Animal Health Capacity Building in Papua New Guinea: A Comprehensive Approach to Strengthening Animal and Wildlife Health Systems Through Biosecurity, One Health, and Cross-Border Collaboration

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Abstract: Papua New Guinea (PNG) occupies a critical position in regional biosecurity as a biodiversity hotspot and geographical nexus between Southeast Asia, Australia, and the Pacific Islands, yet faces unprecedented challenges in animal and wildlife health management. This comprehensive review examines the interconnected challenges confronting PNG's animal health systems and their impacts on public health, economic stability, food security, cultural preservation, and regional biosecurity. Through systematic analysis of geographical vulnerabilities, infrastructural constraints, and systemic limitations, this review reveals critical gaps in PNG's capacity to manage emerging infectious diseases. The research identifies four strategic pillars for transformation:

1. Developing a sustainable veterinary workforce through innovative training and community-based networks,
2. Establishing robust disease surveillance systems integrating traditional knowledge with modern technologies,
3. Strengthening diagnostic capabilities through strategic partnerships and point-of-care solutions, and
4. Fostering cross-sectoral collaboration through One Health frameworks and transboundary partnerships.

Recent disease incursions, including Newcastle Disease (ND) and African Swine Fever (ASF) outbreaks, demonstrate PNG's vulnerability and the urgent need for enhanced preparedness. With only four qualified veterinarians serving over 9 million people and limited diagnostic capacity concentrated in Port Moresby, PNG's current animal health infrastructure is inadequate for addressing transboundary disease risks threatening national and regional security. The review emphasizes exceptional opportunities for PNG-Australia-Indonesia-Pacific Island Countries collaboration for mutual biosecurity enhancement, coordinated disease prevention, and knowledge exchange across shared ecological boundaries. By adopting integrated One Health approaches that honour indigenous knowledge systems, leverage digital technologies, and establish strategic multilateral partnerships, PNG can transform its animal health landscape from a regional vulnerability into a cornerstone of Pacific biosecurity. This framework addresses immediate capacity gaps while positioning PNG to manage climate-induced disease emergence, protect culturally significant species, ensure food security for rural communities, and contribute to global health security. The study provides a comprehensive roadmap for sustainable animal and wildlife health system development with significant implications for public health resilience, economic development, biodiversity conservation, and regional stability across the Asia-Pacific region.

Keywords: animal health systems, capacity building, One Health, biosecurity, wildlife disease surveillance, PNG-Australia collaboration, transboundary disease management, zoonotic diseases, Pacific Island partnerships.

1. INTRODUCTION

Papua New Guinea (PNG) occupies a strategically critical position at the intersection of Southeast Asia, Australia, and the Pacific Islands, serving as both a biodiversity hotspot containing approximately 7% of the world's species and a natural corridor for wildlife migration and human movement (Barrows et al. 2009; EU 2025). This unique geographical position, combined with the global reality that 75% of emerging infectious diseases originate from animal sources, positions PNG as a crucial frontline in protecting regional and global health security (FAO 2022; Nichol 2024). However, despite this critical role, PNG faces unprecedented challenges in animal and wildlife health management that threaten both national biosecurity and regional stability.

The COVID-19 pandemic and recent outbreaks of Newcastle Disease (ND), avian influenza and African Swine Fever (ASF) have demonstrated that animal health extends far beyond veterinary concerns to encompass national security, economic stability, and public health protection (PHARMAPlus 2021; NAQIA 2013; Jonduo et al. 2012). For PNG, these challenges are compounded by complex geographical and socioeconomic factors including rugged terrain, limited infrastructure, cultural diversity spanning over 800 languages, and significant resource constraints (FAO et al. 2022; MexicoHistorico.com 2025).

This comprehensive review examines PNG's animal and wildlife health systems through four critical dimensions: workforce development and capacity building; disease surveillance and early warning systems; diagnostic infrastructure and laboratory capacity; and cross-sectoral collaboration through One Health approaches. The analysis recognizes that these components must function as an integrated system to effectively protect human, animal, and environmental health. The significance of strengthening PNG's animal health systems extends beyond immediate health considerations to encompass food security for the 85% of the population engaged in subsistence agriculture, preservation of cultural practices where animals hold spiritual significance, and regional biosecurity for the broader Asia-Pacific region (Ayalew et al. 2011; Bourker et al. 2009). PNG's traditional ecological knowledge systems, developed over millennia, offer valuable insights that can enhance modern veterinary approaches when effectively integrated. Employing a One Health framework that recognizes the interconnections between human, animal, and environmental health, this review provides a strategic roadmap for transforming PNG's animal health systems from current vulnerabilities into robust, resilient frameworks (Destoumieux-Garzón et al. 2018; Rüegg et al. 2018). As PNG continues economic development and regional integration, combined with climate change altering disease patterns, strengthening these systems represents both a national imperative and a crucial contribution to Asia-Pacific regional stability and global health security.

2. LITERATURE SEARCH METHODOLOGY

A comprehensive literature search was conducted using primary databases including Google Scholar, PubMed, ScienceDirect, and Google searches. All sources were systematically organized using EndNote X9 reference management software.

The search strategy employed targeted keyword combinations: "Papua New Guinea animal health," "Wildlife health systems PNG," "Biosecurity Papua New Guinea," "One Health Pacific Islands," "Veterinary capacity building," "Zoonotic disease surveillance," and "Animal health infrastructure developing countries." Inclusion Criteria:

- Published 2000-2025
- Focus on animal or wildlife health in PNG
- English language
- Relevant to biosecurity, health systems, or veterinary infrastructure

The initial search identified 148 potential sources from peer-reviewed journals, government reports, conference proceedings, webpage, newspaper article, reports, academic thesis and unpublished papers. Following screening, total of 72 sources was cited. The search incorporated both academic literature and grey literature from organizations including the National Agriculture and Inspection Authority (NAQIA), World Health Organization (WHO), and Food and Agriculture Organization (FAO), World Organization for Animal Health (WOAH) and other concerned organizations and institutions. Personal experience through workshop attendance, consultative meetings, and discussions provided additional practical insights into animal and wildlife health challenges and

capacity-building opportunities in PNG.

3. CHALLENGES FOR ANIMAL-WILDLIFE HEALTH IMPROVEMENTS IN PNG

3.1 Geographical and Logistical Challenges for Capacity Building

PNG's strategic location creates a complex web of biosecurity vulnerabilities that extend far beyond traditional border control measures. The country's 700-kilometer porous land frontier with Indonesia's Papua provinces serves as a historically significant pathway for traditional movement that largely bypasses formal health screening protocols (Horwood et al. 2018). These informal border crossings, while culturally and economically important for local communities, create substantial challenges for monitoring and controlling potential disease introduction from regions with different disease profiles and varying levels of animal health surveillance.

The eastern maritime boundaries between Bougainville and the Solomon Islands, combined with the southern Torres Strait connections to Australia, establish PNG as a critical nexus in regional disease transmission pathways (Horwood et al. 2018). This geographical positioning, while advantageous for trade and cultural exchange, places PNG at the intersection of multiple migratory routes for both wildlife and disease vectors. The country's location along major bird migration corridors, combined with its role in regional trade networks, creates ideal conditions for the rapid spread of transboundary diseases such as highly pathogenic avian influenza, rabies, and emerging zoonotic pathogens (Jonduo et al. 2012).

These geographical challenges are compounded by PNG's internal topographical complexity, characterized by mountainous terrain, dense tropical forests, and extensive river systems that create natural barriers to surveillance and response efforts (Cleary et al. 2022). The resulting isolation of many rural communities' limits access to veterinary services, disease reporting mechanisms, and emergency response capabilities, creating pockets of vulnerability that could serve as undetected reservoirs for emerging diseases (Brioudes et al. 2014; Alamgir et al. 2019).

3.2 Critical Knowledge and Information Deficits

The foundation for effective animal health management requires robust, contemporary data on disease prevalence, risk factors, and system performance. PNG faces significant challenges in this regard, with much of the available information dating from historical studies conducted decades ago that no longer reflect current conditions, population dynamics, or emerging threats (Aurélie 2017; Brioudes et al. 2017). This knowledge vacuum persists despite PNG's historically favourable disease profile, where geographical isolation and limited livestock introductions have historically protected the country from many diseases common in tropical regions (Aurélie 2017; Ayalew et al. 2011).

The absence of systematic, contemporary data collection hampers evidence-based policy development, resource allocation decisions, and international collaboration efforts. Without reliable baseline data on animal populations, disease prevalence, and system capacity, it becomes impossible to measure progress, identify emerging trends, or demonstrate the impact of interventions to potential funding partners and collaborating institutions.

3.3 Severe Infrastructure and Human Resource Constraints

PNG's animal health infrastructure represents one of the most significant bottlenecks in system performance, with critical shortages across all essential components (Alamgir et al. 2019; Fabila-Kavana 2024). The country currently employs fewer than ten registered veterinarians to serve a population of over 9 million people and their livestock—a ratio that falls dramatically short of international standards and regional benchmarks (WOAH 2023). This workforce shortage is compounded by geographical distribution challenges, with most qualified personnel concentrated in urban centers while most livestock and wildlife interactions occur in remote rural areas.

Laboratory diagnostic capacity remains severely constrained and geographically concentrated, with the primary NAQIA facility in Port Moresby serving as the main diagnostic hub for the entire country (ACIAR 2020).

This centralization creates substantial delays in sample processing, limits surveillance coverage in remote areas, and constrains rapid response capabilities during disease outbreaks. The combination of limited personnel, inadequate infrastructure, and geographical barriers creates a perfect storm that hampers effective disease detection, diagnosis, and control across PNG's diverse landscapes (Brioudes et al. 2015).

3.4 Historical Patterns of Underinvestment and Policy Neglect

The current state of PNG's animal health systems reflects decades of systematic underinvestment and policy prioritization that favoured other sectors over agricultural and veterinary services. During the 1980s and 1990s, when many foundational investments in health infrastructure were made, animal health received significantly less attention compared to human health services, education systems, and extractive industries that promised immediate economic returns (Bourker et al. 2009).

This pattern of underinvestment has perpetuated into recent decades, with animal health services receiving approximately 2% of the national agricultural budget—a figure that reflects the low political priority assigned to veterinary services despite their critical importance for food security, public health, and economic stability (NAQIA 2023; Lin-stukey 2025). The lack of sustained investment has created a cycle where limited capacity constrains system performance, which in turn reduces political support for increased funding, perpetuating the resource constraints that limit system effectiveness.

3.5 Escalating Disease Risks and Public Health Implications

The convergence of global travel, climate change, and intensifying human-animal interactions has dramatically increased the risk profile for disease emergence and transmission in PNG. Recent outbreaks, including ND in poultry populations and the devastating ASF epidemic that has decimated highland pig populations, demonstrate PNG's acute vulnerability to transboundary diseases and the cascading impacts these outbreaks can have on rural communities (PHARMAPlus 2021; Raitano 2010; NAQIA 2013).

The public health implications extend far beyond immediate animal losses, encompassing food security threats for communities dependent on livestock for protein and income, economic disruption that can persist for years after outbreaks are controlled, and potential for zoonotic transmission that could affect human populations with limited access to healthcare services. With approximately 80% of PNG's population living in rural areas with frequent animal contact, the potential for zoonotic spillover events represents a constant and growing threat that current surveillance and response systems are inadequately equipped to address (Horwood et al. 2019; NRI 2019; The National 2019).

With approximately 75% of emerging infectious diseases in humans originating from animals, the interface between animal health and public health represents a critical vulnerability in global health security (Nichol 2024; Gummow 2010; Jones et al. 2008). This vulnerability is magnified in regions with close human-wildlife contact, limited surveillance capacity, and underdeveloped health infrastructure, characteristics that are particularly relevant to PNG's context (Mackenzie et al. 2019).

Recent zoonotic outbreaks have demonstrated the catastrophic global consequences of insufficient animal health monitoring and response systems, providing stark reminders of the interconnectedness of animal and human health. The COVID-19 pandemic, with its origins linked to wildlife, has resulted in millions of deaths and unprecedented economic disruption worldwide, highlighting the severe consequences of gaps in early detection and containment systems (De Sadeleer et al. 2020; Holmes et al. 2021).

Similarly, Nipah virus outbreaks in Southeast Asia, transmitted from fruit bats to humans often via intermediate pig hosts, have caused fatal encephalitis with case fatality rates of 40-75%, demonstrating the lethal potential of zoonotic pathogens (Gurley et al. 2017; ECDC 2025). Within PNG itself, endemic zoonoses including leptospirosis, brucellosis, and Q fever continue to affect rural communities with limited access to diagnostic and treatment facilities, creating ongoing public health challenges (WOAH 2020; NAQIA 2011).

4. BROADER IMPACTS AND REGIONAL IMPLICATIONS OF ANIMAL HEALTH CHALLENGES

4.1 Transboundary Biosecurity Vulnerabilities and Regional Disease Transmission

PNG's animal health challenges create vulnerabilities that extend far beyond national borders, particularly affecting neighbouring countries through shared ecological systems and migration pathways (CSIRO 2022; Post Courier 2024; WOAH 2019; World Bank 2022). The porous nature of PNG's borders with Indonesia and the natural wildlife corridors connecting PNG to Australia create pathways for disease transmission that cannot be effectively controlled through traditional border security measures alone (DAFF 2024; Horwood et al. 2018).

Recent disease incursions have demonstrated these vulnerabilities in stark terms. The ASF outbreak, which has devastated smallholder pig populations with mortality rates exceeding 90% in affected communities, poses direct threats to Australia's substantial pig industry valued at approximately AUD 5.3 billion annually (APL 2023; PHARMA Plus 2021; Puana 2021). Similarly, the Newcastle Disease outbreaks have highlighted the potential for rapid transmission of highly contagious diseases across regional poultry systems (Raitano 2010; NAQIA 2008).

These transboundary risks are amplified by climate change, which is altering vector distributions and creating new pathways for disease transmission. Rising temperatures are enabling disease vectors to survive in previously unsuitable habitats, while changing precipitation patterns affect wildlife behaviour and migration routes, potentially creating novel transmission opportunities that existing surveillance systems are not designed to detect or respond to effectively (Chen et al. 2024; Caminadeet al. 2019).

4.2 Economic Disruption and International Trade Consequences.

Animal disease outbreaks create immediate and long-term economic disruption that extends far beyond direct animal losses. For PNG, where agriculture sustains the livelihoods of over 85% of the population and contributes significantly to export earnings, disease outbreaks can have devastating economic consequences at both household and national levels (DAL 2020; Upton 2004).

The economic impacts manifest through multiple pathways: direct losses from animal mortality and reduced productivity, market access restrictions following disease notifications, substantial costs for disease control and eradication efforts, and ripple effects throughout related industries including feed suppliers, processors, and retailers. These immediate impacts are often compounded by long-term consequences, as international market access restrictions can persist well beyond successful disease control, creating prolonged economic disruption (Upton 2004; WTO 2022).

For rural communities, where livestock often serve as both income sources and savings mechanisms, disease outbreaks can create immediate poverty and food insecurity that persists long after animal. populations recover. The disproportionate impact on women, who often manage livestock and depend on animal sales for household expenses and educational costs, adds gender equity dimensions to the economic consequences of inadequate animal health systems.

4.3 Food Security and Nutritional Resilience Challenges

Animal diseases directly threaten food security by reducing the availability of animal-source foods that provide essential micronutrients often lacking in plant-based diets (FAO 2009). For PNG's rural communities, where livestock serve multiple functions beyond simple protein production, disease outbreaks create cascading effects across nutritional security, income stability, and social systems.

The nutritional impacts are particularly severe for vulnerable populations, including children and pregnant or lactating women who benefit significantly from animal-source proteins and micronutrients essential for proper development. Disease outbreaks also disrupt integrated farming systems where animals provide traction power and organic fertilizer for crop production, creating broader agricultural productivity impacts that affect overall food system resilience (Neumann et al. 2003; Paro et al. 2024).

Recent outbreaks have demonstrated these multifaceted impacts clearly (Puana 2021; NAQIA 2013;

PHARMA Plus 2021). The ASF epidemic has not only eliminated protein sources for affected communities but has also disrupted traditional social systems where pigs play central roles in ceremonial exchanges, conflict resolution, and community governance structures (Hide 2003; Bourker et al. 2009).

4.4 Environmental Conservation and Biodiversity Protections Challenges

PNG's exceptional biodiversity—hosting approximately 7% of global species diversity within its terrestrial and marine ecosystems—faces increasing threats from inadequate animal health systems that fail to address disease transmission between domestic animals and wildlife populations (EU 2025; UNDP 2017). Disease spillover events can threaten endangered species, disrupt critical ecosystem functions, and undermine conservation efforts that depend on healthy wildlife populations (Smith et al. 2009).

The limited understanding of wildlife disease ecology in PNG constrains the development of effective conservation strategies and hampers efforts to predict and prevent disease-related biodiversity losses. Inappropriate disease control measures, including indiscriminate wildlife culling or habitat destruction, can cause long-term ecological damage that undermines both conservation goals and ecosystem service provision (Gummow 2010).

The loss of ecosystem services due to disease-related wildlife population declines affects everything from pollination and seed dispersal to natural pest control and nutrient cycling, creating cascading effects that extend far beyond immediate conservation concerns to affect agricultural productivity and environmental resilience (Smith et al. 2009).

4.5 Cultural and Social Impacts

Animals hold profound cultural significance in PNG's diverse societies, serving functions that extend far beyond economic value to encompass spiritual beliefs, social status, traditional governance, and community identity. The loss of culturally significant animals due to disease outbreaks can disrupt social cohesion, traditional governance structures, and cultural practices that have sustained communities for generations (Upton 2004; Bourker at al. 2009).

In highland societies, pigs represent not merely livestock but embodiments of wealth, social status, and spiritual connection that plays central roles in traditional exchange systems, ceremonial practices, and conflict resolution mechanisms (Hide 2003; Ayalew et al. 2011; Robby et al. 2019). Wildlife species feature prominently in totemic relationships, traditional knowledge systems, and spiritual practices across PNG's diverse cultural landscape, forming integral components of indigenous worldviews and customary governance systems (Mack 2021).

The disruption of these cultural dimensions through disease outbreaks creates impacts that extend far beyond immediate economic losses to affect community identity, traditional authority structures, and intergenerational knowledge transmission systems that form the foundation of PNG's rich cultural heritage (Tideman and Gosler 2010).

4.6 Climate Change Amplification Effects

Climate change is systematically amplifying the challenges facing PNG's animal health systems through multiple interconnected pathways that create new vulnerabilities while exacerbating existing constraints. Shifting temperature and precipitation patterns are altering the geographic distribution of disease vectors, expanding their range into previously unsuitable habitats and extending transmission seasons for vector-borne diseases (Caminade et al. 2019; Thomas et al. 2017).

Extreme weather events place considerable stress on animal populations while creating environmental conditions that favour pathogen transmission and survival. These changing conditions facilitate the emergence of novel pathogens through increased wildlife-domestic animal interactions during resource scarcity, while enabling existing pathogens to adapt to new hosts as ecological niches shift (Chen et al. 2024).

For PNG, where climate vulnerability is exceptionally high due to geographical exposure and limited adaptation capacity, these climate-animal health interactions present additional challenges for sustainable

livestock production and wildlife conservation. Rising sea levels threaten coastal livestock systems, while changing rainfall patterns disrupt traditional seasonal grazing and breeding cycles that have sustained PNG's pastoral communities for generations (Chen et al. 2024; UNDP 2017; Thomas et al. 2017).

5. OPPORTUNITIES FOR ANIMAL-WILDLIFE HEALTH IMPROVEMENTS AND CAPACITY BUILDING.

5.1 Innovate Workforce Development and Training Solutions

Addressing PNG's critical shortage of animal health professionals requires innovative, multi-tiered approaches that combine immediate capacity building with long-term sustainable workforce development. The current workforce of four qualified veterinarians and eleven animal health officers is fundamentally inadequate for PNG's needs, but creative solutions can rapidly expand effective coverage while building toward sustainable long-term capacity (NAQIA 2011; WOAH 2023; Reid et al. 2010).

Community-Based Paraprofessional Networks: Developing networks of trained community animal health workers can extend basic veterinary services to remote areas while creating pathways for career advancement in animal health fields. These networks leverage existing community structures and traditional knowledge systems while providing formal training in disease recognition, basic treatment protocols, and reporting mechanisms (Riviere-Cinnamond et al. 2003).

Academic Program Integration: The PNG University of Natural Resources and Environment's institutionalization of a Paraveterinary Program represents a significant step toward systematic workforce development (PNGUNRE 2020; PNGUNRE 2023). Expanding this model to other educational institutions and integrating animal health components into existing agricultural and health programs can create multiple pathways for workforce entry and development.

Digital Learning Platforms: Leveraging PNG's expanding mobile network coverage (approximately 47% of the population) to deliver distance learning programs, diagnostic support, and continuing education can overcome geographical barriers while providing ongoing professional development for distributed workforce members (Kemp 2025).

Regional Exchange Programs: Establishing formal exchange programs with Australia, Indonesia, and other Pacific Island countries can provide advanced training opportunities while building networks for ongoing collaboration and knowledge sharing (NAQIA 2008; NAQIA 2023; Bessler et al. 2024).

5.2 Technology-Enhanced Surveillance and Early Warning Systems

Modern surveillance approaches can overcome PNG's geographical and resource constraints through innovative integration of traditional knowledge systems with digital technologies and community-based reporting networks (WHO 2024; Woods et al. 2019).

Participatory Digital Surveillance: Expanding the existing ACIAR-developed syndromic reporting template through mobile phone applications and SMS-based systems can enable real-time reporting from remote communities while providing immediate feedback and guidance to reporters (ACIAR2021).

Integrated One Health Surveillance: Developing surveillance systems that simultaneously monitor human, animal, and environmental health indicators can maximize resource efficiency while providing comprehensive early warning capabilities for emerging threats (Benedetti et al. 2024).

Community Sentinel Networks: Training teachers, church leaders, and community health workers as disease sentinels can create extensive coverage networks that leverage existing community structures

while providing sustainable surveillance capacity.

Regional Data Sharing Platforms: Establishing secure, real-time data sharing platforms with neighbouring countries can enable coordinated responses to transboundary threats while providing mutual early warning capabilities for emerging diseases (ACDC 2024).

5.3 Strategic Diagnostic Capacity Enhancement

Maximizing PNG's limited diagnostic capacity requires strategic approaches that combine infrastructure development with innovative service delivery models and regional partnerships.

Point-of-Care Diagnostic Networks: Implementing field-deployable diagnostic technologies can extend testing capabilities to remote areas while reducing dependence on centralized laboratory facilities. Solar-powered diagnostic units with satellite connectivity can overcome infrastructure limitations in rural areas.

Laboratory Network Optimization: Creating formal networks among existing facilities (NAQIA, PNGIMR, university laboratories) with standardized protocols and shared resources can maximize collective capacity while ensuring quality standards and efficient resource utilization. Regional Reference Laboratory Partnerships: Establishing formal agreements with advanced laboratories in Australia and other regional countries can provide backup diagnostic support for complex cases while facilitating knowledge transfer and capacity building.

Mobile Diagnostic Services: Developing mobile diagnostic units that can provide periodic coverage to remote areas can extend services while building local capacity through training and technology transfer.

5.4 Cross-Sectoral One Health Integration

Implementing integrated One Health approaches can maximize limited resources while addressing the interconnected nature of human, animal, and environmental health challenges in PNG.

Institutional Coordination Mechanisms: Establishing formal One Health coordination platforms that bring together veterinary services, public health agencies, environmental management organizations, and traditional governance structures can create synergies that enhance collective capacity while respecting cultural protocols.

Integrated Training Programs: Developing training programs that address human, animal, and environmental health as interconnected systems can create workforce members capable of addressing complex challenges while maximizing training resource efficiency.

Community-Based One Health Networks: Training community members to recognize and respond to health threats across the human-animal-environment interface can create comprehensive coverage while leveraging traditional ecological knowledge and community governance systems.

Research and Innovation Hubs: Establishing collaborative research programs that address One Health challenges can generate locally relevant knowledge while building institutional capacity and international partnerships.

6. CONCLUSION

The journey towards robust animal and wildlife health systems in PNG represents a complex yet crucial endeavour with profound implications for national and regional well-being. This comprehensive analysis has illuminated the

intricate challenges facing PNG's animal health landscape, revealing not just obstacles but also extraordinary opportunities for transformative change.

The convergence of geographical vulnerabilities, limited infrastructural capacities, and emerging global health dynamics demands a holistic, strategic approach to animal health management. PNG's unique position at the intersection of diverse ecological systems and cultural contexts provides both a challenge and a unique opportunity for innovative health system development.

The proposed strategies – ranging from workforce development and enhanced surveillance to cross-sectoral collaboration and indigenous knowledge integration – offer a comprehensive roadmap for systemic transformation. By embracing the One Health approach, PNG can develop a resilient, adaptive animal health system that not only addresses immediate challenges but also anticipates and mitigates future risks.

7. ENHANCED RECOMMENDATIONS FOR STRATEGIC IMPLEMENTATION

Based on this comprehensive analysis, the following strategic recommendations provide a roadmap for transforming PNG's animal and wildlife health systems:

7.1 Immediate Priority Actions (0-2 Years)

Establish a National Animal Health Workforce Development Initiative: Create a comprehensive strategy combining emergency short-term training programs for immediate capacity building, integration of veterinary content into existing educational curricula at universities and technical colleges, establishment of community-based paraprofessional networks leveraging traditional governance structures, and development of digital learning platforms utilizing PNG's expanding mobile network coverage.

Implement Technology-Enhanced Surveillance Systems: Expand the existing ACIAR syndromic reporting template through mobile applications and SMS-based systems, establish community sentinel networks utilizing teachers, church leaders, and community health workers, create integrated One Health surveillance platforms monitoring human-animal-environment interfaces simultaneously, and develop real-time data sharing mechanisms with neighbouring countries for coordinated early warning.

Optimize Existing Diagnostic Infrastructure: Formalize collaborative networks among NAQIA, PNGIMR, and university laboratories with standardized protocols and shared resources, establish formal agreements with regional reference laboratories in Australia and Pacific countries for emergency diagnostic support, implement point-of-care diagnostic technologies for remote area deployment, and develop mobile diagnostic services providing periodic coverage to underserved regions. 499

7.2 Medium-Term Transformational Goals (2-5 Years)

Create a Regional Pacific Animal Health Partnership: Establish a formal multilateral collaboration framework between PNG, Australia, Indonesia, and Pacific Island countries focused on capacity building, knowledge exchange, coordinated disease surveillance, and emergency response coordination, with shared funding mechanisms and standardized protocols for transboundary disease management.

Develop Indigenous Knowledge Integration Programs: Create systematic approaches for incorporating traditional ecological knowledge into modern animal health systems, establish community-based surveillance networks that respect cultural protocols while enhancing disease detection capabilities, and develop culturally appropriate health interventions that honour traditional values while addressing contemporary challenges.

Establish National One Health Coordination Mechanisms: Create formal institutional platforms

bringing together veterinary services, public health agencies, environmental management organizations, and traditional governance structures, implement integrated training programs addressing human-animal-environment health interconnections, and develop community-based One Health networks capable of addressing complex challenges across sectors.

7.3 Long-Term Sustainable Development (5-10 Years)

Establish PNG Veterinary College: Create domestic veterinary education capacity through partnership with regional universities, develop specialized programs addressing PNG's unique geographical and cultural context, establish research programs generating locally relevant knowledge, and create pathways for advanced specialization in wildlife health, zoonotic diseases, and tropical veterinary medicine.

Build Comprehensive Diagnostic Networks: Develop distributed laboratory capacity with regional hubs providing specialized services, establish biosafety level 3 facilities for high-risk pathogen research, create next-generation sequencing capabilities for pathogen characterization, and implement quality assurance programs meeting international standards.

Create Innovation and Research Hubs: Establish collaborative research programs addressing One Health challenges specific to PNG and the Pacific region, develop technology solutions appropriate for resource-limited tropical settings, create knowledge transfer mechanisms facilitating rapid adoption of innovations, and build international partnerships supporting long-term capacity development.

Implement Comprehensive Policy Frameworks: Develop national animal health legislation meeting international standards while respecting traditional governance systems, establish sustainable financing mechanisms reducing dependence on external funding, create regulatory frameworks supporting private sector engagement while maintaining public sector oversight, and implement performance monitoring systems enabling evidence-based policy adaptation.

These enhanced recommendations provide a comprehensive framework for transforming PNG's animal and wildlife health systems from current vulnerabilities into robust, resilient capabilities that can protect national interests while contributing to regional and global health security. Success will require sustained commitment, innovative approaches, and collaborative partnerships, but the potential benefits—for PNG, the Pacific region, and global health security—justify the investment and effort required for this critical transformation.

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