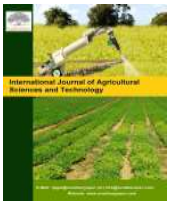
https://doi.org/10.51483/IJAGST.4.1.2024.13-17 ISSN: 2710-3366

SvedbergOpen
DISSEMINATION OF KNOWLEDGE

International Journal of Agricultural Sciences and Technology

Publisher's Home Page: https://www.svedbergopen.com/



Review Article Open Access

Precision Farming: A New Era of Antibiotic-Free Agriculture

Hemant Bothe[1*], Laxmikant Kamble[2] and Santosh Bothe[3]

[1]Daksh Foundation, Washim Maharashtra, India. E-mail: hemantbothe@dakshgroup.org
[2]Swami Ramanand Teerth Marathwada University, Nanded, India. E-mail: lhkamble@srtmun.ac.in
[3]Sadhana Shikshan Mandal's Saraswati College, Shegaon India. E-mail: santoshbothe@gmail.com

Article Info

Volume 4, Issue 1, May 2024
Received : 01 January 2024
Accepted : 19 April 2024
Published : 05 May 2024
doi: 10.51483/IJAGST.4.1.2024.13-17

Abstract

Precision farming is transforming how antibiotics get used on farms. It fights the overuse that creates superbugs and harms nature. Farmers now have high-tech tools to use antibiotics ultra-precisely. Drones, AI, and advanced watering equipment help them pinpoint only sick plants and animals needing treatment. This shields crops while avoiding environmental damage. More careful antibiotic use makes livestock healthier and boosts harvests too. And it prevents resistant germs, where antibiotics stop working altogether. The approach helps farms in multiple ways, using fewer resources for even better results. There are some growing pains, like high costs for small farms. And questions around data privacy also cause concern. But overcoming these hurdles could help precision farming spread far and wide. This technology promises safer, greener, and more productive agriculture. Targeted use of antibiotics protects both crops and people from drug-proof germs. And nature benefits when less medicine spreads into soil and water. The future looks bright for farming with precision.

Keywords: *Precision Farming, Antibiotic Reduction, Sustainable Agriculture, Emerging Agricultural Technologies, Environmental Impact*

1. Introduction

Farms are using way too many antibiotics. This creates superbugs that antibiotics can't kill. Doctors struggle treating infections. Also, the drugs throw nature out of balance - harming soil, water, and helpful bugs.

But new farm technologies offer hope. They carefully target where and when antibiotics get used, instead of just dumping lots of them everywhere. This is called "precision agriculture" (Finco *et al.*, 2013).

The goal is to use less antibiotics but still grow healthy crops. Advanced tools like drones with cameras help. They scan fields to instantly spot sick plants needing medicines (Abbas *et al.*, 2023). Then only those spots get treated, not the whole field.

This super-accurate approach could safeguard human health. With less antibiotics used, fewer drug-beating superbugs take hold. It's gentler on the land too.

So in simple terms, high-tech precision farming aims to fix careless antibiotic use. Its scanning tools allow more precise application. That means less chance of new miracle-drug-resistant bugs. Plus greener farms that balance nature's needs too.

* *Corresponding author: Hemant Bothe, Daksh Foundation, Washim Maharashtra, India. E-mail: hemantbothe@dakshgroup.org*

The bottom line - new technologies offer the smartest ways to use antibiotics. Targeted treatments only where absolutely necessary. This protects people, crops and the planet.

2. Emerging Technologies

Several emerging technologies are being used in precision farming to reduce antibiotic use:

2.1. Remote Sensing

New technologies are helping farmers use less antibiotics on crops. An essential technology for modern farming is the use of drones and satellites that capture aerial imagery and data over agricultural fields (Abbas *et al.*, 2023; Chin *et al.*, 2023). They take detailed pictures of plants to spot sick or struggling ones.

Before, farmers might just spray entire fields with antibiotics to try preventing problems. But these eyes in the sky show exactly which plants actually need help. Instead of spraying everything, farmers can now target medicine only where it's needed. This saves antibiotics and keeps them from building up everywhere. It's easier on the environment too.

The zoom-in shots help catch issues early. Farmers know the trouble spots and can take care of them. So problems don't spread out of control across the whole field (Elam Cheren *et al*., 2023).

It's all about hitting the right spots at the right times. These high flying helpers make that possible without covering healthy plants too (Sapkota *et al*., 2023). Saving antibiotics means they'll keep working when we really need them.

The new tech brings precision to farming. Accurate scans guide where and when meds get applied. It makes treatment smarter - less waste, less environmental impact, but still better crop health.

2.2. AI and Machine Learning

New farm tech is starting to reduce reliance on antibiotics. Artificial intelligence (AI) and "machine learning" are two key examples.

These involve computer systems that can analyze information and learn from it. On farms, they examine crop and animal data gathered by sensors. Their goal is to spot diseases extremely early. Catching problems super quick means farmers can act before outbreaks happen (Esau *et al.*, 2023). If they know what's brewing, they can take steps so diseases don't spread. This prevents needing lots of antibiotics later on.

It's like having an advanced scanner that sees signs of trouble long before people could notice. Almost like predicting the future! Once a warning appears, farmers address it. So simmering issues don't ever boil over. These smart learning systems help avoid emergencies. By detecting the tiniest clues, they enable early action. Farmers stay ahead of threats (Dawn *et al.,* 2023). And avoiding full-on outbreaks means less need for antibiotic treatments down the road.

AI and machine learning allow more targeted use of antibiotics. Farmers only use them when absolutely necessary, not routinely. This is better for health and the environment.

2.3. Precision Irrigation

New watering tools are helping cut antibiotic use on farms. These "precision irrigation" systems use sensors to track soil moisture levels (Wu *et al.*, 2023). They tell exactly where and when fields need more water. Unlike old ways of watering whole fields at once, precision irrigation only sprays spots that are getting dry. This targeted watering has big benefits.

Wet soil spreads bacteria that cause plant diseases. But precision systems don't over-water and create mud everywhere. Water goes right where it's needed, avoiding soggy breeding grounds for germs. Precision irrigation keeps soils healthier. No more mud means less disease. And less disease means fewer antibiotics required.

The special sensors allow water to be applied with surgical precision across fields. This keeps crops nourished while reducing risks of moisture-loving germs (Aslam *et al.*, 2023). It's high-tech protection for healthier plants that don't need lots of antibiotics.

2.4. Biocontrol Agents

Farms are using less antibiotics these days. And new natural tools are helping make that possible. These are called "biocontrol agents."

Biocontrol agents are living things like helpful insects, microbes, and fungi. They naturally keep pests and diseases in check, protecting plants (Lee *et al*., 2023). Farmers are now using them instead of so many chemicals. For example,

good guy bugs eat bad guy bugs nibbling on crops. Useful microbes crowd out or kill germs and parasites. And beneficial fungi wrap roots, guarding vegetables and fruits.

Nature designed these protectors. Now farmers are putting them to work without pouring on antibiotics that can cause problems later. It's a green, gentle way to grow healthy crops. Biocontrol agents allow reducing antibiotics safely (Lee *et al*., 2023; He *et al.*, 2023). Letting helpful living things do their job keeps plants safe from enemies trying to bite, infect, or invade them. And it's good for the environment too!

3. Benefits

The use of precision farming technologies can have a number of benefits, including:

3.1. Reduced Antibiotic Use

New precise farming methods have big benefits. One is using less antibiotics on livestock. There are good reasons for this.

Precise tools let farmers spot and treat only sick animals. No need to use antibiotics everywhere just in case. This precision targeting works better at beating diseases.

It also helps deal with antibiotic resistance. This is when germs become so strong the drugs can't kill them. Using less antibiotics makes that less likely.

The high-tech approach means healthier animals. And safer antibiotics that keep working when we really need them. It makes raising livestock more responsible and sustainable (Upinder *et al*., 2023).

Precision farming brings careful antibiotic use. Farmers use the exact right amount, in the exact right places. This protects animals and people while being greener for the planet.

3.2. Improved Crop Yields

One big benefit of precision farming is growing more food. The high-tech tools help farmers get higher yields from fields. Crops are healthier and more plentiful.

It's all about giving plants exactly what they need, right when they need it. Sensors track soil and moisture levels. Smart systems then provide the perfect amount of water, fertilizers, etc. (Wu *et al.,* 2023; C.A., 2023). It's like each plant gets bespoke care and feeding. No shortages or excesses that stress them out. Just dialed-in conditions so they can thrive at max capacity.

The result is both larger and better quality harvests! Farmers pull more bushels per acre. And the produce is extra nutritious and tasty too. So these technologies mean full fields and full bellies! Farmers can provide lots more food to meet demand. And that works out great for hungry families looking to fill their plates.

3.3. Reduced Environmental Impact

New farming technologies help make farming better for the environment. Old farming styles use a lot of water, fertilizer, and pesticides all over a field. But new tech let's farmers use less but be more effective. The new tech collects real-time data about different parts of a field. Using this data, farmers can apply water, fertilizer and pesticides only where they are needed (Abdullah *et al*., 2023). They don't waste resources by spreading them everywhere.

This targeted use of resources saves money for farmers. It also means less fertilizer and chemicals soak into the ground or run off into nearby water. So these new technologies are more sustainable and eco-friendly. They reduce waste and harm to the environment while still letting farmers grow quality crops.

4. Challenges

Precision farming uses cutting-edge equipment to improve efficiency. But there are obstacles stopping many farmers from adopting it.

First obstacle - the price tag. All the high-tech sensors, tools and systems are really expensive up front. Not every farm can afford that investment (Arjune and Kumar, 2023).

Another issue is the learning curve. These advanced technologies take specific skills and knowledge. Farmers would need lots of training to run them properly (Kanaiyalal and Sinha, 2022). That extra time and effort add still more hurdles.

There's also worry about data privacy. These tools collect a ton of precise farm data. Farmers rightfully wonder - could that sensitive information be stolen or misused? Safe data handling hasn't been made clear yet (Kaur *et al.,* 2022).

So for precision farming to go mainstream, there are bugs to work out. The costs need addressing so every farm can take advantage. More support for managing and learning the tech is crucial too. And clear rules around data must ease people's minds.

Solving hurdles like those would really help next-gen agriculture spread. But it's a complicated high-tech changeover for a traditional hands-in-dirt industry. It'll take time to upgrade fields everywhere to precision systems.

5. Conclusion

New technologies could really change how farms use antibiotics. They offer smarter ways to raise healthy crops while avoiding overuse.

Precision farming tools allow farmers to pinpoint where antibiotics are truly needed. This selective spraying reduces overall use. It leads to better harvests without harming the land with excess medicine. But there are still barriers stopping many farmers from making the switch. The advanced equipment is pricey. Learning the tech takes time and training too. And people reasonably worry about their data privacy.

If those downsides get addressed, precision agriculture could see rapid growth. More users would adopt the tech once costs drop and confidence in data security rises. The future looks bright for precision farming - even though hiccups remain. Clearing a few key hurdles could set the stage for safer, more sustainable agriculture.

References

Abbas, A., Zhang, Z., Zheng, H., *et al.* (2023). Drones in Plant Disease Assessment, Efficient Monitoring, and Detection: A Way Forward to Smart Agriculture. *Agronomy*, 13, 1524. doi: https://doi.org/10.3390/agronomy13061524

Abdullah, F.Y., Yaseen, M.T. and Sheet, Y.S. (2023). Smart Eco-Friendly and Low-Cost Farming Control System. *5th International Congress on Human-Computer Interaction, Optimization and Robotic Applications (HORA)*, Istanbul, Turkiye. pp. 1-5. doi: https://doi.org/10.1109/HORA58378.2023.10156672"10.1109/HORA58378.2023.10156672

Aslam, M.A., Cheema, M.J.M., Saleem, S., Basit, A., Hussain, S. and Waqas, M.S. (2023). Application of Sensor-Based Precision Irrigation Methods for Improving Water Use Efficiency of Maize Crop. in *MDPI AG.*, 38. doi: https://doi.org/10.3390/environsciproc2022023038

Chin, R., Catal, C. and Kassahun, A. (2023). Plant Disease Detection Using Drones in Precision Agriculture. *Precis Agric.,* 24(5), 1663-1682. doi: https://doi.org/10.1007/s11119-023-10014-y

Dawn, N., Ghosh, T., Ghosh, S., *et al.* (2023). Implementation of Artificial Intelligence, Machine Learning, and Internet of Things (IoT) in revolutionizing Agriculture: A review on recent trends and challenges. *International Journal of Experimental Research and Review,* 30, 190-218. doi: https://doi.org/10.52756/ijerr.2023.v30.018

Elam Cheren, S., Yuvan Raj Kumar, M., Vivek, G., Udhayakumar, N. and Saravanakumar, M.V. (2023). Farmer's Eye Using CNN. In *Intelligent and Soft Computing Systems for Green Energy* (Eds A. Chitra, V. Indragandhi and W. Razia Sultana). doi: https://doi.org/10.1002/9781394167524.ch23

Esau, T.J., Hennessy, P.J., MacEachern, C.B., Farooque, A.A., Zaman, Q.U. and Schumann, A.W. (2023). Artificial Intelligence and Deep Learning Applications for Agriculture. *Precision Agriculture: Evolution, Insights and Emerging Trends*, 141-167, ISBN 9780443189531. doi: https://doi.org/10.1016/B978-0-443-18953-1.00003-9.

Finco, A., Bentivoglio, D., Belletti, M., *et al.* (2013). Does Precision Technologies Adoption Contribute to the Economic and Agri-Environmental Sustainability of Mediterranean Wheat Production? An Italian Case Study. *Agronomy*, 13, 1818. doi: https://doi.org/10.3390/agronomy13071818

He, D.C., He, M.H., Amalin, D.M., Liu, W., Alvindia, D.G. and Zhan, J. (2023). Biological Control of Plant Diseases: An Evolutionary and Eco-economic Consideration. *Pathogens,* 10, 1311. doi: https://doi.org/10.3390/pathogens10101311

Kaur Jasmin, Hazrati Fard Seyed Mehdi, Amiri-Zarandi Mohammad and Dara Rozita. (2022). Protecting Farmers' Data Privacy and Confidentiality: Recommendations and Considerations. Frontiers in Sustainable Food Systems, 6. doi: https://doi.org/10.3389/fsufs.2022.903230

Lee, J., Kim, S., Jung, H., Koo, B.K., Han, J.A. and Lee, H.S. (2023). Exploiting Bacterial Genera as Biocontrol Agents: Mechanisms, Interactions and Applications in Sustainable Agriculture. *Journal of Plant Biology,* 66, 485-498. doi: https://doi.org/10.1007/s12374-023-09404-6

Sapkota, R., Stenger, J., Ostlie, M. and Flores, P. (2023). Towards Reducing Chemical Usage for Weed Control in Agriculture Using UAS Imagery Analysis and Computer Vision Techniques. *Sci Rep*., 13, 6548. doi: https://doi.org/10.1038/s41598-023-33042-0

Upinder Kaur, Victor, M.R., Malacco, Huiwen Bai, Tanner, P. Price, Arunashish Datta, Lei Xin, Shreyas Sen, Robert, A. Nawrocki, George Chiu, Shreyas Sundaram, Byung-Cheol Min, Kristy M. Daniels, Robin, R. White, Shawn, S. Donkin, Luiz, F. Brito, Richard, M. Voyles. (2023). Invited Review: Integration of Technologies and Systems for Precision Animal Agriculture—A Case Study on Precision Dairy Farming, Journal of Animal Science, 101, skad206, https://doi: org/10.1093/jas/skad206

Wu, X., Walker, J.P. and Wong, V. (2023). Proximal Soil Moisture Sensing for Real-Time Water Delivery Control: Exploratory Study over a Potato Farm. *Agriculture (Switzerland)*, 13, 1297. doi: https://doi.org/10.3390/agriculture13071297

Cite this article as: Hemant Bothe, Laxmikant Kamble and Santosh Bothe (2024). Precision Farming: A New Era of Antibiotic-Free Agriculture. *International Journal of Agricultural Sciences and Technology*. 4(1), 13-17. doi: 10.51483/IJAGST.4.1.2024.13-17.