparency and accountability in AI-driven systems. At the international stance, standards like OECD Principles on Artificial Intelligence, should adopt ethical standards and ensure unbiased and transparency in these technologies.

10.6. International Collaboration:

Facilitating international collaborations in ways like knowledge-sharing platforms and joint research initiatives play a eminent role in catalyse the advancement of AI in agriculture. By integrating with pioneers in the agricultural domain like United States, India can accelerate its productivity and sustainability. On a wider note, global collaborations with agencies like G20 Summit, will aid policy harmonization, collaborative research and facilitate technology transfer. This will create a globally interconnected and holistic agricultural ecosystem.