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Intersectoral collaboration shaping One Health in the policy agenda: A comparative analysis of Ghana and India

Ana Maria Perez Arredondo [a,b,c,1,*], Sandul Yasobant [a,d,1], Walter Bruchhausen [a,d], Katja Bender [c], Timo Falkenberg [a,e]

[a] Center for Development Research (ZEF), University of Bonn, Germany
[b] Faculty of Agriculture, University of Bonn, Germany
[c] International Centre for Sustainable Development (IZNE) of the University of Applied Science Bonn Rhein-Sieg (HBRS), Germany
[d] Global Health, Institute for Hygiene and Public Health, University Hospital Bonn, Germany
[e] GeoHealth Centre, Institute for Hygiene and Public Health, University Hospital Bonn, Germany

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ABSTRACT

Intersectoral collaborations are an integral component of the prevention and control of diseases in a complex health system. On the one hand, One Health (OH) is promoting the establishment of intersectoral collaborations for prevention at the human-animal-environment interface. On the other hand, operationalising OH can only be realized through intersectoral collaborations.

This work contributes to broadening the knowledge of the process for operationalising OH by analysing the governance structures behind different initiatives that tackle health problems at the human-animal-environment interface. The cases taken as examples for the analysis are the control and response to rabies and avian influenza under "classical OH", and the management of floods and droughts for insights into "extended OH". Data from Ghana and India were collected and compared to identify the key elements that enable ISC for OH.

Despite the case studies being heterogeneous in terms of their geographic, economic, social, cultural, and historical contexts, strong similarities were identified on how intersectoral collaborations in OH were initiated, managed, and taken to scale.

The actions documented for rabies prevention and control were historically based on one sector being the leader and implementer of activities, while avian influenza management relied more on intersectoral collaborations with clearly defined sectoral responsibilities. The management of the impact of flood and droughts on health provided a good example of intersectoral collaborations achieved by sectoral integration; however, the human health component was only involved in the response stage in the case of Ghana, while for India, there were broader schemes of intersectoral collaborations for prevention, adaptation, and response concerning climate change and disaster.

1. Introduction

Multiple sectors working together is a powerful strategy for optimising health for all, otherwise impossible when independent entities work alone [1]. With increasing dependency on the physical and socio-political environments and the recognition that issues like sustainable development, food security, and public health cannot be addressed by sectoral initiatives alone, new integrated approaches have emerged, such as One Health (OH) that promotes collaborations to attain optimal health for humans, animals, and the environment [2].

The interdependency between human health, animal health, and the environment is ancient knowledge [3]. It can be found in Vedic writings in a rather mythological language (late 2nd millennium BCE) [4], or early medical treatises such as "On Airs, Waters and Places" by Hippocrates (460 BCE–367 BCE) [5]. Particular interest in zoonotic diseases and veterinary medicine concerning human health is a product of the enlightenment period, as with Lancisi (1654–1720) in the management of rinderpest, or Bourgelat (1712–1779) in the institutionalization of

* Corresponding author at: Center for Development Research (ZEF), Genscherallee 3, 53113 Bonn, Germany.
E-mail addresses: ana.perez@uni-bonn.de (A.M. Perez Arredondo), yasobant@uni-bonn.de (S. Yasobant), walter.bruchhausen@ukbonn.de (W. Bruchhausen), katja.bender@h-brs.de (K. Bender), falkenberg@uni-bonn.de (T. Falkenberg).
[1] Joint first author: AA & SY.

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animal health studies about human health [6]. In the development of modern medicine, systematic studies of relations between human and animal health were conducted by Rudolf Virchow (1821–1902) in the understanding of zoonotic diseases [7,8], and William Osler (1849–1919) in the development of comparative medicine.

Today's dominating notion of OH as a borderland between human and animal health domains is referred to as 'classical OH' in this work. It was pioneered by the holistic perspectives of veterinarians as James Steele (1913–2013) [9] and Calvin Schwabe (1927–2006) [6,10]. Moreover, the combination of OH with approaches such as eco-health (i.e., relationships between health, ecosystems, and sustainable development) [11] or planetary health (i.e., the health of human civilization and the state of the natural systems on which it depends) and complex-system thinking [12], lead to what will be called 'extended OH' here.

The diversity of OH actions are grounded on different levels of collaborations towards a common goal, considered as intersectoral collaborations (ISC) [13,14], which can go from communication, cooperation, coordination, collaboration, to coadunation, a continuum that describes from low to high the integration of actions [1,15–17].

As the global movement for operationalising OH is being carried out, i.e., making the OH concept understandable and measurable, empirical evidence reflecting the state of ISC for health is needed for designing and implementing action programs. Existing works have focused in analysing the OH narratives for policy and research see [18,19] or in identifying the OH collaboration strategies see [20,21], but less has been done for the analysis and comparison of OH governance structures. This work contributes to broadening the knowledge of the process for operationalising OH by analysing the governance structures behind different initiatives that tackle health problems at the human-animal-environment interface. The cases taken as examples for the analysis are the control and response to rabies and avian influenza under "classical OH", and the management of floods and droughts for insights into "extended OH". Data from Ghana and India were collected and compared to identify the key elements that enable ISC for OH. The two countries have been previously compared in the literature for their health system performance by the World Health Organization (WHO) [22] and were purposefully selected as they offer an opportunity for contrasting similar socioeconomic indicators, with differences in socio-cultural conditions, population size and approaches to manage health governance, thus creating a scenario useful for extracting lessons of the different approaches to public health and ISC collaborations in the two nations.

2. Methods and data

2.1. Policy analysis frameworks

Policy analysis instruments for research and practice have long been implemented to study the institutional settings and decision-making resulting from the formulation and implementation of reforms. Furthermore, as the main objective of this work is to provide insights into OH operationalising through an analysis of initiatives at the human-animal-environment nexus, the frameworks proposed by Walt and Gilson [23] and by Ostrom [24] are used for data analysis and for extracting valuable information on (i) the existing ISC for the selected cases; (ii) the policy documents relevant for ISC for OH; and (iii) the institutions and individuals involved in ISC.

2.2. Selected countries and study cases

Ghana, located in West Africa, is home to about 30 million people [25], whereas India, a South-Asian nation, has a population of 45 times larger than Ghana, with around 1.4 billion inhabitants [26]. In terms of government, India obtained its independence in 1947 and Ghana in 1957. Both countries operate within the framework of a constitution and are democratic. Both countries are classified as Lower and Middle-Income Countries, their GDP per capita is within the range of 2100 to 2200 USD, both have a similar Human Development Index (Ghana: 0.61 & India: 0.64), and the health expenditure as a percentage of the GDP was. 3.54% for both countries in 2018. Health is a matter of nation in Ghana, whereas a state subject in India [27,28].

For both countries, the cases of impact and responses regarding rabies, highly pathogenic avian influenza H5N1 (AI), and the effects of flood and drought were clustered to represent the classical and the extended OH approach respectively. Rabies and AI contribute significantly to the global burden of disease in mortality, morbidity, and economic loss. Despite global attempts to implement extensive rabies control schemes and public health awareness programs, over 95% of mortality happens in Asia and Africa, where canine rabies is enzootic [29]. Moreover, AI is also prominent in Asia and Africa, with a history of several outbreaks among domestic and wild birds [30]. The onset of the global epidemic of AI became one among other successful cases of ISC for OH in most parts of the globe [31,32]. Furthermore, floods and droughts affect human health directly through injuries, hypothermia, hyperthermia, drowning, snake bites, and indirectly through contamination of water, destruction of infrastructure, social disruption and population dislocation with crowding and poor living conditions favouring air-borne infectious diseases, mostly respiratory illness, faecal-oral transmission of gastro-intestinal pathogens causing water and food-borne illnesses, other infectious diseases (e.g., leptospirosis, vector-borne disease), and also mental illnesses [33,34]. The literature suggests that Asia has the largest number of people exposed to disasters [35], but African countries are the most vulnerable to them [36].

2.3. Data gathering and extraction

Data was obtained through a scoping review (i.e., a systematic process for gathering the limited evidence related to an emerging topic, for which the requirements of a systematic review cannot be fulfilled) as described by Munn et al. [37], and Arksey and O'Malley [38].

For the review, various registers were used for identifying ISC, policy documents and action plans, and the actors involved. To gather relevant information, the websites of the ministries of health, food, and agriculture, and the environment with their respective agencies and programs were searched in depth from February 2020 to April 2020. To validate and extend the information found on the internet sites of the ministries and agencies, libraries from the United Nations organizations and other relevant donors and voluntary organizations were screened. A snowball process using the links provided on the pages of the national ministries was used for the identification of relevant libraries. To include all possible pieces of information, the exclusion and inclusion criteria for the identification of information were kept flexible and without any date restrictions. Only information available in the public domain and published in English were included in the review. The key terms were deliberately kept dynamic to gather maximum information. Data were extracted into an excel sheet before the analysis.

There were several limitations to the scoping review. First, the actors enlisted in the classical and extended OH approach may not represent all involved actors, as the publicly available policy documents may not enlist all involved parties. Secondly, information was incomplete regarding the depth of involvement and level of integration of ISC. Lastly, the extraction of information was subject to interpretation biases.

3. Overview of intersectoral collaborations under the one health approach

3.1. Rabies

Rabies in Ghana is endemic and was been identified as a neglected disease that posed a threat to public health due to many factors, including the large dog population, the weak surveillance system, and limited laboratory and vaccines supply [39–44]. Before 1998, the

Government of Ghana conducted an annual national vaccination campaign led by the Veterinary Services Directorate and funded by the Ministry of Food and Agriculture. After the vaccination campaigns stopped, localized and non-regular vaccination campaigns were organized jointly by different non-governmental organizations, international donors and District Veterinary Officers (see appendix A Table 1).

In 2015, the WHO, the Food and Agriculture Organization of the United Nations (FAO), the World Organization for Animal Health (OIE), and the Global Alliance for Rabies Control (GARC) launched a global strategic plan to end human deaths from dog-mediated rabies by 2030. As part of the GARC, Ghana implemented a tool for monitoring and evaluating the advances in reducing rabies called the Stepwise Approach towards Rabies Elimination (SARE). Although the legislation mentioned compulsory rabies vaccinations of dogs, those were not enforced. There was no national coordination for the vaccination campaigns, but the activities of SARE and other non-government organizations managed to bring the control of rabies back to the attention of policymakers in the public health domain. At the end of 2017, a One Health Technical Working Group (OHTWG) was created to develop a national OH policy and promote ISCs for the prevention and control of zoonotic diseases, including rabies.

In India, dog bites were a reportable case under the presumptive section of the Integrated Disease Surveillance Program [45]. However, the data on human rabies was irregular, inconsistent, and mostly incomplete. Major challenges for rabies control were inadequate post-exposure prophylaxis and service delivery at the anti-rabies clinics, lack of awareness at the community level, and inadequate training and knowledge of post-exposure prophylaxis among health care providers [46–49]. Notwithstanding, the National Rabies Control Programme (NRCP) made efforts to strengthen the surveillance of dog bites and human rabies. There were two types of progress documented in India, (i) in the human health sector, education and awareness programs for healthcare professionals, and communities were implemented, and (ii) in the animal health sector, the Animal Birth Control (ABC) was ordered by the Honourable Supreme Court for implementation in all states of India [50,51]. The ABC program effectively reduced the street dog population and rabies incidence in specific regions of the country, whereas it failed in some other parts [52–54].

As for the actors and institutions involved, the Indian Union Ministries of Health and Agriculture and the State Animal Husbandry Departments worked together towards rabies elimination. Moreover, there were multiple bilateral, international, and national non-government organizations working in India for rabies control (see annex Table 1), but the political commitment needed to be enhanced.

In the absence of a national OH task force in India, ISC was created through the State Level Zoonosis Committees [55], and the corresponding responsibilities shared between the District Level Zoonosis Committee and actors from the human and animal health sectors, as well as other sectors such as police department, real estate, forest department, etc. Two States in particular (i.e., Tamil Nadu, and Sikkim) implemented OH strategies for rabies prevention and control [56–58].

3.2. Avian influenza

The first recorded outbreak of a highly pathogenic avian influenza (AI) in Ghana was in 2007 (H5N1 subtype) [59,60]. The Veterinary Services Directorate provided the main framework for surveillance in commercial, and family poultry systems, as well as wild birds throughout the country. Other surveillance systems were complemented at international border entry points [61]. During the 2007 AI outbreak, biosecurity procedures and guidelines were established, and their adoption was enforced by several poultry farmers' associations. After the 2007 outbreak, a National Technical Coordination Committee on Avian Flu Preparedness was created as part of the Department of Pest and Insect Infestations of National Disaster Management Organization with financial and technical support from international donors. Documents assessing the number of stakeholders involved in surveillance and control report around 65 stakeholders, including producers, traders, input suppliers, government agencies, local level individuals and international organizations [62] (see appendix A Table 1). Challenges for disease control were related to the ambiguous role of animal health technicians for reporting, the centralized surveillance systems, the reluctance of traders and farmers for disclosing information, limited technical infrastructure for culling and disposal of birds, the low investment levels in the poultry sector, and several cultural aspects. The OHTWG also promote ISCs for the prevention and control of AI.

In India, the first AI outbreak was notified on 18th February 2006 [63]. Surveillance of the disease and monitoring of preparedness for prevention and control of AI was constantly emphasized with state governments. Under the Surveillance Plan, general surveillance in the absence of an AI outbreak included passive surveillance. There was a national guideline of the action plan on "Preparedness, Control and Containment of Avian Influenza" [63] that advised the states on preparedness against AI outbreaks, indicating the actions to follow in case of a suspected outbreak, during a confirmed outbreak, and identified individuals to handle infected poultry, and advised on biosafety and biosecurity measures (see annex Table 2).

3.3. Flood and drought

The prevention, adaptation, and response to natural disasters, such as floods and drought, is a good example of ISC to tackle indirect and direct causes of animal and human morbidity and mortality through environmental action. Flood and drought have been addressed by the areas of disaster management, climate change, and initiatives such as eco-health and planetary health [64–66]. Therefore, most of the reviewed documents addressed the broader scale of disaster prevention and management. The interest in considering the management of floods and drought as part of the 'extended OH' lies in the fact that floods and drought have consequences for the health of humans, animals, and the environment while requiring multiple professionals to address these effects.

In both countries, changing precipitation patterns, as well as other climatological, hydrological, and human-related factors (e.g. damming, dumping refuse in watercourses, encroaching into wild habitats, unplanned urban developments) have caused floods and droughts, affecting lives, livelihoods, and physical and institutional infrastructures [67,68]. Indirectly, the effects of floods can increase the incidence of infectious diseases, such as water-borne (e.g. typhoid fever, cholera, leptospirosis, and hepatitis A and E) and vector-borne (e.g. malaria, dengue, and West Nile Fever). Similarly, droughts can also increase the transmission of water-borne diseases (e.g. *E. coli* and cholera), vector-borne diseases (e.g. malaria, dengue, and West Nile Virus), and air-borne diseases (e.g. coccidioidomycosis) [69].

For both countries, vector-borne diseases increased in the mid-term, mediated by precipitation, temperature, and humidity changes. An important number of critical economic sectors of Ghana and India (i.e. water resources, fisheries, agriculture, forestry, and energy) were found drought and flood-sensitive, affecting livelihoods in general [67,70,71]. Beyond human health, also soil health, plant health, and animal biodiversity were at stake, highlighting the relevance of ISC under an extended OH approach to reduce the effects of flood and drought.

Nearly 35 international and regional frameworks influenced the development mechanisms towards climate action and disaster risk reduction in Ghana. At the national level, the Government of Ghana adopted a National Climate Change Adaptation Strategy, which was followed in 2014 by the National Climate Change Policy (see appendix A Tables 3 and 4). Continuous campaigns on disaster prevention and management included education and awareness campaigns organized by local and district authorities [72]. The lead agency for disaster response in Ghana was the National Disaster Management Organization, operating under the Ministry of Interior and established by Act 517 of

1996 to manage disasters and similar emergencies in the country [73].

In India, the geo-climatic conditions and its high degree of socio-economic vulnerability make it one of the most disaster-prone countries in the world [74]. The National Institute of Disaster Management, under the Ministry of Home Affairs, and the National Disaster Management Authority were the responsible authorities for disaster control in India [75]. In addition to it, there were multiple sectors involved in assisting the preparedness and control mechanisms (see appendix A Tables 3 and 4). In 2009, the National Policy on Disaster Management (NPDM) was implemented with the vision to build a safe and disaster resilient India by developing a holistic, proactive, multi-disaster oriented and technology driven strategy through a culture of prevention, mitigation, preparedness and response. The NPDM provided for an integration approach for management with emphasis on building strategic partnerships at various levels.

4. Discussion: the dynamics of intersectoral collaborations

4.1. The classical OH approach. Rabies

Considering the surveillance and reporting system, Ghana had parallel surveillance systems from the Ghana Health Service (GHS) and the Veterinary Units. In India, surveillance and reporting were covered under the presumptive section of the Integrated Disease Surveillance Programme. Information extracted from the review indicated that the major challenges of rabies prevention were limitations in information exchange, training of healthcare providers, surveillance capacities, laboratory capacities, vaccine supply, and some obstructive socio-cultural practices.

Ghana and India have strategically planned for the vision of achieving a dog-mediated human-rabies-free nation by 2030. Both countries have action plans for rabies control that engage relevant stakeholders from the human and animal health sectors. One of the major contrasts between the countries was found in the organization of dog vaccination campaigns. Ghana went from having national vaccination campaigns before 1997 to having to rely on more localized interventions dependent on local government and voluntary associations for financial and technical support after 1998 [39,43,44]. In India, the opposite was true, as local control programs were organized before implementing the NRCP and the ABC [76].

Changes in policy and the creation of action plans for rabies control made ISC collaboration activities possible. Strategies at the national level for both countries included improved vaccination coverage, training for healthcare service providers, awareness campaigns, adoption of international frameworks to eradicate rabies by 2030, and collaboration between the implementation agencies of the ministries of health, agriculture, local governments, and international organizations such as WHO, OIE, and FAO [51,77–81].

As for operationalising OH, initiatives were introduced in both countries. Rabies control mechanisms have evolved in Ghana and India through multiple actors at different levels of action. In both countries, international and bilateral agencies for rabies control were active. However, Ghana's control mechanisms were mostly influenced by international donors and voluntary organizations, whereas most of the initiatives were from national agencies in India. Rabies control has followed a long transition from sectoral work to collaborations between human and animal sectors, but challenges in information exchange, training, dog population control, and the distribution of sectoral responsibilities make rabies eradication a complex task.

4.2. The classical OH approach: Avian influenza

The surveillance programs for AI compared to rabies were more structured, with specific guidelines and protocols. Both passive (clinical) and active (serological samples) surveillance have been routinely conducted over time in both countries. Considering prevention measures for AI, raising awareness of hygienic issues and the culling of infected birds was practised in both countries.

The case of AI was different from rabies because it is a relatively newly emerged disease, first registered as highly pathogenic in 2006, and regarded as an emergency that called for global action [82,83]. The country-level strategies included collaborations between agencies of the ministries of health, agriculture, environmental protection agencies, border control services, and the police to implement a set of biosecurity measures [31]. These strategies were led by the disaster management administrations of each country through national committees on AI.

The actions taken during outbreaks included notification of outbreaks to OIE, demarcation of culling and surveillance areas, culling of birds in the outbreak areas, an absolute ban on movement of poultry and products from the culling and surveillance zones, disposal of dead birds, instant compensation for culling, clean-up and disinfection, and post-operation surveillance [63,84]. After the outbreaks in 2006, active surveillance systems were implemented in wild birds, domestic poultry, and the human population throughout both countries [63,82,85–88].

The actions to control the AI outbreaks in 2007 and the subsequent outbreaks brought major investments from international agencies and donors to bio-security training. Those investments and the capacities for coordinated response and control of health emergencies set the foundation for the OHTWG in Ghana, and the Surveillance Committees and Rapid Response Teams at the state and district level in India, comprising experts from health, animal husbandry, and other sectors for regular outbreak surveillance (i.e. early warning system) [82].

Actors involved in AI control were wider and more diverse. Moreover, the actors' engagement was similar in both countries for AI, as this was influenced by international agencies like the WHO-OIE-FAO coalition after the global AI outbreak (post-2005). AI monitoring and control strategies are standard operations agreed by international organizations, and the disaster management authorities are the implementers, making ISC possible to a greater extent.

4.3. The extended OH approach: flood and drought

The effects of flood and drought successfully illustrated ISC for prevention, adaptation, response, and resilience. Despite the involvement of many ministries, the contribution of the health sector was limited to disease control.

In both Ghana and India, major policy changes were related to environmental protection and climate action influenced by international frameworks and conventions. The national disaster administrations created strategies to cover preparedness, monitoring, enforcement, and response to adapt to and mitigate the effects of climate change at different levels and in different sectors.

The ministries' implementing agencies responsible for the environment, and the ministries for internal or national affairs of each country, worked together with other agencies, international partners, and donors. The disaster management agencies had representatives at the national, regional, and district levels in charge of registering the damages, appeal to the central government and international organizations for assistance, and deliver relief items [72,73,89].

For both countries, national bodies worked together with other government agencies, international partners, and donors to set up monitoring and early warning systems to aid the identification of disasters in their formative stages and to provide information to the existing disease surveillance programs.

5. Conclusion and recommendations

Despite the data limitations, and the case studies being heterogeneous, strong similarities were identified in how ISC for OH were initiated, managed, and taken to scale.

The prime learning from this analysis is that within the classical OH approach, the actions documented for rabies prevention and control

were historically based on one sector being the leader and implementer of activities while receiving support from a broad range of other actors with unclear responsibilities. More recently, the collaboration of multiple sectors has been possible due to the creation of action plans for rabies control, but challenges for the coordination of such plans remain. AI management, influenced by international action for control and the involvement of OIE, FAO, and WHO relied more on ISC with clearly defined sectoral responsibilities, having small and decentralized groups of organizations coordinating the efforts of the support actors to prevent and control AI outbreaks. Particularly for the case of AI, ISC can contribute to the global movement for 'Health in All Policies (HiAP)' that emphasizes health across different sectors to improve population health. However, the OH approach is being implemented by centralized, coordinated efforts through the regional OH coordination committees in Ghana and India.

The management of the impact of floods and droughts on health under the extended OH provided a good example of ISC achieved by sectoral integration, in which different actors pursue together the goal of disaster prevention and adaptation by implementing joint actions. It was difficult to deduce the transition process of these ISC, because the guidelines and policy documents reported the relationship, roles, and responsibilities of each of the sectoral actors differently. As for the impacts on health by floods and droughts, the human health component was only involved in the response stage in the case of Ghana. In the case of India, there were broader schemes of including the human health sector in ISC for prevention, adaptation, and response concerning climate change and disaster. This could be a potential learning point for Ghana from the Indian experiences on ISC.

Many overlaps were found between the extended OH as defined here, and the primary concerns of other approaches, such as eco-health and planetary health, highlighting the importance of ISC even between different approaches, to gain insights into the ecologies of disease and their according control.

As both countries have taken important first steps in implementing OH, it is crucial to bring OH actions to life by engaging the different sectors through joint problem formulation and emphasising how these problems affect the individual sectors. From the study, the conditions that support effective ISC were (i) a concrete problem that multiple sectors have a clear stake in, (ii) national or international frameworks guiding actions, (iii) a coordinating and implementation authority that has an overview of multiple sectors, (iv) financial resources (i.e. donor support or clear economic incentives), and (v) strong political will.

Future ISC for OH should emphasize the coadunation and the system integration strategies with support from multiple sectoral actors, which will assure the holistic view to address complex issues at the human-animal-environment interface, and will make OH initiatives to be sustained over time, and not only for responding to health emergencies. Based on the current synthesis, we recommend future research and action to address ISC after achieving a common understanding of the following aspects:

- WHAT: What are the ways in which OH is being institutionalized?
- WHO: Who are the actors conducting the activity with their roles and responsibilities?
- WHY: Why is OH needed?
- HOW: How will this relationship be sustained over time?
- WHEN: When is there a need for action and with whom?

Only if such a highly differentiated analysis of resources and needs for relevant ISC for OH is performed, for which our study gave some examples from different health issues and geographic locations, it can be hoped that OH is transformed from lip service in many official documents and international programmes to a powerful tool for improving health.

Authors' contributions

All authors contributed equally to the development of this study. AA & SY participated in the conception and design of the protocol. AA & SY conducted the scoping review of policies, guidelines, frameworks, and extracted the necessary data for analysis. AA & SY drafted the first draft of the paper. WB, KB, and TF advised during the conception and development of the study and critically reviewed the paper. All authors read and approved the final manuscript.

Disclosure statement

The authors declare that they have no competing interests.

Ethics approval and consent to participate

Not applicable.

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Availability of data and materials

All relevant data that support the findings of this study are within the manuscript.

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Appendix A

Table 1
Summary of actors engaged in the prevention and control of rabies and avian influenza (classical OH approach) in Ghana and India.

	Levels of action	Rabies	Avian influenza
Ghana	International Organizations	WHO, OIE, FAO, GARC, PARCN	FAO, WHO, OIE, UNDP, UNICEF, African Union Inter-African Bureau for Animal Resources, GIZ, USAID
	Ministries and agencies	GHS, VSD, OHTWG	GHS, VSD, OHTWG, NADMO, Agricultural Extension Directorate, Immigration Services, Wildlife Division of the Forestry Commission, Ghana Police Service, the Ghana Immigration Service, the Ghana Customs Excise and Prevention Services, and the Ghana Ports and Harbor Authority
	Local groups and individuals	Local Governments	Noguchi Institute at the University of Ghana

(*continued on next page*)

Table 1 (*continued*)

	Levels of action	Rabies	Avian influenza
	Other actors	WSAVA Foundation	NGOs
India	International Organizations	WHO, FAO, OIE, GARC, Vets beyond borders, Rabies in Asia Foundation, Mission rabies[#]	WHO, FAO, OIE
	Ministries and agencies	Ministry of Health & Family Welfare (Central & State), Ministry of Agriculture now Ministry of Animal Husbandry, Dairying, and Fisheries (Central & State), the State Animal Husbandry Department	Health department, Public Works Department, Public Health Engineering Department, Animal Husbandry & Veterinary Service department, Forest department, Panchayat & Rural Development, Land & Land Reforms Department, Home Department, Border Security Force
	Local groups and individuals	(State-specific) (Tamil Nadu) Directorate of Public Health & Preventive Medicine, Directorate of Medical Education, Directorate of Rural Health & Medical Services, Municipal Administration Department, Department of Animal Husbandry, State Surveillance Office & Tamil Nadu Medical Services Corporation, and civil society organizations (Sikkim) Collaboration between the Government of Sikkim, Vets Beyond Borders, and Foundation Brigitte Bardot	District Collector, Deputy Commissioner, District Magistrate, Revenue officers, Senior Superintendent of Police, Chief Medical Officer, Chief Veterinary Officer, Heads of Panchayati Raj Institutions/ Municipality/ Local bodies
	Other actors	Animal Welfare Board of India (National Institute of Animal Welfare), APCRI, Consortium against rabies, IMA, IVA, Local and national level NGOs	NECC, APEDA, NGOs.

GARC: Global Alliance for Rabies Control; WHO: World Health Organization; OIE: World Organization for Animal Health; FAO: Food and Agriculture Organization of the United Nations; PARCN: Pan-African Rabies Control Network; GHS: Ghana Health Service; VSD: Veterinary Services Directorate; OHTWG: One Health Technical Working Group; NGO: Non-Governmental Organization; UNDP: United Nations Development Programme; UNICEF: United Nations International Children's Emergency Fund; GIZ: German Society for International Cooperation; USAID: United States Agency for International Development; APCRI: Association for the Prevention and Control of Rabies India; IMA: Consortium against rabies, Indian Medical Association; IVA: Indian Veterinary Association; NECC: National Egg Coordination Committee; APEDA: Agricultural & Processed Food Products Export Development Authority
#Mission rabies partners: see [65].

Table 2
Policy documents, action plans and programs for the prevention and control of rabies and avian Influenza (Classical OH approach) in Ghana and India.

	Rabies	AI
	Global framework for the elimination of dog-mediated human rabies (WHO-OIE-FAO-GARC)	Global Strategy for the Progressive Control of Highly Pathogenic Avian Influenza (WHO-OIE-FAO)
Ghana	■ Control of Animal Disease Act 83 (1961) ■ Public Health Act (2012) ■ Ghana Rabies and Prevention Action Plan 2018–2030 ■ Stepwise Approach towards Rabies Elimination from the Global Alliance for Rabies Control ■ The Technical Guidelines for Integrated Disease Surveillance and Response in the African Region	■ Control of Animal Disease Act 83 (1961) ■ Animals (Control of importation) Ordinance (1952) number 36 ■ Local bylaws governing animal raring in settled areas
India	■ National Rabies Control Program ■ United Against Rabies (Zero death by 2030) ■ Post-Exposure Prophylaxis through Anti-Rabies Clinics ■ Animal Bite Management Training Programs ■ Information Education Communication awareness programs ■ Animal Birth Control program and/or Mass vaccination of dogs	■ Action plan on Preparedness, Control, and Containment of Avian Influenza ■ Prevention and Control of Infectious and Contagious Diseases in Animals Act (2009) Section 4(2) ■ Food Safety and Standards Act (2006) ■ Prevention of Cruelty to Animals Act (1960) ■ Avian Influenza Surveillance Plan

Table 3
Summary of actors engaged in the disaster prevention, management and control (Extended OH approach) in Ghana and India.

	Levels of action	Actors involved in disaster prevention, management and control
Ghana	International Organizations	Nearly 35 international and regional frameworks. Some examples are the UNFCC, GCF, CBD, UNCCD, AfricaAdapt, several programs from ECOWAS, UNOCHA, the Red Cross, Action Aid, CARE International, World Vision, WHO
	Ministries and agencies	NADMO, EPA, National Development Planning Commission, Ghana Meteorological Services Department, Water Resources Commission, Hydrological Services Department, Town and Country Planning Department, MoFA, MoF, the Ghana Police Service, the Ghana National Fire Service, the Ghana Armed Forces
	Local groups and individuals	Regional Disaster Management Committees, Development services of different churches
	Other actors	G-CAN, Ghana Climate Change, Agriculture and Food Security Platform
India	International Organizations	UNISDR with the ADR, USAID and the CIA, UNDP and other UN agencies, World Bank, ADB, ASEAN-ARF, FAO, IFAD, ILO, IMF, Oxfam, Save the Children, UNHCR, WFP, WHO, MSF
	Ministries and agencies	National Institute of the Disaster Management, National Disaster Management Authority, NDRF, NCMC, India Metrology Department, Geological Survey of India, Environmental Information System, Ministry of Environment and Forests, Building Material Technology Promotion Council, Ministry of Urban Development, National Agricultural Drought Assessment and Monitoring System under the Department of Space, Ministry of Agriculture, DOD and civilian agencies, Integrated Disease Surveillance Project under Ministry of Health & Family Welfare, India Disaster Resource Network by Ministry of Home Affairs, MDWS, Ministry of Consumer Affairs, Food, and Public Distribution, SECs, SDRN, SDMA, DDMAs, SDRF
	Local groups and individuals	ActionAid India, ADRA, Arghyam Trust, Child Rights, and You, Indian Red Cross Society, Habitat for Humanity India, CJP, CSR, CSE, Watershed Organization Trust
	Other actors	CPMFs, the State Police Forces and Fire Services, Civil Defense and Home Guards

UNFCC: United Nations Framework Convention on Climate Change; GCF: The Green Climate Fund; CBD: United Nations Convention on Biological Diversity; UNCCD: United Nations Convention to Combat Desertification; AfricaAdapt: Integrated and Comprehensive Approach to Climate Change Adaptation in Africa; UNOCHA: United Nations Disaster Assessment and Coordination Team; WHO: World Health Organization; NADMO: National Disaster Management Organization, EPA: Environmental Protection Agency; MoFA: Ghana Ministry of Food and Agriculture; MoF: Ghana Ministry of Finance; G-CAN: Climate Adaptation Network; UNISDR: United Nations Office for Disaster Risk Reduction; ADR: Asian Disaster Reduction, USAID: United States Agency for International Development; CIA: Central Intelligence Agency; UNDP: United Nations Development Program; UN: United Nations; ADB: Asian Development Bank; ASEAN: Association of Southeast Asian Nations; ARF: ASEAN Regional Forum; FAO: Food and Agricultural Organization of the United Nations; IFAD: International Fund for Agriculture Development; ILO: International Labour Fund; IMF: International Monetary Fund; UNHCR: United Nations High Commission for Refugee; WFP: World Food Programme; WHO: World Health Organization; MSF: Medecins Sans Frontieres; NDRF: National Disaster Response Force; NCMC: National Crisis Management Committee; DOD: Department of Defense; MDWS: Ministry of Drinking Water and Sanitation; SECs: State Governments and State Emergency Committees; SDRN: State Disaster Resource Network; SDMA: State Disaster Management Authority; DDMAs: District Disaster Management Authority; SDRF: State Disaster Response Force; ADRA: Adventist Development and Relief Agency; CJP: Citizens for Justice and Peace; CSR: Centre for Social Research; CSE: Centre for Science and Environment; CPMFs: Central Paramilitary Forces

Table 4
Policy documents, action plans and programs for disaster management & control (Extended OH approach) in Ghana and India.

Ghana	■ National Climate Change Policy (2014) ■ National Environmental Policy (2012) ■ Food and Agriculture Sector Development Policy (2007) ■ National Environmental Sanitation Policy (2010) ■ Water Policy (2007) ■ National Urban Policy (2012) ■ National Energy Policy (2010) ■ National Contingency Plan ■ National Climate Change Master Plan (2015–2020) ■ National Climate Change Adaptation Strategy (2012) ■ National Environmental Sanitation Strategy and Action Plan (2010) ■ Gender and Water Resources Management Strategy (2011) ■ National Integrated Water Resources Management Plan (2012) ■ National Urban Policy Action Plan (2012) ■ National Drought Management Plan (2018)
India	■ Disaster Management Act (2005) ■ National Environment Policy (2006) ■ National Action Plan on Climate Change (2008) ■ National Policy on Disaster Management (2009 & 2015) ■ The National Flood Control Program (1954) ■ National Water Policy (2012) ■ Sendai Framework for Disaster Risk Reduction (2015–2030) ■ Global Facility for Disaster Risk Reduction Programme (2007) ■ National Disaster Management Plan (2016) ■ National Disaster Response Plan (2011)

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