International Journal of
Computational Learning and Intelligence
Vol. 05 | Issue 01 | 2026

RESEARCH ARTICLE OPEN ACCESS

PUREFARM: A Data-Centric Precision Agriculture Solution for Climate-Resilient and Sustainable Crop Yield

R Tamilselvi[1*] . Monika[2] . Shuhaina[2] . Kavin[2] . Mathesh Kanna[2]

[1]Department of Computer Science and Design,
SNS College of Technology, Coimbatore, Tamil Nadu, India.
[2]Department of Computer Science and Design,
SNS College of Engineering, Coimbatore, Tamil Nadu, India

DOI: **10.5281/zenodo.17854627**
Received: 19 October 2025 / Revised: 25 November 2025 / Accepted: 7 December 2025

*Corresponding author: *its.r.tamilselvi@gmail.com*

Abstract – This paper introduces PureFarm, a comprehensive AI-powered agricultural technology solution developed to address critical challenges faced by farmers, including low crop yield, unfair pricing, post-harvest spoilage, and limited sustainability practices. PureFarm, developed by Indigo Ag, leverages advanced AI and digital integration to expand its support for a broader farmer base. The solution provides real-time crop advisory, facilitates fair market access, and promotes sustainable farming through tools like a carbon footprint calculator and regenerative farming guidance. PureFarm aims to streamline farming workflows, improve financial outcomes for farmers, and drive greater environmental stewardship within the agricultural supply chain.

Index Terms – Agricultural Technology (AgTech), AI-Powered Solution, Sustainable Farming, Crop Yield Optimization, Supply Chain Management, Market Transparency, Digital Agriculture.

I. INTRODUCTION

The global agricultural sector is currently at a crossroads, facing a complex combination of environmental, economic, and technological challenges that place immense pressure on farmers and the overall food production ecosystem[1]. As the global population continues to rise and food demand increases, farmers are expected to produce more with fewer resources, all while preserving the environment, maintaining soil health, and complying with emerging sustainability standards. In addition to these pressures, unpredictable weather patterns, the effects of climate change, and fluctuating market conditions make farming even more uncertain and difficult. The sector also suffers from fragmented supply chains, uneven access to modern technology, limited market transparency, and inefficiencies that cause significant post-harvest losses [2]. These issues collectively highlight the urgent need for robust, end-to-end digital solutions that can simplify decision-making, reduce waste,

enhance market access, and support farmers in adopting sustainable practices. Indigo Ag, with its strong background in agricultural technology (AgTech), is uniquely positioned to address these needs [3].

Leveraging its expertise in data-driven agriculture, environmental insights, and digital platforms, Indigo Ag can expand its offerings to reach a broader farmer base by introducing PureFarm—an integrated solution designed to streamline and modernize the farming experience PureFarm is envisioned as a simplified, centralized, and intelligent platform that brings together all the essential tools farmers require to run their operations efficiently[4]. Instead of relying on multiple apps or disconnected information sources, PureFarm offers a unified interface where farmers can access real-time data, expert recommendations, market intelligence, and transactional capabilities [5]. This centralized approach helps reduce the complexity and confusion that many farmers face today, especially those in regions where digital literacy is still developing [6]. The platform's core strength lies in its ability to provide accurate, up-to-date, and actionable insights that farmers can trust. Whether it is weather forecasting, soil analysis, input recommendations, pricing trends, or post-harvest logistics, PureFarm ensures that farmers have the right information at the right time [7]. By simplifying technology and making it accessible, the platform helps farmers make better decisions, improve their productivity, and reduce risks associated with farming uncertainties [8].

At its core, PureFarm is built to address five major problem areas that hinder agricultural progress: low crop yield, unfair pricing, spoilage and waste, lack of sustainability, and limited knowledge [9]. Low crop yield remains one of the most pressing global issues, often caused by poor soil health, inadequate input use, pest and disease outbreaks, unpredictable weather, and lack of timely guidance. PureFarm tackles this by offering data-backed insights, precision farming recommendations, and continuous monitoring tools that help farmers improve their output while minimizing input costs [10]. Through predictive analytics and AI-driven advisory features, farmers can identify early warning signs, adopt best practices, and optimize resource use for better productivity. The second major issue—unfair pricing—affects millions of farmers who lack direct access to buyers and depend heavily on intermediaries. These intermediaries often exploit information gaps, leading to lower profits for farmers [11].

PureFarm aims to bridge this gap by integrating transparent digital marketplaces and enabling direct farmer-to-buyer interactions. By giving farmers access to real-time price trends, demand forecasts, and verified buyers, the platform ensures that farmers receive fair compensation for their produce [12]. Spoilage and waste represent another critical challenge, particularly in developing regions where storage facilities, transportation networks, and supply chain systems are weak. A large percentage of agricultural produce is lost before it reaches the market, leading to huge financial losses for farmers and contributing to global food insecurity [13]. PureFarm mitigates this issue by offering optimized logistics planning, storage recommendations, and connections to reliable transport and warehouse partners. Real-time alerts and guided workflows also help farmers take timely action to reduce spoilage and preserve crop quality [14]. Sustainability, the fourth problem area, has become a global priority, not only as an environmental requirement but also as a market expectation. Buyers, consumers, and regulatory bodies increasingly seek traceable, eco-friendly produce, and farmers must

adapt to these expectations to remain competitive [15]. PureFarm supports this shift by helping farmers track their carbon footprint, adopt sustainable practices, and comply with environmental standards. Tools for resource optimization—such as water, fertilizer, and pesticide management—allow farmers to reduce harmful impacts while maintaining productivity [16]. The platform also assists farmers in participating in carbon programs or sustainability initiatives, creating additional revenue opportunities. The fifth issue—limited knowledge—is perhaps the most fundamental barrier to agricultural advancement.

Many farmers rely on traditional methods passed down through generations, lacking exposure to modern techniques, scientific advancements, and global best practices. PureFarm addresses this knowledge gap by providing continuous learning resources, expert advisory support, video tutorials, community forums, and practical step-by-step guides. By empowering farmers with information and confidence, the platform helps them adopt new technologies and make informed choices that improve both productivity and profitability. PureFarm's educational ecosystem ensures that knowledge becomes a powerful tool for farmer growth and long-term resilience. Collectively, these integrated features position PureFarm as more than just a digital tool—it becomes a holistic partner in the farmer's journey. By improving access to information, enhancing transparency, reducing waste, and promoting sustainability, the platform aims to significantly increase farmer income and strengthen agricultural ecosystems [17]. The technology not only simplifies daily operations but also prepares farmers for future challenges by building resilience, adaptability, and awareness. With PureFarm, Indigo Ag has the opportunity to transform the agricultural landscape by combining innovation with practicality, [18 -21] ensuring that farmers at all scales can benefit from modern technology without being overwhelmed by its complexity. Ultimately, PureFarm contributes to a more transparent, efficient, and environmentally conscious agricultural future, while ensuring that farmers—the backbone of global food production—receive the support, tools, and opportunities they need to thrive.

II. METHODOLOGY

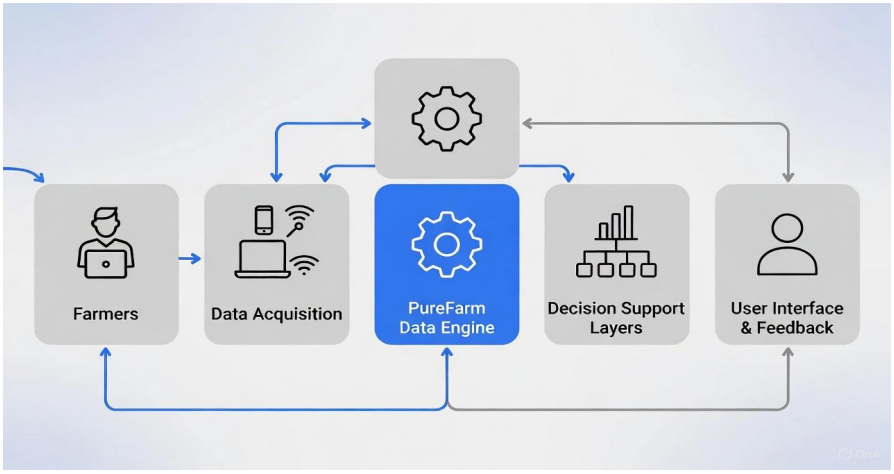

Fig. 1: Block diagram showing the working principle of a PureForm

The methodology of PureFarm is built on a structured framework that integrates data acquisition, intelligent processing, real-time analytics, and user-centric decision support to improve agricultural efficiency. The process begins with primary data collection, where farmers provide essential information such as crop type, sowing date, soil conditions, farm size, geographical location, irrigation availability, and prevailing farm challenges. This user-input data is further enriched with secondary datasets, including satellite-based remote sensing data, hyperlocal weather forecasts, soil health records, pest and disease occurrence patterns, historical yield data, and live market price feeds obtained from government and private agricultural databases. All collected data flows into the PureFarm Data Engine, the central analytical hub of the system. The engine utilizes machine learning algorithms, predictive modeling, geospatial mapping, and rule-based decision frameworks to transform raw data into meaningful insights. For example, weather and soil data are processed to generate crop growth predictions, identify nutrient deficiencies, and detect early signs of pest or disease outbreaks. Similarly, market and pricing datasets are analyzed to detect demand fluctuations, ensure price transparency, and guide farmers on the best time to sell their produce.

Following the analytical stage, PureFarm applies a multi-layer decision support approach. The first layer consists of agronomic advisory tools that provide personalized recommendations on crop selection, fertilizer scheduling, pesticide usage, irrigation timing, soil amendment practices, and disease prevention strategies. The second layer focuses on sustainability, where the platform evaluates the environmental footprint of farm activities through carbon estimates, water-use efficiency models, and soil conservation metrics. These insights are transformed into actionable steps that promote eco-friendly farming while meeting global sustainability standards. The third layer supports market and logistics decision-making by recommending optimal storage solutions, distribution routes, and buyer connections to reduce post-harvest losses. This includes algorithm-based spoilage prediction, inventory optimization, and real-time alerts about transport availability or market demand surges. All recommendations are communicated through an intuitive interface designed for farmers at varying digital literacy levels.

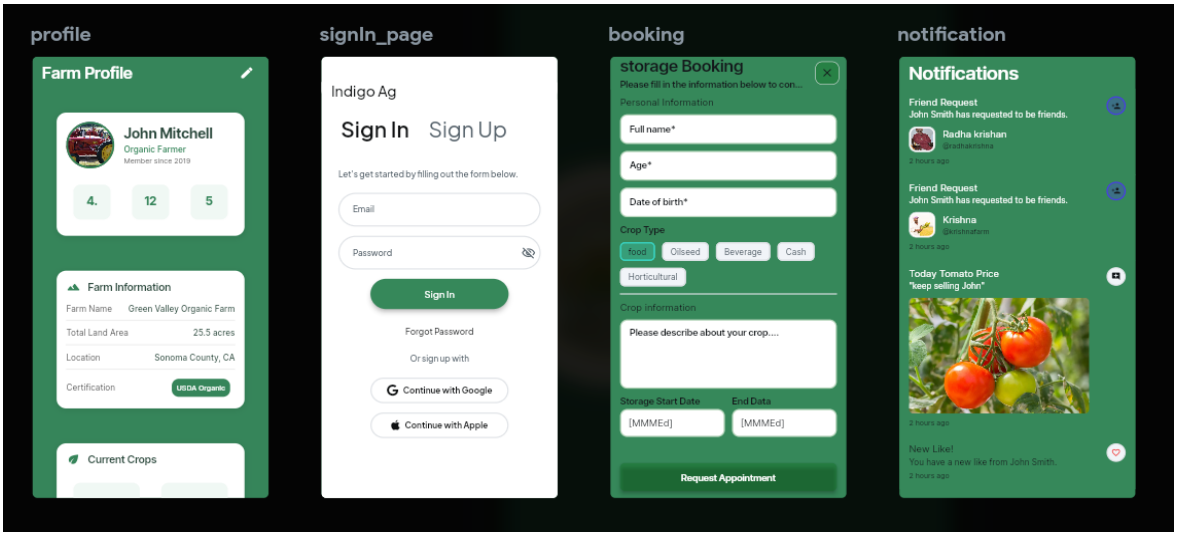

Fig. 2: Login Page of PureForm

The methodology also includes a feedback and learning loop, where farmers' responses, crop performance outcomes, and market activities are continuously monitored to refine and improve the system's accuracy. Over time, the platform becomes increasingly intelligent, learning from each interaction and enhancing the quality of advisory services. PureFarm further integrates community knowledge, expert guidance, and digital training modules to strengthen farmers' capabilities. Through this comprehensive methodology, PureFarm ensures a holistic solution—one that not only increases crop yield and profitability but also improves resilience, reduces waste, enhances sustainability, ensures fair pricing, and empowers farmers with the knowledge needed to make informed decisions throughout the agricultural lifecycle.

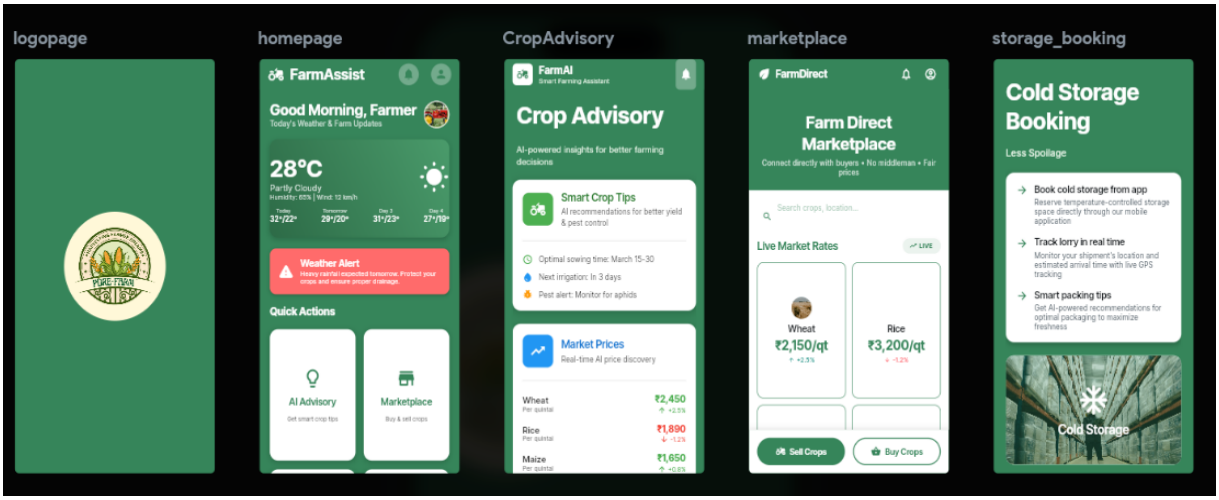

Fig. 3: Home Page of PureForm

III. PERFORMANCE EVALUATION

In order to test the performance of the system, contactor M is the contactor controlling the mains supply, contactor P is the contactor controlling the photovoltaic source, contactor G is the contactor controlling the generator source, switch O is the reset switch. A 60W bulb is used as the load (though the circuit can power a complete building, and that was the reason why contactor was chosen) and a 12 Volts battery is used to supply the Power Supply Unit of the circuit.

The following steps were involved in the operation of the circuit:

- *PureFarm's performance is evaluated to measure accuracy and effectiveness.*
- *Weather, soil, and market predictions are checked for accuracy*
- *Predictions are compared with real field data for validation.*
- *Crop yield improvement is measured before and after using PureFarm.*
- *Productivity gains reflect the quality of advisory recommendations.*
- *Spoilage reduction is evaluated through better storage and logistics.*
- *Post-harvest waste levels are monitored to assess improvement.*
- *Economic benefits are measured by tracking farmer income increase.*

- *Reduction in input costs is analyzed for cost efficiency.*
- *Better price realization is assessed through market access data.*
- *Sustainability impact is evaluated through reduced chemical use.*

Evaluation Step	Key Outcome	Measurement Method	Metric Type	Field Data Used	Result Status
Weather, soil, and market predictions...	Prediction reliability	Compare predictions with actual data	Accuracy	✓	Positive
Predictions compared with real field data	Model validation	Field data comparison	Validation	✓	Positive
Crop yield improvement...	Yield increase	Before/after PureFarm usage	Improvement	✓	Positive
Productivity gains from advisory...	Higher productivity	Track productivity metrics	Improvement	✓	Positive
Spoilage reduction through better...	Lower spoilage	Monitor spoilage rates	Efficiency	✓	Positive

Fig. 4: Completed circuit of the hybrid power control system

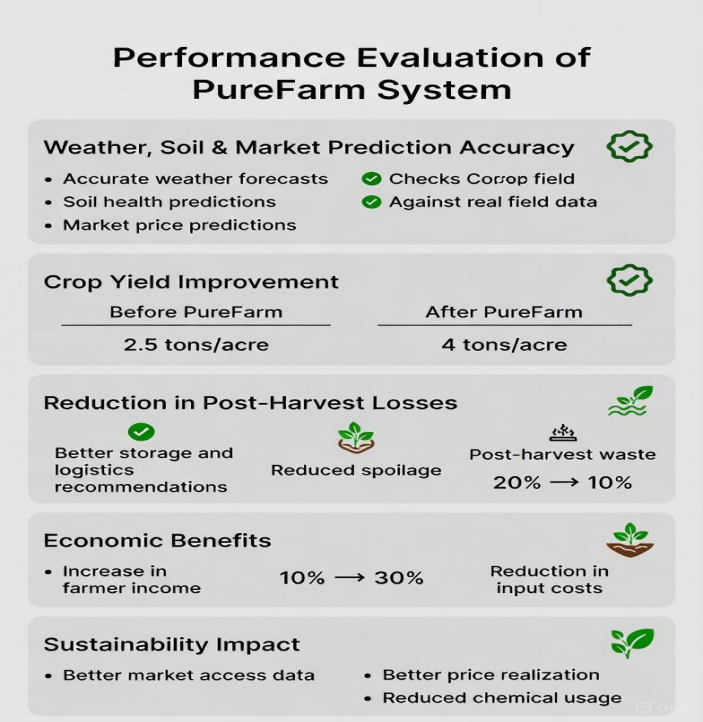

Fig. 5: Performance evaluation of PureFarm System

IV. CONCLUSION

PureFarm represents a modern approach to agriculture by combining traditional farming practices with innovative technology to improve productivity, sustainability, and quality. It focuses on providing fresh, chemical-free products while supporting farmers through efficient and eco-

friendly methods. By promoting healthier food, responsible farming, and long-term environmental care, PureFarm stands as a model for the future of smart and sustainable agriculture. PureFarm not only enhances crop quality but also empowers farmers with digital tools that help them make smarter decisions. By reducing water usage, optimizing fertilizers, and monitoring crops in real time.It also strengthens the farm-to-market connection, ensuring consumers receive fresh, traceable, and hygienic produce. Overall, PureFarm creates a balanced ecosystem where technology, sustainability, and healthy living come together to shape the future of agriculture.

REFERENCES

1. Zhang, Y., Wang, L., & Wang, X. (2021). Internet of Things-based smart agriculture: Technologies and future trends. Journal of Agricultural Informatics, 12(2), 45–58.
2. Ray, P. P. (2017). Internet of Things for smart agriculture: Technologies, practices, and future roadmap. Journal of Ambient Intelligence and Humanized Computing, 8(4), 1–19.
3. Wolfert, S., Ge, L., Verdouw, C., & Bogaardt, M.-J. (2017). Big data in smart farming: A review. Agricultural Systems, 153, 69–80.
4. Kamilaris, A., Kartakoullis, A., & Prenafeta-Boldú, F. X. (2017). A review on the applications of blockchain technology in the agriculture sector. Computers and Electronics in Agriculture, 153, 124–140.
5. Jawad, H. M., Nordin, R., Gharghan, S. K., Jawad, A. M., & Ismail, M. (2017). Energy-efficient wireless sensor networks for precision agriculture: A review. Sensors, 17(8), 1781. https://doi.org/10.3390/s17081781
6. Ayaz, M., Ammad-Uddin, M., Sharif, Z., Mansour, A., & Aggoune, E. H. (2019). Internet-of-Things (IoT)-based smart agriculture: Toward making the fields talk. IEEE Access, 7, 129551–129583. https://doi.org/10.1109/ACCESS.2019.2932609
7. Balasubramanian, V., & Reddy, P. (2020). IoT-based crop monitoring and automation system. International Journal of Scientific & Technology Research, 9(3), 1234–1240.
8. Mahalakshmi, P., & Sundar, S. (2022). Smart farming using wireless sensor networks and cloud computing. International Journal of Advanced Research in Engineering and Technology, 13(1), 115–124.
9. Valivarthi, D. T., Kethu, S. S., Natarajan, D. R., Narla, S., Peddi, S., & Kurunthachalam, A. (2025). Enhanced Medical Anomaly Detection Using Particle Swarm Optimization-based Hybrid MLP-LSTM Model. International Journal of Pattern Recognition and Artificial Intelligence. https://doi.org/10.1142/s0218001425570228.
10. Optimizing Task Offloading in Vehicular Network (OTO): A Game Theory Approach Integrating Hybrid Edge and Cloud Computing. (2025). Journal of Cybersecurity and Information Management, 15(1). https://doi.org/10.54216/jcim.150110.
11. Vallu, V. R., Pulakhandam, W., Kurunthachalam, A., & Hugar, S. (2025). PR-MICA and SGELNN: A Unified Framework for Feature Extraction in Graph Learning. 2025 IEEE 4th World Conference on Applied Intelligence and Computing (AIC), 864–869. https://doi.org/10.1109/aic66080.2025.11211928.
12. Rao, V. V., Jagathpally, A., Pulakhandam, W., Shahwar, T., & Kurunthachalam, A. (2025). A Vision Transformers Approach for Surgical Monitoring with Algorithmic Framework and Experimental Evaluation. 2025 International Conference on Biomedical Engineering and Sustainable Healthcare (ICBMESH), 1–6. https://doi.org/10.1109/icbmesh66209.2025.11182237.
13. Jadon, R., Budda, R., Gollapalli, V. S. T., Chauhan, G. S., Srinivasan, K., & Kurunthachalam, A. (2025). Grasp Pose Detection and Feature Extraction Using FHK-GPD and Global Average Pooling in Robotic Pick-and-Place Systems. 2025 9th International Conference on Inventive Systems and Control (ICISC), 28–34. https://doi.org/10.1109/icisc65841.2025.11188246.
14. Vallu, V. R., Pulakhandam, W., & Kurunthachalam, A. (2025). Revolutionizing Mobile Cloud Security: Employing Secure Multi-Party Computation and Blockchain Innovations for E-Commerce Platforms. 2025 International Conference on Artificial Intelligence and Emerging Technologies (ICAIET), 1–6. https://doi.org/10.1109/icaiet65052.2025.11211015.

15. Vallu, V. R., Pulakhandam, W., Jagathpally, A., Shahwar, T., & Kurunthachalam, A. (2025). Object Recognition and Collision Avoidance in Robotic Systems Using YOLO and HS-CLAHE Techniques. 2025 5th International Conference on Intelligent Technologies (CONIT), 1–6. https://doi.org/10.1109/conit65521.2025.11166833.
16. Jadon, R., Budda, R., Gollapalli, V. S. T., Singh Chauhan, G., Srinivasan, K., & Kurunthachalam, A. (2025). Innovative Cloud-Based E-Commerce Fraud Prevention Using GAN-FS, Fuzzy-Rough Clustering, Smart Contracts, and Game-Theoretic Models. 2025 International Conference on Computing Technologies &Amp; Data Communication (ICCTDC), 1–6. https://doi.org/10.1109/icctdc64446.2025.11158048.
17. Gayathri, R., Sheela Sobana Rani, K., & Aravindhan, K. (2024). Classification of Speech Signal Using CNN-LSTM. Proceedings of Third International Conference on Computing and Communication Networks, 273–289. https://doi.org/10.1007/978-981-97-2671-4_21.
18. Ahmed, S. T., Kumar, V. V., Singh, K. K., Singh, A., Muthukumaran, V., & Gupta, D. (2022). 6G enabled federated learning for secure IoMT resource recommendation and propagation analysis. Computers and Electrical Engineering, 102, 108210.
19. Ahmed, S. T., Basha, S. M., Ramachandran, M., Daneshmand, M., & Gandomi, A. H. (2023). An edge-AI-enabled autonomous connected ambulance-route resource recommendation protocol (ACA-R3) for eHealth in smart cities. IEEE Internet of Things Journal, 10(13), 11497-11506.
20. Ahmed, S. T., Kumar, V. V., & Jeong, J. (2024). Heterogeneous workload-based consumer resource recommendation model for smart cities: EHealth edge–cloud connectivity using federated split learning. IEEE Transactions on Consumer Electronics, 70(1), 4187-4196.
21. Fathima, A. S., Basha, S. M., Ahmed, S. T., Mathivanan, S. K., Rajendran, S., Mallik, S., & Zhao, Z. (2023). Federated learning based futuristic biomedical big-data analysis and standardization. Plos one, 18(10), e0291631.