Post-AGP Ban Dynamics in Veterinary Drug Registration and Its Contribution to Food Security

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Abstract

The Indonesian government banned Antibiotic Growth Promoters (AGP) in animal feed through Ministry of Agriculture Regulation No. 14/2017, effective January 1, 2018, as a strategic effort to mitigate antimicrobial resistance (AMR) risks. This study aims to analyze the registration dynamics of veterinary drugs in Premix and Herbal categories as AGP substitutes, comparing the pre-ban (2015–2017) and post-ban (2018–2024) periods. Data from the Indonesian Veterinary Drug Index (IOHI) were analyzed using a non-experimental quantitative descriptive-comparative approach with total sampling method. The results show that Premix products increased from 777 in 2015 to 1,472 in 2024, with Feed Additives rising from 525 to 803 and Feed Supplements from 252 to 669. Herbal products also increased significantly from 14 in 2015 to 56 in 2024. The findings reveal distinct industry response patterns, registration trends, and product category shifts following the policy implementation. This empirical evaluation contributes to evidence-based policy assessment and supports the transition toward safer livestock production, ultimately strengthening food security and aligning with the One Health framework.

Keywords: AGP ban; food security; IOHI; one health; veterinary drug registration

I. INTRODUCTION

The use of Antibiotic Growth Promoters (AGP) in livestock production has been a common practice for decades to enhance feed efficiency and promote animal growth. By suppressing subclinical infections and altering the gut microbiome, AGPs historically allowed farmers to achieve optimal productivity at lower costs. However, the emergence of antimicrobial resistance (AMR) has become a global health crisis, prompting many countries to strictly regulate or ban the use of AGP in animal feed. Antimicrobial resistance poses a significant threat to public health, as it reduces the effectiveness of antibiotics in treating human infections. Recent estimates indicate that AMR was directly responsible for 1.27 million global deaths in 2019 and was associated with 4.95 million deaths, a mortality burden comparable to HIV and malaria combined (Laxminarayan, 2022). The World Health Organization (WHO) has identified AMR as one of the top ten global public health threats facing humanity (WHO, 2020). The transmission of resistant bacteria from animals to humans can occur through direct contact, the food chain, or environmental pathways, making the livestock sector a critical focal point for AMR mitigation.

In response to this growing concern, the Indonesian government issued Ministry of Agriculture Regulation No. 14/2017, which banned the use of AGP in animal feed effective January 1, 2018. This regulation represents a strategic policy shift aimed at mitigating AMR risks while maintaining livestock productivity and national food security. The ban necessitated the development and registration of alternative products, particularly in the Premix and Herbal categories, to replace AGP functions in animal nutrition. The transition period required massive adjustments from feed mills, veterinarians, and farmers, who had to rely heavily on the formulation of non-antibiotic feed additives. This regulatory change did not occur in a vacuum; it was part of Indonesia's broader commitment to the Global Action Plan on Antimicrobial Resistance, which emphasizes the prudent use of antimicrobials in both human and animal health sectors.

The transition from AGP to alternative feed additives has significant implications for the veterinary drug industry, livestock producers, and ultimately food security. Premix products, which include feed additives and feed supplements, serve as vehicles for delivering essential nutrients, enzymes, probiotics, prebiotics, and other growth-promoting substances.

Under the Indonesian regulatory framework (Ministry of Agriculture Regulation No. 14/2017), **Feed Additives** are defined as feed raw materials that do not contain nutrients, used for specific purposes such as growth promotion (historically AGP), coloring, or feed preservation. In contrast, **Feed Supplements** are substances naturally present in feed but added in higher amounts to meet nutritional requirements, such as amino acids, vitamins, and minerals.

Herbal products, derived from natural plant sources, have gained significant attention as potential AGP substitutes due to their antimicrobial, anti-inflammatory, and immunomodulatory properties (Wang et al., 2024). Phytogenic feed additives, such as those derived from turmeric, ginger, and garlic, exert multi-target mechanisms that not only inhibit pathogens but also enhance antioxidant status and immune responses in livestock (Yang et al., 2020). The registration dynamics of these product categories reflect the industry's response to regulatory changes and its capacity to provide viable alternatives in the market.

Previous studies have examined the impact of AGP bans in various countries, including the European Union, which implemented a complete ban in 2006 (Casewell et al., 2003). Studies from the EU indicated an initial increase in production costs and a rise in enteric diseases among livestock, but eventually led to improved animal welfare and reduced AMR prevalence. However, limited empirical research exists on the Indonesian context, particularly regarding the registration patterns of veterinary drugs following the AGP ban. Understanding these dynamics is crucial for evaluating the effectiveness of the policy, identifying market gaps, and ensuring that farmers have access to affordable and effective alternatives.

The objective of this research is to analyze the registration dynamics of veterinary drugs in the Premix and Herbal categories as AGP substitutes in Indonesia, comparing the pre-ban (2015–2017) and post-ban (2018–2024) periods. Specifically, this study examines the trends in product registration, category shifts, and the contribution of these products to food security within the One Health framework. The findings are expected to provide empirical evidence for policy assessment and support the development of safer and more sustainable livestock production systems.

The manuscript is structured as follows: Section II describes the research methodology, including data sources and analysis techniques. Section III presents the results and discusses the implications of the findings. Section IV provides the conclusion, and Section V contains acknowledgments and references.

II. METHOD

This study employed a non-experimental quantitative descriptive-comparative approach to analyze the registration dynamics of veterinary drugs in Indonesia. The research design was selected to provide a comprehensive overview of trends and patterns in product registration before and after the AGP ban, without manipulating any variables. The descriptive approach allows for the identification of patterns, while the comparative approach enables the evaluation of policy impacts by contrasting pre-ban and post-ban data. This methodological framework is particularly suitable for policy evaluation studies where experimental manipulation is neither feasible nor ethical.

A. Data Sources

The primary data source for this study was the Indonesian Veterinary Drug Index (IOHI), published by the Indonesian Animal Health Company Association (ASOHI). The

IOHI database contains comprehensive information on registered veterinary drugs in Indonesia, including product names, categories, registration dates, active ingredients, manufacturers, and target animal species. The IOHI serves as the official reference for veterinary medicinal products circulating in Indonesia and is updated periodically to reflect new registrations, renewals, and withdrawals. The data were collected for two distinct periods: pre-ban (2015–2017) and post-ban (2018–2024). The selection of these periods allows for a robust comparative analysis of registration trends before and after the implementation of Ministry of Agriculture Regulation No. 14/2017. The pre-ban period captures the market conditions prior to the regulatory intervention, while the post-ban period reflects the industry's adaptation to the new regulatory environment.

B. Sampling Method

A total sampling method was employed, whereby all registered products in the Premix and Herbal categories were included in the analysis. This approach was chosen to ensure a comprehensive representation of the market and to avoid selection bias. The Premix category comprises two subcategories: Feed Additives and Feed Supplements. The Herbal category includes products derived from natural plant sources, such as herbs, botanicals, and phytogenic extracts. The total sample consisted of all products registered in these categories during the specified periods, ensuring a complete picture of the registration landscape.

C. Variables and Data Collection

The variables observed in this study include:

1. Number of registered Premix products (Feed Additives and Feed Supplements)
2. Number of registered Herbal products
3. Registration trends over time (annual data from 2015 to 2024)
4. Product category shifts following the AGP ban

Data collection was conducted through a systematic review of the IOHI databases for the 2015, 2017, 2019, 2021, and 2024 editions. The 2023 edition was excluded from the analysis because, starting in 2023, the IOHI has been published annually with different product coverage depending on the year. Odd-numbered editions (such as 2023) cover pharmaceutical and biological veterinary medicines, whereas even-numbered editions focus specifically on premixes and natural medicines. Since this study focuses on premixes and natural medicines, the 2023 edition was excluded.

Data on registered premix and natural veterinary medicines were compiled and presented in tabular form to provide an overview of the development of registered veterinary medicine products across the different editions. Based on this compilation, the annual growth in the number of registered veterinary medicines was analyzed. The results were then compared between the pre-AGP ban period (2015 and 2017 editions) and the post-AGP ban period (2019, 2021, and 2024 editions).

In addition, secondary data from relevant literature, government regulations, and industry reports were collected to provide context and support the interpretation of the research findings.

D. Data Analysis

Data analysis was performed using descriptive statistics to summarize the registration trends and patterns. Comparative analysis was conducted to identify differences between the pre-ban and post-ban periods. The following analytical techniques were employed:

1. Descriptive statistics: Frequencies, percentages, and measures of central tendency were calculated to describe the data.

2. Trend analysis: Time-series analysis was used to examine registration trends over the study period.
3. Comparative analysis: Pre-ban and post-ban data were compared to identify significant changes in registration patterns.

The analysis was conducted using Microsoft Excel. Results are presented in tables and figures to facilitate interpretation.

III. RESULTS AND DISCUSSIONS

A. Result

The analysis of veterinary drug registration data from the Indonesian Veterinary Drug Index (Indeks Obat Hewan Indonesia/IOHI) reveals significant dynamics in the Premix and Herbal categories following the AGP ban. Table 1 presents the number of registered products in each category across the study period.

Table 1. Number of Registered Veterinary Drug Products in Premix and Herbal Categories (2015–2024)

Category	2015	2017	2019	2021	2024
A. Premix Products					
1. Feed Additives	525	561	588	637	803
2. Feed Supplements	252	277	256	291	669
Total Premix	**777**	**838**	**844**	**928**	**1,472**
B. Herbal Products	14	15	23	32	56

Source: IOHI data (processed)

The data show a consistent increase in the number of registered Premix products throughout the study period. Feed Additives increased from 525 products in 2015 to 803 products in 2024, representing a 53% increase. Feed Supplements exhibited an even more pronounced growth, rising from 252 products in 2015 to 669 products in 2024, a 165% increase. The total number of Premix products grew from 777 in 2015 to 1,472 in 2024, nearly doubling over the nine-year period.

The Herbal category also demonstrated significant growth, with registered products increasing from 14 in 2015 to 56 in 2024, a fourfold increase. This growth accelerated notably after 2018, with the number of Herbal products rising from 15 in 2017 to 23 in 2019 and continuing to increase in subsequent years.

To provide a broader perspective, Table 2 presents a summary of the growth dynamics across categories.

Table 2. Summary of Growth Dynamics in Premix and Herbal Categories

Category	Pre-Ban (2015–2017)	Post-Ban (2017–2024)	Percentage Change (2015–2024)
Feed Additives	+6.9%	+43.1%	+53.0%
Feed Supplements	+9.9%	+141.5%	+165.5%
Herbal Products	+7.1%	+273.3%	+300.0%

Notes: Percentage change is calculated based on the number of registered products

The data in Table 2 reveals three distinct growth patterns across the product categories. First, **Feed Additives** exhibited a moderate and steady increase, with a pre-ban growth of +6.9% (from 525 to 561 products) and a post-ban growth of +43.1% (from 561 to 803 products), resulting in a total change of +53.0% over the nine-year study period. This category demonstrated the most gradual growth trajectory among the three categories.

Second, **Feed Supplements** showed a more pronounced acceleration. During the pre-ban period, the growth was relatively modest at +9.9% (from 252 to 277 products). However, following the implementation of the AGP ban, the category experienced a substantial surge of +141.5% (from 277 to 669 products), culminating in a total percentage change of +165.5% from 2015 to 2024. Notably, the data in Table 1 indicates a slight decline in absolute numbers between 2017 (277 products) and 2019 (256 products), before rebounding sharply to 291 products in 2021 and eventually reaching 669 products in 2024.

Third, **Herbal Products** demonstrated the most dramatic relative growth, albeit from a significantly smaller baseline. The pre-ban growth was minimal at +7.1% (from 14 to 15 products). In contrast, the post-ban period witnessed an exponential increase of +273.3% (from 15 to 56 products), resulting in an overall total change of +300.0% from 2015 to 2024. This category exhibited the highest percentage growth among all three categories, despite having the lowest absolute number of registered products throughout the study period.

Figure 1 illustrates the trend in product registration for Premix and Herbal categories over the study period, providing a visual representation of the data presented in Table 1 and Table 2.

Figure 1. Trend of Veterinary Drug Registration in Premix and Herbal Categories (2015–2024)

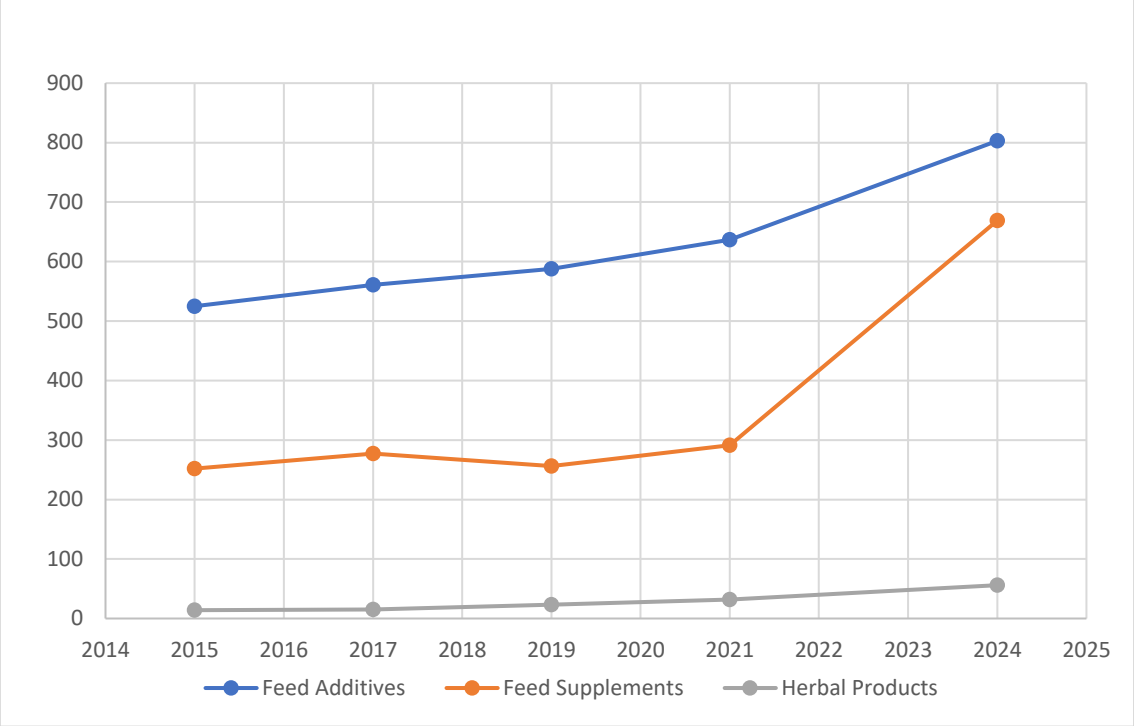


Figure 1 presents a visual representation of the registration trends for Feed Additives, Feed Supplements, and Herbal Products over the study period. The graph plots the number of registered products on the y-axis against the observation years (2015, 2017, 2019, 2021, and 2024) on the x-axis. By visualizing the data from Table 1, the figure clearly illustrates the distinct growth trajectories of each category and highlights the impact of the AGP ban implemented in early 2018.

The line representing **Feed Additives** demonstrates a consistent and steady upward trend throughout the entire study period. Starting at 525 products in 2015, the number of Feed Additives increased gradually to 561 in 2017, 588 in 2019, and 637 in 2021, before reaching 803 in 2024. The slope of this line remains relatively constant, indicating a stable, incremental growth pattern.

In contrast, the line for **Feed Supplements** exhibits a much more dynamic pattern. From 2015 to 2019, the line shows a relatively flat trajectory, rising from 252 to 277 products in 2017 but then slightly dipping to 256 products in 2019. This slight decline represents the initial "shock phase" immediately following the AGP ban, where some products may have been withdrawn or awaiting re-registration. However, after 2019, the line begins to curve upward sharply. The number of Feed Supplements increased to 291 in 2021 and then surged dramatically to 669 by 2024. This steep upward slope in the final segment of the graph clearly illustrates the industry's accelerated response in developing and registering alternative products once the initial transition period had passed.

The most striking visual feature of Figure 1 is the line representing **Herbal Products**. Starting from a very low baseline of only 14 products in 2015, the line remains almost flat through 2017 (15 products). However, after 2018, the line begins a clear upward climb, reaching 23 products in 2019 and 32 in 2021. The trajectory then accelerates significantly,

culminating at 56 products in 2024. Although the absolute numbers remain the smallest among the three categories, the steepness of the curve relative to its starting point visually underscores the exponential growth of the Herbal category. This pattern reflects a paradigm shift toward natural, plant-based alternatives in the post-ban era.

When comparing the three lines, it becomes evident that while Feed Additives maintain the highest absolute number of registered products throughout the period, the growth rates of Feed Supplements and Herbal Products are far more aggressive in the post-ban period. The visual divergence of these lines—particularly the sharp upward turn after 2019—provides strong empirical evidence that the AGP ban acted as a structural catalyst, fundamentally altering the trajectory of product registration in the Indonesian veterinary drug market. The graph thus visually corroborates the growth dynamics quantified in Table 2.

B. Discussion

1. Industry Response and Product Shifts

The findings of this study reveal significant dynamics in the registration of veterinary drugs in Indonesia following the AGP ban. The substantial increase in Premix products, particularly Feed Supplements, and the notable growth in Herbal products reflect the industry's aggressive response to the regulatory change and the growing market demand for AGP alternatives.

The accelerated growth in Feed Supplements registration after 2018 suggests that the industry has actively developed and registered products to fill the void left by AGP. Feed Supplements typically contain a combination of nutrients, enzymes, probiotics, prebiotics, acidifiers, and other substances that promote animal health and growth. The 165% increase in Feed Supplements from 2015 to 2024 indicates a robust industry response, with manufacturers investing heavily in research and development to create effective alternatives. Unlike Feed Additives, which are primarily focused on fulfilling basic nutritional requirements, Feed Supplements offer more complex formulations aimed at gut health modulation and immune system enhancement, directly mimicking the growth-promoting effects of AGPs without the associated resistance risks. A recent scoping review by Salman et al. (2026) confirmed that probiotics, phytogenics, and organic acids are the most frequently studied alternatives to AGP globally, with a significant portion of commercial products combining these elements into multi-component feed supplements.

The fourfold increase in Herbal products registration is particularly noteworthy. Herbal products, derived from natural plant sources, have gained prominence as potential AGP substitutes due to their antimicrobial, anti-inflammatory, and immunomodulatory properties (Yang et al., 2020). The significant growth in this category suggests a paradigm shift toward natural and sustainable alternatives, aligning with global trends in livestock production. Wang et al. (2024) highlighted that phytogenic feed additives exert multi-target mechanisms, including the disruption of bacterial cell membranes, the scavenging of free radicals, and the enhancement of endogenous digestive enzyme secretion. In Indonesia, local resources such as Curcuma xanthorrhiza (temulawak), Andrographis paniculata (sambiloto), and Morinda citrifolia (mengkudu) are increasingly being explored and commercialized as phytobiotic feed additives. This trend is consistent with findings from other countries that have implemented AGP bans, where herbal and phytogenic feed additives have emerged as viable alternatives (Windisch et al., 2008).

2. Empirical Evidence of AGP Ban Impact on Broiler Performance

While registration data indicates a positive industry response in providing alternatives, empirical field data reveals the actual impact of AGP withdrawal on livestock performance.

A recent study by Affandi et al. (2024) in Kuningan Regency, West Java, provides crucial evidence regarding the performance gap between broilers fed AGP and those fed non-AGP diets. The study analyzed 88 production cycles from 2013 to 2019, comparing three AGP-containing starter feeds (A, B, C) with three non-AGP feeds (X, Y, Z).

The t-test results indicated that broiler body weight (BW), feed intake (FI), and feed conversion ratio (FCR) were significantly better ($P<0.05$) in the AGP group compared to the non-AGP group. Specifically, the average body weight in the AGP group was 1.54 kg, while the non-AGP group only reached 1.38 kg, representing an 11.59% decrease. Feed intake also decreased by 9% in the non-AGP group (2.35 kg vs. 2.44 kg), and the FCR worsened by 8.28% (1.70 vs. 1.57). Most concerning is the Farmer Performance Index (IP), which dropped from 307.10 in the AGP group to 253.65 in the non-AGP group, a decline of 21.07% (Affandi et al., 2024).

Interestingly, the study found no significant difference ($P>0.05$) in mortality rates between the AGP and non-AGP groups. This suggests that while the ban on AGP negatively impacts growth performance and feed efficiency, it does not directly increase mortality under the specific management conditions of the study. This finding is critical for the industry: it confirms that the transition period requires farmers to accept lower productivity or find alternatives that can match AGP performance. The decline in IP by 21% highlights the economic vulnerability of farmers if the alternative products registered in the IOHI cannot compensate for the growth-promoting effects of AGP.

3. Comparative Analysis of Alternative Product Mechanisms

The surge in product registrations observed in the IOHI data is not merely a quantitative phenomenon; it reflects a diversification in the mechanisms of action of the alternative products. Based on current scientific classifications, the products categorized as Premix and Herbal in Indonesia can generally be grouped into probiotics/prebiotics, phytogenics (herbal), and organic acids.

First, regarding organic acid products. Abd El-Ghany (2024) explains that organic acids (such as formic, butyric, and citric acid) work by lowering the pH of the digestive tract. In their undissociated form, these acids can penetrate the cell membranes of pathogenic bacteria, disrupting internal pH balance and causing bacterial death. Furthermore, organic acids have been shown to increase the activity of digestive enzymes (pepsin, trypsin) and improve intestinal morphology (villi). This makes organic acids one of the strongest candidates for AGP replacement, particularly because their effectiveness is comparable to AGP in several trials (Abd El-Ghany, 2024). The increase in Feed Supplement registrations in Indonesia is likely dominated by these acidifier-based products.

Second, phytogenic products (Herbal Preparations). Wang et al. (2024) outline that phytogenic feed additives (based on herbs such as turmeric, ginger, garlic, and oregano) possess multi-target mechanisms of action. Their bioactive compounds (such as polyphenols, flavonoids, and essential oils) not only function as antimicrobials but also as antioxidants that neutralize free radicals, as well as immunomodulators that stimulate antibody and cytokine production. The 300% increase in Herbal Preparations in Indonesia (dominated by local herbs) indicates Indonesia's great potential to develop local resource-based phytogenics, as highlighted by Wang et al. (2024) regarding the importance of exploring herbal plants.

Third, probiotics and prebiotics (which largely fall under the Feed Supplement category). Salman et al. (2026) state that probiotics work by modulating the gut microbiota, producing short-chain fatty acids (SCFA), and enhancing mucosal immunity. However, both Salman et al. (2026) and Wickramasuriya et al. (2024) highlight the main challenge of these alternative products: inconsistency of results. The effectiveness of the product is highly dependent on dosage, strain (for probiotics), extraction method (for phytogenics), product stability, and

farm environmental conditions. Therefore, although the number of registered products has increased, the government and associations need to encourage standardization and field efficacy testing to ensure that circulating products truly provide performance equivalent to AGP, rather than merely making marketing claims.

4. Implications for Food Security and One Health

The dynamics observed in this study have important implications for national food security. The availability of effective AGP alternatives is essential for maintaining livestock productivity and ensuring a stable supply of affordable animal protein. Indonesia's population continues to grow, alongside an increasing middle class that demands higher protein intake. If the AGP ban had resulted in a severe lack of alternatives, it could have led to a decline in broiler and layer productivity, ultimately driving up the price of poultry products. The increased registration of Premix and Herbal products indicates that the industry is successfully adapting to the regulatory environment and providing farmers with viable options for maintaining animal health and growth performance.

From a One Health perspective, the transition away from AGP aligns with the broader goal of mitigating AMR risks while maintaining animal health and welfare. The One Health framework recognizes the interconnectedness of human, animal, and environmental health (Destoumieux-Garzón et al., 2018). By reducing the use of antibiotics in livestock production, Indonesia is taking a significant step toward preserving the effectiveness of antimicrobials for human medicine. Laxminarayan (2022) emphasized that preventing infections in the first place and reducing inappropriate antibiotic consumption are critical to saving millions of lives. Furthermore, it reduces the environmental burden of antibiotic residues in soil and water, which can disrupt local ecosystems and microbial communities. The shift toward herbal alternatives also supports the sustainable use of local biodiversity.

5. Challenges of Implementation at the Farmer Level

Although registration data shows a positive trend, implementation at the farmer level still faces challenges. Tangendjaja (2020) reported that two years post-ban, there was still an increase in antibiotic use in drinking water, a decline in productivity, and an increase in chicken mortality. The factors causing the gap between product availability and field adoption include:

1) Information limitations. Tangendjaja (2020) revealed that many small-scale farmers are not yet aware of the existence of alternative AGP replacement products.
2) Economic factors. The higher price of alternative products compared to AGP is a barrier to adoption.
3) Habits and trust. Farmers who have long used AGP find it difficult to switch because they are accustomed to the results. This "status quo bias" phenomenon is common in agricultural technology adoption (Rogers, 2003).
4) Infrastructure limitations. Biosecurity and suboptimal maintenance management reduce the effectiveness of alternative products. Alternative products work optimally when sanitation and management conditions are already good; otherwise, the effect will not be significant (Japutra et al., 2021).

The challenge of implementing alternative products is also acknowledged in global literature. Salman et al. (2026) noted that most studies on AGP alternatives are small-scale, short-duration, and have inconsistent methodologies, so commercial-scale (field) validation is still very lacking. This aligns with findings in Indonesia where, although many products are registered, adoption at the smallholder level is still constrained by a lack of information, higher product prices compared to AGP, and old habits. Wickramasuriya et al. (2024) also

add that economic barriers, regulatory harmonization, and adoption by producers are critical constraints in the implementation of AGP alternatives worldwide.

6. Regulatory Challenges and Product Quality

The findings also highlight potential challenges that require robust regulatory oversight. The disparity in growth rates between Feed Additives (53% increase) and Feed Supplements (165% increase) suggests that the industry may be focusing more on products that can be easily formulated and registered. This rapid proliferation of Feed Supplements and Herbal products could lead to a highly fragmented market with varying levels of efficacy and quality. Unlike pharmaceutical antibiotics, which undergo rigorous clinical trials to prove efficacy and safety, many herbal and supplement products lack standardized testing protocols.

There is a risk that some products may be marketed with unsubstantiated claims, potentially misleading farmers. Therefore, the Indonesian Ministry of Agriculture and the Indonesian Veterinary Drug Association (ASOHI) must enhance post-market surveillance. Strict quality control, including the verification of active compound concentrations, absence of contaminants (e.g., heavy metals or pathogenic microbes), and stability testing, is crucial. Additionally, the lack of complete data for Other Products categories in 2024 (such as cosmetics, vaccine solvents, and raw materials) limits the comprehensiveness of this analysis and highlights the need for improved data collection and reporting systems within the IOHI framework.

7. Comparison with Global Trends and Future Research Directions

The results of this study contribute to the growing body of literature on AGP bans and their impacts on the veterinary drug industry. While previous studies have examined the effects of AGP bans in Europe and other regions (Casewell et al., 2003; Aarestrup, 2005), limited research exists on the Indonesian context. This study fills that gap by providing empirical evidence on registration dynamics and industry responses. The trajectory observed in Indonesia mirrors the European experience, where the initial ban led to an explosion of alternative products (acidifiers, phytogenics, probiotics) entering the market.

Future research should explore the in vivo efficacy and safety of the newly registered Premix and Herbal products, specifically evaluating their impact on the Feed Conversion Ratio (FCR) and mortality rates in commercial farms. Longitudinal studies tracking the actual use of these products on farms would provide valuable insights into their adoption and real-world effectiveness. Additionally, research examining the economic implications of the AGP ban for different scales of farmers and the overall industry would contribute to a more comprehensive understanding of the policy's impacts.

8. Comparison with Neighboring Countries

Compared to other ASEAN countries, Indonesia is among the nations that responded relatively quickly in banning AGPs. The process began in 2009 with the enactment of Law No. 18/2009 on Animal Husbandry and Animal Health, which included provisions prohibiting antibiotic growth promoters. The mandate of this law was operationalized when the Minister of Agriculture issued Ministerial Regulation No. 14/2017 on the Classification of Veterinary Drugs, which explicitly banned the use of AGPs effective early 2018.

Table 3. Comparison of AGP Ban Policy Responses in Southeast Asia

Country	Policy Status	Regulatory Basis & Key Notes
Thailand	Total Ban	A pioneer in Southeast Asia, having ceased AGP registration in 2005 and banned its use in poultry in 2006. The Ministry of Agriculture and Cooperatives (MOAC) subsequently expanded the total ban to all livestock sectors in 2015.
Indonesia	Total Ban	Regulated under Law No. 18/2009 in conjunction with Law No. 41/2014 and reinforced by Ministerial Regulation No. 14/2017. The official ban has been effective since January 1, 2018. Antibiotic use is only permitted for treatment purposes with a veterinarian's prescription.
Singapore	Total Ban	Through the Singapore Food Agency (SFA), antibiotics are strictly prohibited for use as growth promoters. Antibiotics are only permitted to treat bacterial infections according to prescriptions, with strict monitoring of withdrawal periods.
Vietnam	Total Ban & Tightened	The use of AGPs in animal feed has been prohibited for several years. Starting January 1, 2026, Vietnam will tighten its regulations by banning the use of antibiotics for disease prevention (prophylaxis), allowing their use only for diagnosed sick livestock.
Malaysia & Philippines	Restricted / Gradually Tightened	Both countries implement strict controls on the circulation of antimicrobial samples and restrict the types of medically important antibiotics used in livestock. Regulations focus on the gradual phasing out of high-risk feed additives and the tightening of veterinary prescription requirements.

Source: Compiled from various sources.

9. Limitations of the Study

This study has several limitations. First, the data used is limited to products registered in the IOHI, thus excluding products that may be circulating but are not yet registered. Second, this study has not analyzed the technical efficacy of the alternative products on livestock performance in vivo. The analysis is limited to the registration level, not the implementation and impact level. Third, the IOHI data does not include information on production volume, economic value, or market share of each product. Fourth, this study cannot establish a causal relationship between the policy and the increase in registrations. Although there is a temporal correlation, other factors such as economic conditions and market demand also play a role. Finally, the analysis has not considered the quality aspects of the products and the compliance of business actors.

IV. CONCLUSION

The AGP ban in Indonesia has catalyzed significant changes in the veterinary drug registration landscape, with Premix products increasing from 777 in 2015 to 1,472 in 2024 and Herbal products growing from 14 to 56 over the same period. The accelerated growth in Feed Supplements and Herbal products following the ban demonstrates the industry's capacity to adapt to regulatory changes and provide alternative solutions for livestock producers. These dynamics contribute to food security by supporting sustainable livestock production systems that are less reliant on antibiotics, aligning with the One Health framework. The findings underscore the importance of continued monitoring, regulatory oversight, and research to ensure the efficacy and safety of AGP alternatives and to maximize their contribution to food security and public health.

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